

# Strobist

::: Apparatus minor • Cogitatio magis • Lux melior :::

# Lighting 101

## Introduction

Welcome to Lighting 101. You may not realize it yet, but you have just stepped through a door that may change your photography forever.

Over the past few years, over four million people from nearly every country in the world have begun their lighting education right here. And if they can do it, you can do it.

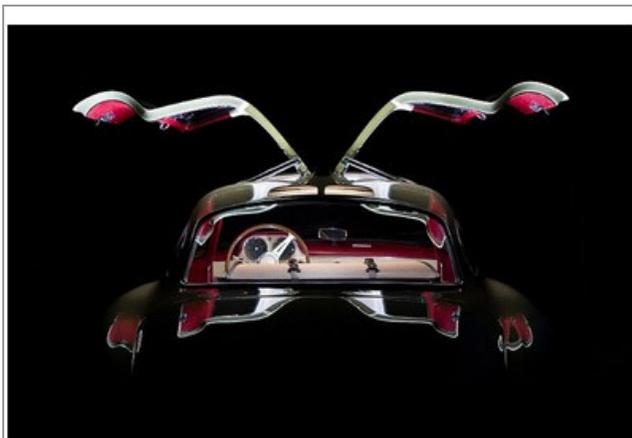
Photography is literally writing with light. As you read through Lighting 101 you'll learn how to control every aspect of your electronic flash. If you can imagine it, you'll be able to create it.

You'll learn how to take the removable flash that you probably already have on the top of your camera and use it off-camera to make beautiful, more three-dimensional photos. Once you learn the basics of controlling light, you'll quickly see that most lighting is intuitive, easy and fun.

## The Good News: The Gear Doesn't Cost Much

Basic lighting gear is also refreshingly inexpensive. If you have a camera, lens and flash you have already done the spendy part. The gear needed to take your light off-camera is very inexpensive compared to your camera, your flash or even a single lens.

By getting your flash off-camera, your images become more three-dimensional, more textural and more professional looking. All of the photos on this page were made by Strobist readers (who very recently may well have been exactly where you are right now) just lighting with small flashes.



*(Photo by Strobist reader Ken Brown)*



*(Photo by Strobist reader Sam Simon)*

Click on a reader's picture to learn a little more about how it was made. (The uncredited ones are mine, mostly culled from my career as a staff photojournalist at a series of newspapers.) And don't worry if you don't understand the terminology yet. You will soon.

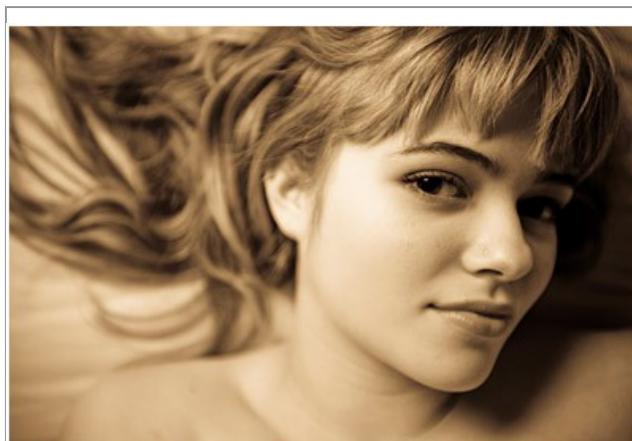
The difference between their photos and yours

is that they already know how to use their flash off camera. They know how to synchronize it with their shutter, position it, modify the quality of the light, change the color with gels and tweak the balance of exposure between their flashes and available light.

Which is exactly what you'll soon learn in Lighting 101. That may sound difficult, but I promise you it isn't.

Learning how to light is incremental, creative and fun. There is almost no math involved, nor any difficult technical know-how. In fact, good lighting is less like math and more like cooking.

It's like, you taste the soup and if it needs more salt you add some salt. You'll see that when we learn to balance a flash with the existing, ambient light.



*(Photo by Strobist reader Benny Smith)*

## Understanding Your Flash



*(Photo by Strobist reader GreggBK)*

So let's talk about the basic gear you'll need to learn how to light, beginning with your flash. Generally, most people at this point will have a DSLR, a lens or two and a typical flash. (I.e., the removable kind that mounts to the top of your camera, not the built-in pop-up kind.) If so, you have already bought the expensive stuff. The gear to use that flash off-camera is surprisingly, refreshingly cheap.

But before we get to that, let's take a moment and talk about your flash.

---

## The Bare Essentials

So, here's what your flash absolutely has to have: The ability to work in manual mode, and to do so at different power settings. (i.e., full power, ½ power, ¼ power, etc.)

And that's it.

Most flashes, including the one you probably already have, include that capability. And that's the only thing that is mandatory. If your flash has that, skip buying another flash for right now until you have a chance to play with the gear you already have. You may really be surprised at what you can learn to do with it.

So take a quick look at your flash and see if it can go into manual mode, or "M". If your flash has manual setting that you can vary, you are golden. Most of your major wallet pain has already happened. (Woo hoo!)

---

**IMPORTANT NOTE:** If your flash is more than, say, 10-15 years old, do a little [research](#) to make sure it is safe to directly hook up to a modern digital camera. Some old flashes can fry the electronics of a digital camera. And once that little bit of magic smoke escapes your camera, it is almost impossible to get it back in...

---

Since we're going to learn to use that flash off-camera, we'll have to synchronize it with your shutter so your flash will go off when you take the photo.

Normally, this happens with electrical connections on your flash's hot shoe, which is the built-in electrical connection that is completed when you mount your flash to your camera. When your flash is off-camera, that physical connection is no longer there. But you can electrically sync it with a simple wire, called a sync cord.

Sadly, your flash almost certainly does not have the jack for this external sync capability. But no worries, you can add it for about \$15 bucks. At the other end of the sync cord connection, your camera also probably does not have a 1/8" jack. But a second, same \$15 device (pictured at left) will add the capability to your camera, too. Then you can use a cheap 1/8" audio cord to sync your flash.



This little doohickey also adds an old-style "PC" jack, (it's on the other side and not visible in the photo above) which means it will marry just about any camera to just about any off-camera flash. For that reason, I like to call it a Universal Translator. But no need to worry about that now—we'll get to it later.

Very important: We are not about spending unnecessary money around here. Relax in knowing that most everything in the basic kit from here is going to be inexpensive. So you got that going for you, which is nice.

---

And that's the basics on your flash. Let's look at the gear you'll need to turn it into your own little portable lighting studio...

## A Beginner's Lighting Kit



In this post we'll talk about the small, inexpensive gear kit that you will need for going off-camera with your flash. And this is all you really need to make the jump into being a lighting photographer.

You can see it in use left. It will allow you to do some very cool things as a photographer. But as you can see, it is extremely portable and lightweight, too. (Which makes sense to this 40+ guy who does not want to carry around a lot of gear.)

So here are the basics, i.e., what you'll absolutely need:

### 1. A Light Stand



Budget about \$40. This folds or extends, and holds your flash in the position where you want it. The main choice is compact or full-size. I recommend compact, as they will go from seven feet (extended) to about 19 inches (folded). These models will also hold your flash at about 21 inches off the ground, which is cool for low shots.

Full size stands typically go to eight feet, but only fold to about three feet so they don't travel as well. Plus, they cannot get your flash very low to the ground if needed. The vast majority of people go with compact.

## 2. An Umbrella Swivel

Budget about \$15. This is a small bracket that attaches to the top of the light stand and holds your flash (and an umbrella, usually) and will tilt to any angle. They are small, cheap and rugged. With one of these you can also mount a flash to any type of a standard, 5/8" post (like a photo clamp) if you are not using a stand.

For this and the light stand above, I also recommend LumoPro models as they are inexpensive, well-made and guaranteed for five years. LP has built a great reputation as an off-camera lighting supplier, and for good reason.



## 3. An Optical White, Shoot-Through Umbrella

Just like in the photo up top. Budget about \$20. It will be your very first light modifier. And even after 25+ years of shooting professionally, it's still a go-to choice for me. The most versatile umbrellas are those that open up in the 40" range.

I can recommend the Westcott White Double-Fold with removable black backing or a normal-fold white shoot-through version. This double-fold umbrella goes from 43" to just 15 inches when folded. Which, of course, makes it travel very well alongside the compact version of the stand listed above.

Or you may well prefer the single-fold (standard) umbrella which is, I think, a little stronger and more durable but does not pack quite as small. If you haven't guessed yet, we are building a small, light kit that will sling over your shoulder (on in a small bag or pack) and let you take your new "studio" with you anywhere.

It's really kind of a pick 'em. Both work fine.

The only thing with lighting umbrellas is that they are just as fragile as normal umbrellas. If you use care they will last you quite awhile. But you can't be rough with it and expect to hand it down to your kids.

## 4. A Sync Kit

Budget \$30-\$40. This three-piece kit will marry your off-camera flash to your camera and sync it to your shutter. It consists of two Universal Translators (seen on previous page, one for the flash and one for the camera) with a 16-foot sync cord (fitted with a 1/8-inch plug at each end.)

You can go with wireless, and eventually you probably will. But shooting wired is the simplest, most reliable and cheapest way to start. It also becomes your backup (important) should you move to wireless later. Trust me, this is the way you want to start.

---

If you have been running the math in your head, we have totaled out at about \$100, give or

take. That's amazing to me. As much as DSLRs, lenses and high-end flashes cost, just the addition of about \$100 (and some basic knowledge) can get you from "meh" to gorgeous, studio-style lighting. And you can easily take that light anywhere you want it to go.

By the way, here's the actual shot from the setup photo shown at top:



## Two Very Good Starter Kits

Below are two pre-packaged options for beginner kits as described above. I recommend Midwest Photo as a source because they are reputable, reasonable and carry the full line of LumoPro gear. (The 2- and 5-year warranties are a big deal, and to my knowledge no other brands have it.)

Plus, when things do go wrong I have found MPEX to be responsive (to the point of bending over backwards) via phone, [email](#) or on [Twitter](#). Life's too short to deal with needless stress.

[Compact-Size Kit](#) (~\$107)

[Standard-Size Kit](#) (\$108)

*Note: If you do not yet have a flash, for a long list of reasons explained [here](#), I recommend the current model LumoPro LP180 Quad-sync speedlight. It is less than half the cost of the Nikon and Canon flagship flashes, twice the guarantee and, frankly, a better flash.*

---

So that was a lot of gear talk to throw at you. Sorry. But we just wanted to get you started off on the right foot, with the basic equipment and not spending more than you needed to.

While we wait for the new toys to arrive, let's start learning about them—and how to use them...

## Light Stands



So the idea is, you want the capability to light without breaking the bank—or your back. And as you'll soon see, your new portable studio is easier to cart around than even a pricey ultralight tripod.

Above is a (7.5-foot) LP605, which I consider to be the best compact light stand made today and which you probably by now already have on the way as a part of your starter lighting kit. Compact light stands like the LP605 generally have five sections (so they fold up very small—21 inches or so) and are ideally suited for photographers using lightweight, speedlight-based lighting gear.



The LP605 uniquely comes with folding spikes for extra stability when you are outside in the wind. Folded up, they will ride in a small roller case. Or you can add some O-rings and a strap, as detailed below, and throw a whole "portable studio kit" over your shoulder.

I love hacking or modding my gear to make it better, and this little trick is one of my favorites. Throw this strapped stand over your shoulder (with a compact umbrella attached, as you'll soon see) and it'll ride just as comfortably as a camera. Seriously, you can hike five miles with this setup and bang out a kick-ass lit portrait when you reach your remote destination.

If and when you get further into lighting, you'll likely end up adding to your stand collection. Maybe some bigger stands, or a boom arm to float a light out over someone. But you cannot go wrong with a compact, 5-section stand for openers. This is the one you want to start with. I have a boatload of photo support gear and these things still get used more than any other.

To drill them, pivot one of the spikes (if your stand has them) out and drill a  $\frac{1}{4}$  hole at each end of one of the legs. Then stick in some decent sized O-rings (this will take a little prying) and strap it up. If you carry it upside down, the natural forces will keep it closed nicely.

This piece of gear is not complicated. Essentially, a light stand exists only to do one thing: oppose



gravity. It holds your light at a place in three-dimensional space. Pretty simple stuff.

For portability, solidity, price (and 5-year warranty) the \$40 [LP605](#) is tough to beat.

## Umbrella Swivel Adapters



To attach your flash to a light stand, you'll need an umbrella swivel adapter. They are also called umbrella adapters, or just "swivels."

This pretty straightforward. These are rugged and cheap at about ([\\$15](#)). Top to bottom, here's how they work.

### A. The Cold Shoe

Unlike a hot shoe, this has no electrical connections. It just holds a flash. (Or, in many cases the Universal Translator that would give your flash a sync jack.) Then you put the flash on top of that.

This cold shoe (on the LP633) has an expanding/locking clamp, which makes it sturdy and also lets it fit the foot of some weird flashes whose feet are slightly oversized.

## **B. The Umbrella Mount**

This is a hole and clamp which holds the optical umbrella (more on that in a bit) which you will use to soften your flash's light. Even if you are not using an umbrella (which you will not do all of the time) you need this to attach a flash to a light stand, or anything else that is tipped with a 5/8" male stud.

You put the umbrella shaft into the hole and clamp down the screw. Pretty simple. If you are doing it right (i.e., not backwards) the umbrella shaft should point about ten degrees up (instead of down) to offset the fact that the flash is a little off-center due to the mount.

## **C. The Tilting Mechanism**

I'll bet you can figure this out by yourself. You loosen it, tilt the flash and/or flash/umbrella combo, and tighten it back to lock in place. This model has a toothed grip for an added margin of no-slip safety.

## **D. The Light Stand Mount**

This is the female receptacle and locking knob that holds the whole assembly to the top of your light stand. Or anything else with a male, 5/8" stud.

## **E. The Extra Stud**

Some swivels ship with an extra stud. (The LP633 does.) This has a female, threaded 1/4" x 20 hole at one end and a 3/8" hole at the other. With a little ingenuity and a bolt of the right size, you can figure out all kinds of positioning devices and/or brackets that might support a flash in a tight or unusual spot.

This stud will marry your frankenstein lighting creation to the swivel and allow you to connect it all together. Go nuts.

## Synching Your Flash

When your flash is connected to your camera, it syncs automatically. When it is off camera, you have to take care of this yourself. And there are several ways to do it.

In the photo above, I synched *everyone else's* flash to my camera to get "one of those lucky moments." Except it wasn't luck. I made it happen over and over again for this shot. More on that in a minute.



## The Wire

If you are a beginner (and presumably on a budget) you'll want to sync your camera with a simple wire, also known as a sync cord. You'll sometimes hear it called a "PC cord," from the old PC jacks. But you'll want to go with the cheaper audio patch cord version.



As we said before, using a universal translator on both your camera and your flash will allow you to sync it with a simple audio cord. The translator will add the 1/8-inch jack to both your camera and your flash.

(If you are using an LP160 flash, you already have the jack on your flash and will not need the second translator.)

This is about as cheap and simple as it gets. No batteries, no sometimes-fickle wireless radio issues. But you are limited in range to 20 feet or so, depending on the length of your cord. Still, go this way first while you are learning.

For the record, I always have a sync cord with me at a shoot as a backup, even when I am using wireless remotes, as we'll talk about below. Cheap, and very reliable.

## Sync With a Slave

If you have more than one flash, you can sync the extra flashes to your original off-camera flash with optical slaves. (If you'll remember, an optical slave fires your flash at the exact instant it sees the light from another flash.)

Which is why, from this day forward, you should not buy a flash that does not have a built-in optical slave. It's that simple -- just don't do it. You are shooting yourself in the foot if you do.

In the photo at top, I used a wireless remote (more on that in just a minute) but *slaved* all of the other peoples' flashes to my flash. Thus, every time I fired my camera all of their flashes fired, too.

Was it a coincidence they just happened to all be in position to create glamorous light for my two subjects? No it was not. I positioned them exactly how I wanted. It was for a live "shootout" in front of a crowd in Dubai in the UAE. You can see a full post -- with video -- on that [here](#). (Opens in a new window to preserve your L101 post thread.)

Suffice to say, having flashes with built-in slaves makes all kinds of cool things possible. I would never buy another flash that did not have a built-in slave.

## Wireless Sync Via Radio



Another popular method of syncing is via radio remotes. This is not cheap, but if you get into lighting to any real degree this is where you'll end up.

For instance, a sync cord would have made it pretty difficult for me to get *this* shot:

(You can read all about how that photo was made, [here](#).)

Here's the thing. You can get cheap remotes, or you can get good remotes. Cheap remotes, which run about \$100 for a set, are not (IMO) nearly as reliable as the inexpensive sync cord kit you probably already have on the way to you now.

The Gold Standard for standard remotes are the PocketWizard Plus series. The entry level model, which I depend on every day, is pictured below. If I am not mistaken, it's the 7th generation of remote trigger for PocketWizard. I have been using Pocket Wizards for over 20 years, as do the majority of working pros I

know. The latest models are far better (and cheaper) than the ones I started with in the early 1990s.

And here's the kicker: these things are still compatible with the PocketWizard remotes from way back when I started out. I love that. (Conversely, I loathe "forced upgrade via planned obsolescence.")

You'll need a PocketWizard on your camera and one on your flash. And they are [\\$99.99 each](#). Given that, I'd still suggest you start with a sync cord (and slaved flashes if going multi-flash.) As you grow into it, wireless remotes will likely make sense for you. And if they do, do yourself a favor and invest in a good one.



There is little more frustrating than a fickle remote trigger, which is why the pros usually end up at PocketWizard. You can spend more (including more advance models of PocketWizard) but a PW Plus X is IMO the very best value in the world. It balances price, quality, reliability and non-obsolescence.

Think of it this way: You'll swap out your camera probably ten times in the lifetime of service you'll get from a good quality remote. Choose wisely, and with the long run in mind.

---

Okay, we are almost done with the basic gear. Sorry to hit you with all toys and no technique, but it is good to be getting an understanding of the stuff you have coming so when it arrives you can be ready to roll.

So let's talk next for a minute about your very first light modifier...

## Using Umbrellas

Okay, now is where things start to get a little more interesting. Let's talk about your first "light modifier."

An umbrella will almost certainly be your first light mod. (It is included in the [jump starter kit](#), if you presently have one on the way to you.) Think of your flash as a very brief-but-powerful flashlight. And like a flashlight the business end of your flash is only about two square inches in area.

Thus, while it gives out a lot of light instantaneously, that light is very harsh. To some degree, that may be why you previously have been unhappy with your flash photos.



An umbrella takes your harsh flashlight and essentially turns it into a window. Except we are talking nice, soft window light that you can position and control—in intensity, in location, in angle, even in the color of the light itself.

Photo umbrellas are cheap, portable and super useful. Which is why you'll want want an umbrella as your first soft light source.

There are two general kinds -- the reflected umbrella and the optical white shoot-through umbrella. I strongly prefer the white (shoot-through) version as it is more versatile. In particular, because you can bring it right up next to someone's face for both power and softness.

If you are going with the compact light stands, you'll probably want a 43" shoot-through umbrella, which is pictured above. It folds down to about 14" so it transports very easily along with your compact stand. You can ball-bungee it to your strapped stand and have a nice, transportable light kit.

They are cheap ([less than \\$20](#)) small and easy to transport. Because of the telescoping shaft, they can be a little fragile. But use care, and they will last.

I used to use the reflected umbrellas (they have a white or silver lining and a black backing) but I almost never do any more. I pretty much stick to the shoot-thru's 99% of the time, which is why we chose the white shoot-through model for your starter kit.

---

Now, let's look at how to use them. (Ahh, the new gear finally begins to transition into technique—and results!)



Shoot your harsh flash through an umbrella and you get softness and control. Stick it in close and you get light that is tailor-made for portraiture.

This is a very simple way to make your mugshots look more like they were shot by a professional and not by someone from the Department of Motor Vehicles. With a short telephoto, and umbrella'd strobe and awareness of your ambient light, you can make any headshot look more like a cover shot.



Back it up a little bit, and your new "portable window" can also light some of the environment:

It is safe, classic-looking light that is easy to tote around. Total no-brainer in the bang-for-the-buck department.

In the photos above, the umbrella is being used from what can be considered to be a "classic" position -- 45 degrees up and over to one side. There's nothing wrong with this, and it is probably how you will start out using the light source.

The danger is, you don't move past that and your photos start to all look alike. That is the blessing and curse of an umbrella -- it is easy to look good with it, and it is a very safe light source.



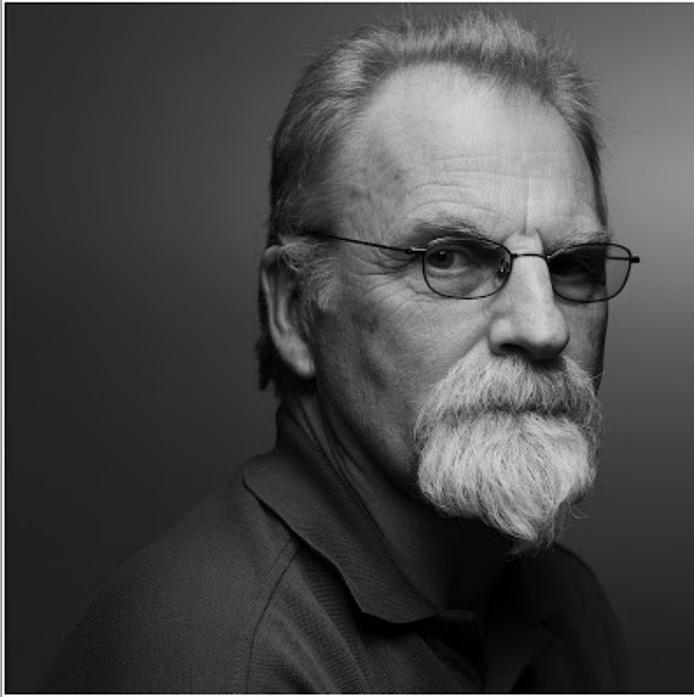
But, as seen above, umbrellas also can be used to create more unusual and dramatic light. And that's where I like to hang out now.

The portrait of cellist Caleb Jones is a great example. (Click [here](#) to have that assignment -- including a behind-the-scenes video -- pop up in a new window.) We were flying the umbrella just over and behind his head. By doing that, we created a light that was less predictable, and more ethereal.

An umbrella on a small light stand is light and portable enough to be flown over someone by using an assistant as a "voice activated light stand". This gives you all kinds of opportunities for different lighting directions.

Work the angle. Try different orientations. Get out of the 45-degree rut. You'll be surprised at what an umbrella can do.





Take this portrait of Pat Morrissey, above, shot in Edinburgh.

By flying the umbrella out over him (but, unlike the cellist, slightly in front) we create a more mysterious "character" light. You can see the location of the light by looking at the reflection in Pat's eyes.

Again, atypical position for an umbrella light. But, I think, more interesting than the standard "45."

For Dancer Kassi Mattera, above, we took an opposite tack. The umbrella is being used not as a key light, but as a "fill" light. (Don't worry, you'll learn more about multi-light setups soon enough.) The umbrella is coming from below. It is actually positioned on the ground in front of her:





Not typical, but interesting. That umbrella is filling at about two stops under the main exposure level. Kassi is being lit by another, hard light source at upper right.

The umbrella, on the floor, is bathing Kassi in soft, "bottom light" and keeping all of the hard light's shadows from going to black. (Click [here](#) to see a full run-thru of this shoot)

Long story short, umbrellas are a great choice for a first soft light modifier. But even better—and if you allow yourself—you can grow with them and get into far more interesting light.

## Bouncing off of Walls and Ceilings



I am thinking many of you already use your on-camera flashes creatively by bouncing them off of a ceiling or wall. This is a great technique, and one of the most common ways to get a taste of creating good light with your flash.

So why bother to take your light off of the camera when you are just going to bounce it off of a wall/ceiling anyway?

- Because you move around when you shoot, which changes where the light hits/comes from in a room.
- Because lighting on manual from a set location gives you consistency in exposure, light direction and hard/soft quality.
- Because it is a quick technique to half-way set up and begin shooting while you decide what you really want to do with cooler light.
- Because working with the light off camera is a good habit/ethic to get into, whether you are just bouncing off of a wall/ceiling, or using a plastic diffuser with a half tungsten gel through an office-plant cookie ([explained here](#)) to make a slick, layered quickie portrait in an otherwise drab, fluorescent office.



*(Photo by Strobist reader Leon Tolner)*

This technique is easy, heavy-use, bread-and-butter stuff. And, you will notice, we are talking pure technique at this point and not hitting you up for yet another piece of hardware. 'Bout time, huh?

OK, then. So this gives broad, room-filling light and is good for setting up a forgiving zone of directional light. Smooth and flat, but crisp, too. This is the strobist's version of quick and dirty.



Things to remember?

First, watch your wall color. It'll color cast your light.

You can frequently use it to advantage, as in the warm light the wall kicked back in this artist portrait.

Use the lens angle adjustment on your strobe to control the size of the patch of light illuminating your subject. Just pop the flash and eyeball the hotspot on your bounce surface. The above photo of the county sheriff had the flash set on 85mm, bounced off of the ceiling near the subject. Note the fall-off through the back of the frame.



Conversely, this shot of a midnight Harry Potter fanatic was lit up into the ceiling behind me with the strobe set to 24mm. So this just casts a wide, soft swath of light.

## Bare-Bulb Lighting



*(Photo by Strobist reader Janaka Rodrigue)*

As you have already seen, we can take the hard light of your bare flash and soften it with an umbrella. We can further soften it by bouncing it off of a wall or ceiling. But we can also turn it into a 360-degree glowing light source.

The old-school term for this is "bare bulb" lighting. That's because older flashes (and most current large studio flashes) have the ability to totally expose the flash tube, allowing the light to radiate in all directions.

Your speedlight can't do that as is, because the grain-of-rice-sized flash tube is permanently housed in its internal reflector and covered with a plastic fresnel lens at front. But we can diffuse the light after it leaves your flash to create omnidirectional, bare-bulb style lighting.

That's just what Strobist reader Janaka Rodrigue did above, using an inexpensive lamp globe from a hardware store. By sticking the speedlight inside, the harsh light turned into a soft, glowing orb. Which made for a beautiful, ethereal portrait.

Many flashes come with a small, white dome (sometimes called a Sto-Fen) that will convert the flashlight-style light into a bare bulb-style light. It is omnidirectional, but is it still small and harsh. But it will absolutely make your flash act like a bare light bulb. In fact, I used that same technique here—that's a speedlight in the tiki hut, not a light bulb:



See how the light illuminates the inside of the tiki hut *and* spills in a natural gradient across the ground? I made that happen by using a small dome on the flash to imitate a bare light bulb. I made the photo of my parents to celebrate their 50th anniversary. You can read in more detail how it was made, [here](#).

Also, bare-bulb modifiers can actually give you softer light—as long as you are near walls and/or a ceiling for that omnidirectional light to bounce off of. That's the secret behind commercially produced larger dome diffusers like the LightSphere.

They work well in small rooms with nearby walls, but they are not well-suited for open spaces. Just saying that so you know what they can and can't do. Plus, next time you see a wedding photographer using one *outside* (and they do that a *lot*) you can feel just a little bit superior.



Not to say they are not useful. But you don't have to spend \$100 on one, either. You can get one for under \$5 at your local Chinese takeout—and they come full of hot-and-sour soup as well:

Just wash it out (or not, whatever, I'm a guy after all) and cut a little "X" in the lid with an X-acto knife. Then it'll slide right onto your flash for a friction fit.

These are great to experiment with. Need light to fill a room in all directions? Bare bulb is your mod.

Gonna light the inside of a fridge to simulate that "late-night-snack" glow? Made sure you've already ordered the hot-and-sour soup first.

There are tons of different ways to modify lights, and many have DIY versions you can try for next to nothing. Heck, we're just getting warmed up here.

But for the moment, let's take everything away and play with that harsh bare flash that has previously been the reason all of your flash pictures looked like, well, flash pictures...

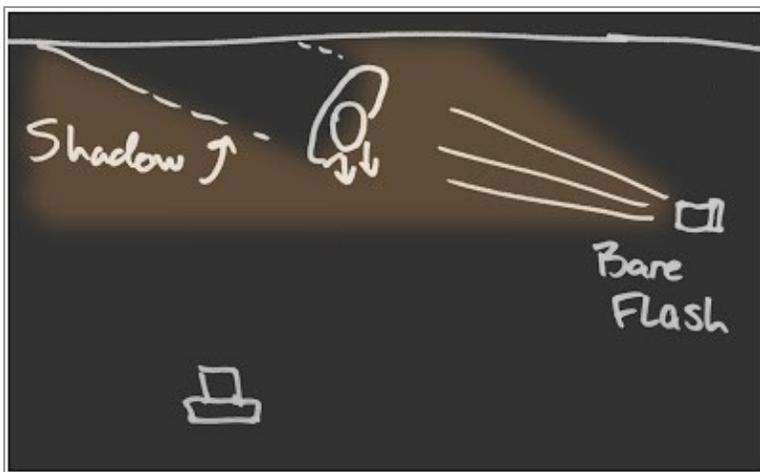
## Hard Light

So, we have spent a decent amount of time on soft light modifiers. Soft light generally comes from physically large sources or modifiers—think umbrellas, walls, overhead clouds, etc. But hard lights—which come from small sources—can look really cool, too. It's just that hard flash gets a bad rap because of how mad it looks when mounted right on top of your camera.



Take the quickie portrait I did of the basketball player, above, done for my newspaper. I have the flash off of the camera, way over to the right. This creates a shadow that I then used as a graphic element in the photo. Still just the one flash, just in a different location.

Mind you, this photo would have looked pretty bad if my flash were mounted on the camera. But it would not have been the hardness of the light, but rather the location that did the damage.



After 25+ years as a lighting photographer, hard light is to me far more interesting than soft light. Especially when you are able to use multiple hard light sources.

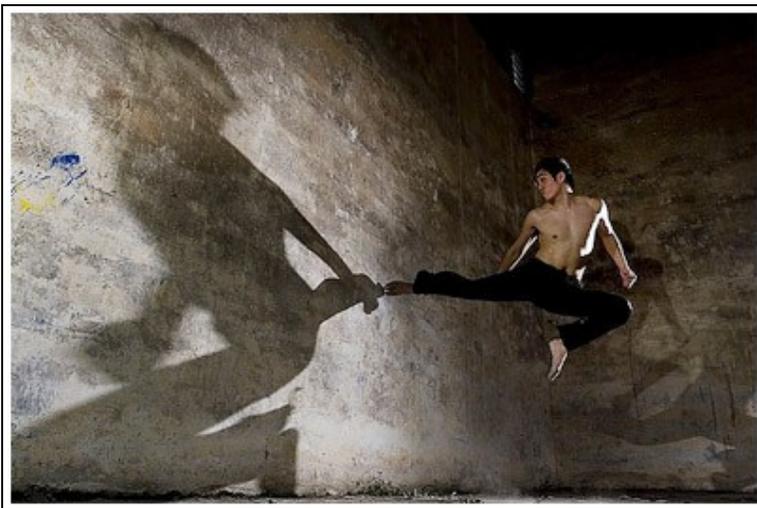
Take this product shot for instance:

This product shot looks completely different (and, to my eye, more interesting) for having been shot with hard light sources. They sculpt the jacket and reveal form and texture.

Let's look at another:



*(Photo by Strobist reader Danny Bird)*



And just as in the photo up top, this photo uses a subject and a wall, but more than one hard light. (For details, click the photo.) The hard lights combine to partially reveal and sculpt the subject. And they are far more appropriate than would be a soft, portrait-looking umbrella or the like.

Often the key to success with your hard light images is to control the lighting ratio (i.e., relative levels of brightness) between the lights and shadows. Think of that hard shadow created by the hard light in the photo up top. It is harsh and abrupt, but not completely black. I can still see detail in the shadows, such as in the wall and on the shadow side of his face.

I like to think of a hard shadow as the equivalent of the light abruptly falling off of a ledge. To briefly press the ledge analogy: The *depth* of that ledge you just fell off of is the difference an interesting experience and, well, a fatal one. It's not about the ledge. It's about the depth.

If you want to dip your toe in the hard light water, try balancing your flash close to the ambient (i.e., normal continuous) light level. The fact that the hard shadows will have good detail in them will lessen the chances of getting a bad result with hard light. But the edgy effect will still be there.

---

Okay, so we have looked at soft light (umbrellas, wall-bouncing, etc.) and hard light. But there are all kinds of ways you can modify and shape the light. Up next, two of my very favorite ways to do that...

## Two of My Favorite (if a Little Unusual) Light Mods

While we are on the subject of the quality of light, here are two of my favorite light modifiers for creating interesting light for portraits. I use them a *lot*—both individually and combined with each other.

The first is a ring flash adapter. A ring flash is a donut-shaped flash, with your lens sticking into what would be the hole of the donut. This allows the light to come from all *around* the lens axis, which does a couple of things.

First, it makes smooth, shadowless light (on the subject at least). Second, it creates a unique, signature shadow on any wall or backdrop that might be directly behind the subject.



*Photo by Strobist reader James Madelin*

You have probably seen that look before in fashion and or modern portrait photography. Now you know how it was done.

Real, professional ring flashes are... very expensive. But you can turn your garden-variety speedlight into a ring flash for a lot less with something called a ring flash adapter. Essentially, these are very sophisticated reflectors that bend light around your lens before releasing it.



My favorite of the ring flash adapters is something called an Orbis (seen above). I like it because it is the only model of ring flash adapter on the market which (a) can be used with nearly any hot-shoe style flash, and (b) has a better quality of light than the others.

I use it a *lot*, both by itself and in combination with other lights. It was invented by James Madelin, a long-time reader of this site. As such, he has set up a tutorial/special offer page where Strobist readers get free shipping

and 10% off, [here](#), (Thanks, James!)

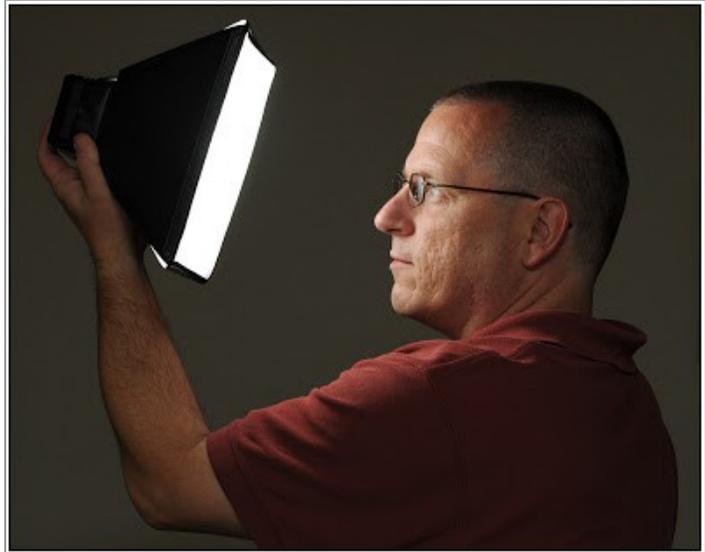


In the montage above, shot by Strobist reader Ed McGowan, you can see how a ring flash adapter can quickly give a cool look/theme to a series of portraits. It's a unique vibe, which works well on its own. But I tend to also use a ring flash in conjunction with other lights. (More on that in a minute.)

## Little Bitty Soft Box

A soft box is simply a box that emits light. They usually run from 2x2 feet to as big as 4x6 feet. But filling a box that big is a lot to ask in terms of power when using speedlights.

So another of my most-used light modifiers is a tiny (as in 8x9inches) version of a soft box, which happens to be very useful for lighting portraits from up close. That's it above, providing the light for a self-portrait. (As you can see, I like to experiment with my light mods...)



But these things are super useful. Take this photo, for example.



The small soft box is being held just out of the frame to the left, and is what is responsible for the great quality of light sculpting his face.

Soft boxes of this size also fold down to almost nothing (8x9", and maybe half an inch deep) so they pack great. They are also very inexpensive. My favorite tiny box is the [LumiQuest Soft Box III](#) (AKA SB-III). I use the crap out of this mod—especially for close-in portraiture.

## Just Like a Reese's Peanut Butter Cup

Often when I photograph people, I am working quickly and with very lightweight gear. And I frequently use the Orbis and the Soft Box III in combination. These last two photos are all good examples of that.

Seen right, I photographed poet Linda Joy Burke using a flash with an SB-III as my "key" (or "main") light off to the left. For fill light, to get that very controlled intensity of shadow, I used a second flash with an Orbis Ring flash Adapter.



Ditto this portrait of blogger Siany Meades, shot in London. Same combo, same general light locations, actually. This was shot in a shaded courtyard but the light(s) gave me the ability to create a little sultry late-afternoon style light.

So, lots of cool toys and gear to think about to get your mind spinning. But now, let's take a moment to learn about balancing the light from your flash with the existing ambient light.

For most people, this will be when you start to really see the control you get from learning to use your small flash like a professional...

## Balancing Flash and Ambient, Pt 1



*Editor's note: To understand balancing flash and ambient, you should have a good, basic understanding of f/stops and shutter speed. That stuff can be found in lots of places (Google it) so I am not going to totally restate it here.*

---

### **F/stop, Shutter Speed and Flash**

While f/stop and shutter speed both control exposure, for our purposes it is important to know how they do so differently. Shutter is a time-based control. F/stop is a diameter-of-the-lens-hole based control.

Since the light from your flash is pretty much instantaneous, it really does not care about the shutter—as long as you are at or below your camera's top "sync" speed. Which for most cameras is either 1/250th or 1/200th of a second.

Note that there are fancy, flash-pulsing methods which will allow you to sync at higher shutter speeds such as 1/1000th of a second. But (a) they have their drawbacks, and (b) getting into that now would be needlessly complex. So just set that aside.

### **Two Exposures Happen at the Same Time**

Every time you take a flash photo, you are making two exposures simultaneously. You are making an exposure of the ambient light, and an exposure of the flash's light. Whether you take this into account or not, it is happening every time.

The ambient exposure is controlled by the f/stop and the shutter speed. The flash, being instantaneous, is controlled by the aperture.

The photo up top is a good visualization of the fact that two images are being made at once. The shot of Robert, a soldier in the U.S. Army, was made with a slow shutter speed. But I also included a flash, which happened instantaneously and froze Robert irregardless of the shutter speed:

Think of it as two overlaid exposures: Frozen, instantaneous flash exposure, mixed with a slow-shutter-speed ambient exposure. Both are made at once, and both light sources are additive to the exposure.

So you have two exposures to consider in every flash-lit picture: the ambient and the flash. I like to find my ambient exposure first—nothing fancy, just trial and error. Once I have that exposure (in which, remember, the shutter speed must be at or below my camera's sync speed) I have a starting point for my final, lit image.

Next, I'll "dial down" my ambient exposure. This means nothing more than changing my camera's settings to underexpose the ambient. How much? That's your choice. And it will determine the contrast range in your final, lit picture.

Remember, when you move your flash off camera, the difference in location produces shadows in your image. That's what makes your subject look all cool and 3-D. And the depth of your shadows—your contrast range; your drama—is determined by the underlying ambient exposure.

### **Let's Give This a Test Drive**

Below is a portrait I shot of Jessie, a local social media entrepreneur. We are going to use a second flash here, to light the background. But the light balancing principles are exactly the same. They work whether you use one flash, two flashes or a hundred flashes.

Okay then. Let's get her in some shade first, because it's much easier to balance a small flash indoors or in shade rather than competing with the full sun. (But we'll get to that next post.)

Here she is, exposed for normal ambient light in shade:



The exposure here is  $f/5.0$  at a  $1/160$ th of a second. For the record, we are at ISO 200 on the camera's overall sensitivity setting.

It's okay, but kinda "meh," right?

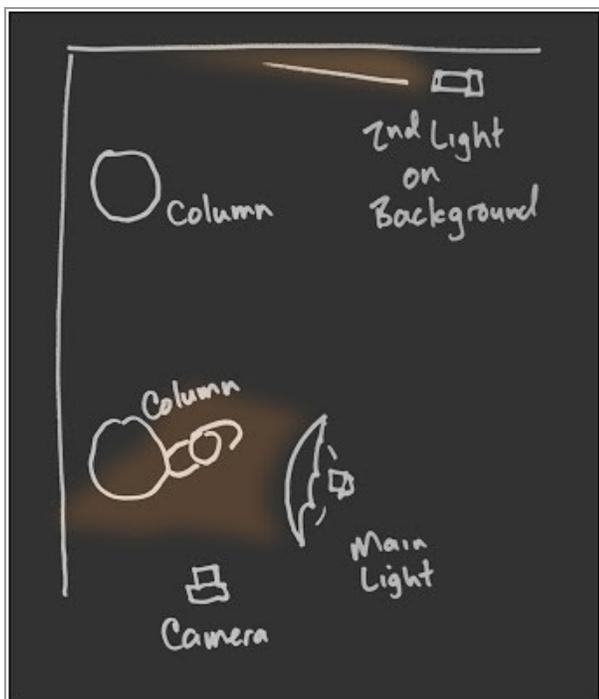
So before we even add any flash, let's crank her down a little bit and create some "drama" in our final image. I am going to close down my aperture and drop her by a little over 2 f/stops. So I am going from  $f/5.0$  to  $f/11$ . Nothing else has changed:

Exactly what you'd expect, right? Everything is darker. But there is still legibility everywhere - no big black areas. This legibility is important in the final image. Also, notice that since we closed down the aperture we now have more depth of field and the wall in back is now more in focus.



We have created a "safety net" of darkened ambient exposure. When we add flash, no part of this image will get any darker. So we'll end up with drama PLUS legibility.

Now, let's bring in our flash. (Flashes, actually.) We work with manual flash—for predictability and repeatability. One less variable to screw up. And because of this, adding the right amount of flash exposure to a photo is simple and straightforward.



I'll bring in a flash, on manual power, in an umbrella positioned out of the frame and from camera right. Take a test shot. If the flash is too dim, I'll turn up the power. Say it was at quarter power (on manual, as nearly always) when I made my first frame. If too dark I might turn it up to half power. Or vice versa if it was originally too light.

Also, I am going to do the same thing with a second flash back on the wall. Just to make the wall pop a little bit.

And here is the result:

Wow, right? Same exact spot as the first shot above, which was properly exposed open shade. Then we dropped down that exposure to get the sort of "safety-net" ambient-only exposure. Then we lit Jessie (and the back wall.)

This is balancing and flash, in a nutshell. If you don't understand it, re-read the above. But be aware that it may not really make sense until you get out there and actually do it.



When working this way, I like to think of my flash as a main (or "key") light and the ambient as my supporting (or "fill") light.

### **The Process:**

1. Get a full ambient exposure.
2. Drop it down to create some "drama". How much, is up to you.
3. Bring your subject back up to full exposure by adding flash.

### **It's Almost Not Fair**

How often have you heard this, usually with a tone of superiority:

*"I am a purist, I only shoot available light."*

(Translation: I am scared shitless of flash.)

As an ambient light photographer, you only have one "correct" exposure. Maybe a little wiggle room if you are being interpretive.

But as a lighting photographer, *we control everything in the frame, independently of the other areas, by how and where we expose and add light.*

I have been doing this for almost three decades, and I still think that is the coolest thing ever. If you want more detail on the Jessie shoot, it is laid out in more detail (but also assuming a little more knowledge) in the On Assignment section, [here](#).

Otherwise, let's flip the process and use flash to control the harsh shadows created by directional ambient light. Same process, just backwards.

## Balancing Flash With Ambient, Pt 2



*(Photo by Strobist reader Brent Williamson)*

Okay, now let's get out of the shade (or the indoors) and do battle against full sun with our off-camera flashes...

When last we met, we talked about the idea of balancing flash with ambient. We were using the flash as a main light and the ambient as fill, but you do not always have to do it that way.

Straight fill flash is very simple these days, with TTL flashes doing the heavy lifting (i.e., thinking) for you automatically. But doing it the easy way usually means keeping the light on the camera.

The goal here is to start to replace the blah concept of 'fill flash' with that of 'balancing light.' And, more important, to separate the idea of fill flash fill/balance from the rote use of on-camera flash.

The process of using flash to *augment* (which is a better concept than fill) sunlight is very straightforward. First you *are* going to start at your camera's highest synch speed, because that'll get you the most flash-friendly aperture. And thus, the most flexibility from your small flash. While you're at it, dial your ASA down as low as it will go to get better quality, too.

Now think about your lighting direction and angle. As opposed to the idea of fill flashing, on-camera, from any angle outside without regard to the sun's direction, using a strobe on a stand effectively gives you two lights to play with. You can balance. You can cross light, You can do both. You'll have more flexible (and consistent) results using this approach.

When you just fill flash from on-camera, true, it does bring up the shadows. But while the flash adds detail it really misses out on the opportunity to improve the depth and quality of the light. So why not do both at the same time?

Step one: Think of the sun as your main light source, and your strobe as a secondary light. You are not just getting rid of raccoon eyes now. You are working with two lights. You have

flexibility. You might even have *style*.

Choose your angle of attack. Maybe you have the sun behind you (on the left side) at a ~45-degree angle. Why would you have your fill on on camera when it might look better lighting from the upper right? On-camera flash limits you. Avoid it if you can.

Maybe you turn the angle around and shoot the subject in profile. Say he is facing to your right. You could have him looking into the sun, which is angled to come from slightly behind his face to provide rim light that is nice, but way too contrasty as is. Just move your strobe over to the left side, elevate it a little, and you have a cool-looking, two-light setup.

That's exactly what I did for this quick portrait of the son of the exiled Shah of Iran, made for The Baltimore Sun:



Whatever the angle, the technique for balancing is the same. We are basing the exposure on the ambient this time, and bringing the flash up to fill shadows and/or provide light from another direction.

Assuming a sunny ambient light level to balance, set your camera at the highest synch speed (i.e. lowest aperture) to provide a lower aperture and ease the burden on your flash. Now, get your base (ambient) exposure. We'll call it a 250th at f/11 at ASA 200 for the sake of argument.

Now, with your strobe on manual and on a stand, set it to somewhere around a quarter to half power if you are working close. Maybe half to full power if the flash is further away. If you are not lighting a large area (and you usually are not) zoom the flash to a 70mm or 85mm lens angle to make it even more powerful.

Pop a test frame and eyeball it. If your flash-lit area is too bright, dial the flash down or move it back. If it is too dark, dial it up or move it forward.

The thought process is the same whether you are balancing sunlight or starlight. (And when you think about it, sunlight *is* starlight, isn't it?) Just start with a good ambient exposure — in this case, exposing the stars — add a little flash to give detail where you want.

In this case, the underside of a natural arch:



*(Photo by Strobist reader Joe Stylos)*

Since we are not exactly swimming in ambient light here, the starting point will be a little different. Instead of 1/250th of a sec (or 1/200th, whatever) to control the sun, we'd probably wanna start with our lens wide open and choose a pretty high ISO to get the fastest reasonable shutter speed for the night sky.

Solve your most pressing variable first, then go from there. *The process is the same.*

---

The important thing to remember (and why I told you the angle stuff first) is that this is now a *starting point* to turn your outside "fill" strobe into a true, useful second light source. Experiment.

I used to practice my outdoor lighting skills any time I was assigned to shoot a simple headshot, AKA a mugshot, for the paper. What you have to remember is that *they don't know* you could do a perfectly good job by just sticking them in the shade for 30 seconds and bolting. *Muah-ha-ha, you are now my lighting model for 15 minutes...*

Outside? Play with fill light and angles. (You might want to grab something safe in the shade first just in case.)

Inside? Set up a quick umbrella in a corner where one wall is your background and another is your fill card.

I'd turn a mug shot into a head shot, which is just a more professional way to do it. I would get some good (low-pressure) experience with my lighting. And they'd look better in the paper. It's a win-win.

And, contrary to what you might think, most people will be secretly flattered by the effort you are putting in to making a better photo of them.

And one more thing. For you newspaper photogs, stop thinking of them as mug shots from this point forward. A reporter trained monkey can do a mug shot. Start shooting head shots. You'll improve your quality and get into a habit of using light effectively.

## Using Gels to Correct Light

Some you may be starting to realize already, but I'll say it aloud:

When lighting a photo it is not about absolute light levels. It's about *relative* levels. You can adjust for just about any overall light level you have by simply changing the overall exposure on your camera. So that zeroes the "absolutes" out.

It is the relative light levels that define the look of your photos. And for shorthand, we call this a "lighting ratio." I.e., what is the ratio of brightness between the highlights and the shadows?

Guess what? Lighting color sort of works the same way. Only instead of adjusting the exposure, we can instead adjust the camera's white balance to zero out the color of a light source.

For instance, if you were in a fluorescent room, you might balance on the "FL" white balance to make ambient light photos. Since FL lights are in fact green (mostly, but pretty variable these days) your camera would compensate by shifting the color balance about 30CC units of magenta. (That's the complimentary color of green.



*(Photo by Strobist reader Siddarth Siva)*



So if you used flash in that environment, and was "mixing" the balance with the ambient, your flash would appear ... too magenta. Your camera is balanced for FL, and there is a daylight-colored light source. Your flash. So that light would react to the color shift in a not great way.

How do you fix this? You turn the flash's light green, like a fluorescent. And you do it with the special green "gel" (AKA "window green" pictured left). What about those orange-tented tungsten (AKA, "incandescent") lights? What gel would they get?

Hint: It's the other gel in the photo above...

You get the picture—orange tungsten ambient light, you compensate in the camera by going to tungsten WB. And the camera adds blue to the image. So you need to make your flash orange to match.

And you do that with a tungsten gel, also known as a CTO gel. (Color temperature orange.) They can also go the other direction (physically converting a tungsten source into daylight) by using a CTB (color temperature blue) gel.

Simple to mount, you just tape or velcro them to the flash. Leave a little space to vent the heat from the tube:



Heck there are even [commercial versions](#), complete with commonly used gels.

But, as far as being able to make your light pretty much any color you want? Or multiple lights a mixture of colors? Are you starting to see lighting possibilities yet?

---

### Oh, and Check *This* Out

It appears as though the photo up top brings our last two topics right into perfect example. It was shot by my friend Sid Siva in Dubai. He balanced his exposure by shooting wide open at a high ISO (to get a good shutter speed) and exposing for the street lights. Which looked extra cool when out of focus.

Then he added a little light into the directors face with a small off-camera flash to bring his face back out of the shadows.

But those lights in the back included tungstens, so he did the white balance swap-and-gel, too. Camera on TUNG WB, CTO gel on the flash. Bingo. Is it starting to make sense yet?

Oh, and to get the cool, limited spot of light on filmmaker Mahmood Kaabour's face, he used a small snoot to restrict the light.

What's a snoot?

Oh, that's just one of several different types of lighting *restrictors*, which we'll be talking about next. (See? These cliffhangers are worse than *Lost*, right?)

## Snoots and Gobos and Grids

Now that you are getting comfortable with the idea of shooting a light into an umbrella or ceiling, creating the lighting ratio and being color correct, it's time to start stretching a little.

Sometimes what makes a photo sing is not so much where the light is, but where it *isn't*. And, given that you already have a basic, off-camera strobe setup, you can make the gear you will need to restrict light for just a few pennies.



Remember when we talked about putting the Velcro on the sides of your flash head? It holds gels fine, but you can also use it to attach lighting mods to your flash. (You don't have to permanently attach Velcro to your flash, either. There are removable Velcro "grippers" for mounting things.)

One of my favorites is called a "gobo." Gobo is short for "goes between optics," as in something that goes between the light and your lens. Some people also call them cutters, or flags. Whatever you call them, they are there to partially block light.



To make a useful-sized GoBo, Cut a piece of still cardboard to make a rectangle about 4x8 inches. Stick some Velcro (the "hooks" side) at one end and at about a third of the way from the other end. This will allow you to attach it to the side of your flash either way so that you can choose how far it sticks out.

I also cover mine with a layer of gaffer's tape. This is the cloth-backed tape that is widely used in the photo industry. It holds great and does not leave any residue. It is *not* duct tape. Not even close. They are not interchangeable.

Now, you have a sort of "barn door" (really, that's what it's called) that can block the light from your flash in the direction that you choose.

Say you are using your flash to side/backlight something. Your flash, being small and not-too-powerful, is just out of the camera frame. The Gobo could be stuck on the side of the strobe closest to you to keep light from flaring into your lens.

You can also use one on each side of the flash to make light that spreads vertically, but not horizontally (or vice versa.) You can keep light off of a background this way, as you may be lighting it from another source.

You can make them out of cardboard or you are into the DIY look. They just slide into the lid or back pocket of a Domke bag and weigh almost nothing. No brainer.

If you want to restrict the light even more, you'll want a snoot. It is nothing more than a sort of tunnel for the light to go through that will restrict it in all directions except for the exact direction the strobe is pointed.

Just shape the cardboard into a rectangular-shaped tube that will slide over your flash head. Make a few - 6", 8", 12" - the longer the tube, the tighter the beam of light. Now cover it in gaffer's tape to make it more durable and light-tight.

(By the way, when you shoot with a snoot, set your flash on its most telephoto setting. No sense in wasting power by sending a wide beam of light just to block it with the snoot.)

How much do snoots restrict the light? Let's do a test:



This is a flash fired against the wall (4 feet away) at the "85mm" zoom setting. Note the pattern of the light.



This is the same setup, with an 5" snoot on the flash.

When doing a portrait, the aim of the snooted flash is obviously a bit critical. How can you tell where the beam will hit without a modeling lamp on your flash?

Easy. You ask your subject, "Can you see the front of my flash through the tube from where you are sitting?" If they can, the light will be falling on their face. Do a test and tweak it as necessary using the back of your camera's display as a guide.

---

In the frame at the start of this section, I used a snoot to light the face of the CEO of Ciena, a digital fiber optics company. I liked the holes and the daylight that streamed through.

But the blinds were light grey, and thus no contrast for the light holes if my main light hit the blinds. So I restricted it with a snoot. (You can read more about creating that particular shot [here](#) , where there's an example shot without the snoot, too.)

On disadvantage to a snoot is that the fall-off area of the light's beam is not very elegant. It's kinda of abrupt. If you want a more elegant, gradient fall-off to the light beam, you'll want to use a grid spot instead of a snoot. Here's an example:

Remember our dancer shot from a few pages ago? The umbrella was on the ground, acting like a *fill* (or secondary) light. The *key* (or "primary") light was a flash with a grid spot. In



this case it was a [Honi Speed Grid](#) (in the 1/8" size).

Grids are a little more expensive than snoots, and generally not worth DIY'ing. But they give *beautiful* gradients at the edges of the light.

You can see how the edges of the key light gradate very nicely above.

---

So, restricted light. The takeaway from this page is that now we can have more precise light that we can sculpt. You know that cool shaft of light you like to exploit when you see it coming from a window or something? Now you can make it any time.

This is a *very* useful style of light for cool portraits, but you have to be aware of your ambient level. Crank up the shutter speed for more drama, or open it up for more detail in the unlit areas. The choice—and control—is yours.

For many beginners, this is a new technique that will open up loads of possibilities. Spend an evening experimenting with it at home to start to understand what it can do.

## Textural Lighting for Detail Shots



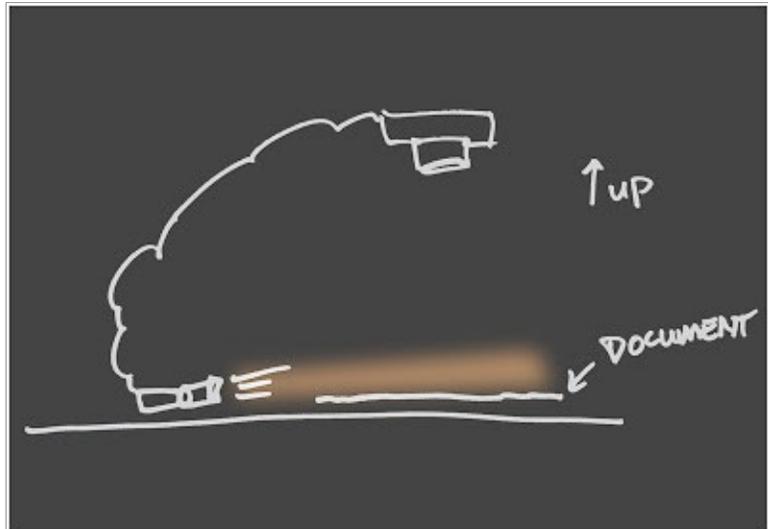
This is one technique I like to use when I am looking for one or two more photos to glean from an assignment.

Designers appreciate the flexibility of being able to use a well-done detail shot in a layout, and you will sometimes be surprised by how well they are used. This is especially the case when they have strong relevance to the story or are executed particularly well.

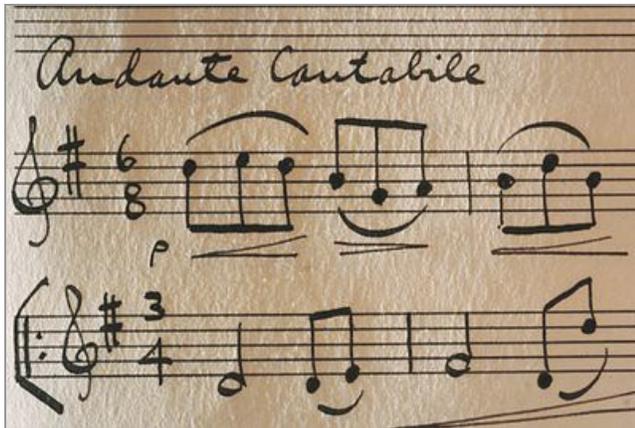
The key is adding depth and texture to what may be a boring, two-dimensional object. To do this, you'll be placing the item somewhere so that you can get the strobe to exactly the same

height to let the hard light rake across your object. You can use a table, or you can simply set the item on a floor and place the flash on the floor a few feet away.

By far, your biggest variable will be the height of the flash to your object. Nail this variable down first. Little moves make big differences in the way a seemingly two-dimensional object expresses its true three-dimensionality. For that reason (and more flexibility) I sometimes like to use a table to get the subject I am shooting off of the ground (and place the flash on a nearby light stand. That way I can control the relative angle and height very precisely.



You'll be surprised at how much texture you can bring out in a "2-D" object this way.



Move the flash away a little. You have power to burn - you are shooting with direct, hard light - so there is no sense in getting light fall-off if you do not want it.

Use a warming gel to mimic late-day light if you wish. Place books strategically between your light and the objects to create interesting shadows.

(If you do this, consider having the light come in from the direction of one of the corners of

your frame. That makes for more interesting compositional lines.)

Actually, I use this "single plane" kind of lighting for more three-dimensional objects, too. You can get more complex with it, adding multiple light sources and pieces of paper to diffuse the light:

As with anything else related to lighting, the only limit is your imagination and creativity.

Are you a freelance editorial shooter? This table-top (or floor) lighting is a technique that can quickly quickly boost your income.

Most assignments are billed on a day-rate-



against-space basis, meaning you get paid more if they run more pictures. Page designers *love* adding detail shots to layouts. You'll be surprised how often spending 5 minutes on making a nice one can net you another hundred bucks on the day.

## Cross Lighting



Cross lighting is nothing more than using two light sources that oppose each other in their direction.

I say light sources, instead of strobes, because it is important to remember that if you are photographing outdoors with one strobe, you really have two lights. Rather than just trying to do damage control on what the sun is doing to your subject, start to think in terms of using the sunlight as your main (or secondary) light.

The photo above is of a fifth grader who, using herself as a human shield, saved this tree at her school when construction workers building a nearby parking lot were about to mistakenly bulldoze it.

She was a hero in the story. And I wanted to visualize her that way in the photo, so I shot up at her from a low angle. To get a clean background, the sun had to be coming from the upper-back-camera-right direction.

I could have very easily fill flashed her if I was just trying to undo bad sunlight. But if you are working with a small stand, it is just as easy to use your strobe more effectively.

I placed the strobe on manual (at 1/2 power) up on a stand coming from the upper-camera-left, and had her face the strobe. Exposure was 1/250th, of course, to make life easier on the flash, with the corresponding aperture to properly expose the sky.

Now, the strobe becomes the main light, and the sun becomes the rim light. Waaay better than on-camera fill flashing.

This cross lighting scheme is pretty forgiving with respect to subject movement, too. As long as you are working on the quarter angles (roughly splitting the difference between the two light sources) you are going to be fine.

When I shoot high school basketball I like to cross light, too. I use two SB's, one at the top center of each set of bleachers, aimed in a cross pattern at the top of the key. Using them at 1/2 power with a 50mm throw will usually get you an honest, crisp-looking f/2.8 at ASA 800 from the mid-court line to the other basket.



It can be helpful to use external battery packs for these strobes, as you are gonna be firing off a lot of half-power frames. AA's get eaten up pretty quickly this way. Plus, you'll be waiting between shots.

## Back Light as Main Light



When you are deciding how you are going to add light to a scene, don't forget to consider the idea of adding only back light.

And try not to think of it as such. Learn to think "separation" light.

Those of us in the newspaper biz need all of the help we can get when it comes to repro. And using a separation light can really make a photo pop.

Additionally, if the light is strong it will create shadows that will create leading lines into the direction of your light source.

One caveat is that you have to hide your light from your camera. As mentioned before, one good technique (especially in a darkened room) is to mount the flash backwards and turn the head around. This will let you use the recycle light as a guide to help keep some item in your



frame between you and your flash.

The shadows should tell you which performer I am using as a GoBo to block my flash. It's the guy in the middle. In the photo below, the hidden flash's location (behind the guy) is revealed by a red dot. You can also see that the shadows always point to the flash:

One other thing you should notice with this photo. This small, shoe-mount flash is about a hundred feet away from the kids rehearsing their end-of-show theatrical bow.

These little strobes put out a lot more power than you might think, especially when working in low light conditions. As you get a little experience with your lighting, you will become less and less afraid of the dark. The dark is your friend. It is full sunlight that is hard to compete against with small flashes.

## Headshot in a Corner

As newspaper photographers, we shoot a lot of headshots.

That's just the way it is. It has always been thus. While you can look at it as a mental vacation (really, a trained monkey could shoot a newspaper headshot) they can also be an opportunity to practice with light.

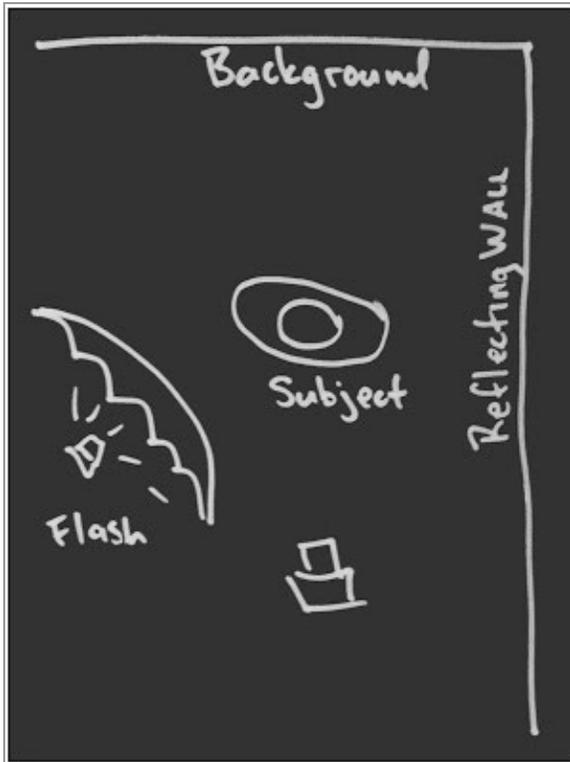
Thing is, your subject probably does not know you could bang it off in about 30 seconds in some shade. So why not use the assignment as a low-pressure chance to work on your lighting skills?

To that end, I offer the quick and easy, one-light corner headshot. The concept is simple, but it allows you the chance to play with ratios to see how they affect your photo.

Exhibit "A," right, is actor Bruce Vilanch, in drag, prepping for his role as Edna Turnblad in *Hairspray*.

All you need for a headshot that is crisp and detailed enough to get bigger play is an umbrella'd strobe, a stand and a neutral corner. Not the boxing-type of neutral corner, but one with white or grey walls.





If they are tan or some other warmer color, you can get away with that, too. But purple? Not so much. You're going to be using the side wall as a reflector, and the light will pick up the color of the wall.

Now, back to the ratios. There are two ratios at play in this photo. The first will control how bright the background is. The ratio would be the **flash-to-subject-distance:flash-to-background-distance**.

Simple English: if your strobe is much closer to the subject than it is to the background wall, you background will be darker.

The fill light for the headshot comes from a reflection off of the other wall of the corner. In this example, the strobe is at camera left, at a nice, safe, boring 45 degrees. At camera right is a wall. (The other wall that comprises the corner becomes our clean background.)

So, the second ratio at play is that of flash-subject-distance:flash-reflecting-wall-distance. In other words, the further your reflector wall is from the flash/subject combo, the darker the shadow side will be.

How does this work in practice? Simple.

For openers, you are shooting at the high synch speed of your camera (probably 1/200th or 1/250th) to minimize the ambient light in your photo. Dial up enough power on your flash to get a working aperture of f/5.6 or f/8. Start with 1/4 power on your flash at ISO 200 at a 4-foot light-to-subject distance and adjust from there.

This will give you sharpness and keep room ambient from screwing you up. If you cannot kill the florescent lights (sigh, there are *always* florescent) you'll have to gel green and balance for them if the ambient is encroaching on your photo.

Say that you start with the subject two feet from the side wall, with the flash three or four feet away (in an umbrella) and the background wall four feet behind him. Pop a test frame. Or better yet use your hand (placed where his head would be) to quickly get into the ballpark before your subject sits in his spot. I shoot my left hand a lot when testing light.

Adjust your flash power until the subject (or your hand as a stand-in) is well exposed. Now, play. Wanna make the background lighter? Move the whole shootin match (subject and light) toward the back wall. Wanna make it darker? Move it away from the background wall.

Same idea applies to the fill light. Move subject/strobe combo towards the side wall for lighter. Away for darker. It's pretty simple once you try it.

Your head shots will look good. And you will be gaining speed and confidence in your lighting skills.

## Lighting for Glasses

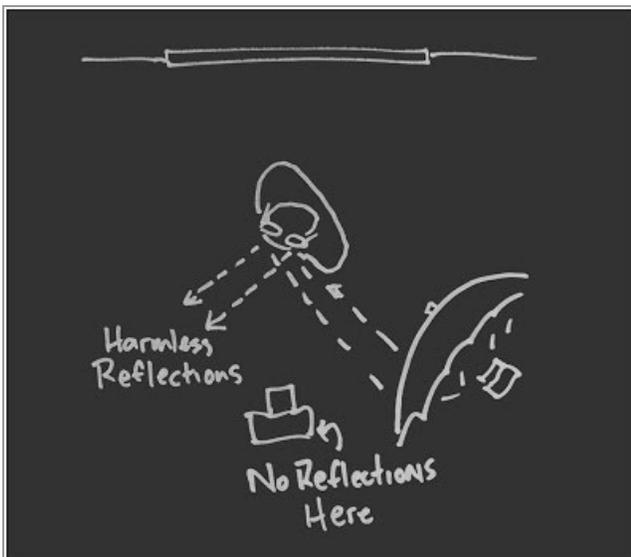
This one is gonna be quick and dirty. If you already know how to do a portrait without having to worry about reflections in peoples' glasses, just scroll down to the bottom and move on.

But if glasses have been giving you a Devil of a time, this is gonna be one of those Homer Simpson "D'Oh!" moments. And if you are having trouble with it, don't feel bad. I did, too.

The problem is that if you are going to the trouble to light someone, you are naturally inclined to have them face toward the light. Which is fine.

Unless they are wearing glasses.

To avoid reflections in glasses, *simply light from one side and have the person face the other*. There is no need to be shooting all of the way in profile, either. A flattering, 3/4 angle (subject to camera) will work just fine.



But honestly, you do not have to go even that far for your angle. Just a smidge will work fine. The important thing is to light him slightly from one side and have him look slightly toward the others.

What if you have more than one person in the photo? No problem. The principle still works. Let's try it with an 11-person group shot:



Bam. Look at that. Not a shiner in the bunch. And four of them are wearing glasses. And I knew I was okay before I took my first test shot. Light is coming from camera left — speedlights in two big umbrellas.

But look at my group. All five(!) people wearing glasses are standing (or sitting) on the left. *And facing slightly right*. Are there still reflections? Yep. But they are falling harmlessly out into space at far camera right.

(For the record, there is a second flash at back camera right adding that splash of rim light.)

Think of the light hitting the glasses as a pool ball. It's going to reflect off of the glasses, no matter what. The thing is to position the glasses so that the angle is such that the light reflects off into space. Doesn't really matter where. Just not towards your camera.

If the subject is looking away from the light, that's a piece of cake. That's all there is to it.

---

A little fun story: There are other ways to do this, too. Some more complicated. Some ... less elegant.

I read about a wedding photographer in China who has everyone who is wearing glasses take them off and replace them with one of the sets of glasses out of the box he brings.

*Only he has removed all of the glass from those frames*. Clever as hell, actually. But I'd think you'd want to be pretty early in that line rather than last. Because I can't imagine that the empty frames are all that great looking...

## Long-Throw Hard Light



Here's another little trick, and one more lighting technique example before we move on to your learning how to "reverse engineer" others' light.

And to get you started thinking that way, I am going to guide you through reverse engineering this photo.

For lack of a better term, I am going to call this technique "long-throw hard light." This photo, like the backlit kids taking a bow onstage, is a good example of just what kind of a working distance you can achieve with a small shoe-mount flash.

The light in this case was a Nikon SB-28 on a stand, at full power, 85mm throw, about a 80-100 feet from the budding gymnasts.

I was working at ASA 800 but the light makes the photo crisp and gives the illusion of a lower ASA, in my opinion at least. This was also shot with an early Nikon D1, which did not do nearly as well with high ASA's as do today's bodies.

OK, let's break down the light as we explain the technique.

Look at the picture. Was the light on the right or the left?

It was to my left, as the shadow of the obscured, back center gymnast on the right side of the background should show you.

Was the light hard or soft? Well, you already know that. Hard. As it darn well had better be if you are throwing a shoe-mount flash 100 feet. Imagine how tiny that actual light source looks at that distance. That's how hard the light will appear to the subject.

What was my lighting ratio? The tonal value of the shadows of the gymnasts on the wall, compared to the lit portion of the wall, should clue you into the fact that I was working my ambient about 1 1/2 stops below the strobe.

"So, gyms are not daylight-lit," you say.

No, they are not. Not where I live, anyway. They are usually icky sodium vapor color. The closest I could get my flash was to gel for fluorescents on the flash, dial it in on the camera, and dial the white balance compensation down to -1 (a bit warmer) to try to "spackle over" the inconsistencies a bit.

If I had missed it badly, where would you see it?

If you said the color of the (ambient-lit) shadows on the walls, brownie points for you. But the gymnasts would have looked a little bit hinky on the shadow side, too.

What about the gymnasts in the foreground? They are closer to the flash, yet they are not as brightly lit. What gives?

Here's where the tight beam spread of the 85mm setting on the SB-28 pays off for a second time. Because it has a controlled beam spread, I was able to "feather" the light, or aim it a few degrees high. This put the kids on the balance beam in the main path of the light and the kids in front in the fall-off, bottom portion of the beam.

Why did I do it? Purely subjective choice. I wanted to emphasize the kids on the beam, instead of the ones in the foreground. They would have been brighter than the beam kids had I not feathered.

The success of this photo is not the final product (I like it, but it is not the end all) but rather the difference in what the photo would have looked like - really bad - if I had shot available light in the dark, cavernous gym.

No on-camera lighting technique could have helped much, either.

## Strobe/Ambient Balance — A Shorthand Way of Thinking

Okay, so by now you should have a decent understanding of how you can [balance flash flash with ambient light](#). In this segment, we'll give that process a little shorthand language to help you understand other photographers when they talk about the way they lit a photo.

Here, I want to accomplish two things:

1. To set you up with a way of quickly understanding and/or communicating how a given photo was balanced, and
2. To not have to repeat full, detailed number-by-number walk-throughs on this process every time we mix flash and ambient. Which is just about every lit photo we shoot.



---

First, a little confession. Lots of times when I am explaining to someone how a photo was lit, they will want to know everything -- shutter speed, ISO, aperture, flash power settings, etc.

I have to be honest with you -- most of the time I have no idea what those numbers were. It is not that I forgot them. It's just that I didn't care enough about them when I was making the photo to remember them, so they never registered.

No kidding, if you ask a professional PJ, "What's your favorite F/stop?" He or she will know you are talking about the amateurs that sidle up to us at a football game. We are really not that numbers oriented.

Truth be told, I don't think in terms of absolute F/stops and shutter speeds. They are not what is important. It's the *relationship between the different light levels* that is important.

Take the photo of my friend Shadi, above. It was shot on a hazy, colorless afternoon in Dubai. Here was the process to make this photo:

1. Find the exposure for the ambient. (That's easy - just grab a shot on auto or zero out a manual exposure.)
2. On manual mode, set the camera to underexpose the scene by two stops.
3. Set the camera to tungsten WB, to shift everything from dark grey to dark blue.
4. Light Shadi from the front with a flash with a CTO gel (plus an additional 1/4 CTO gel for extra warmth.)

5. Rim light him (from behind, low) with two ungelled flashes, at about two stops down compared to the main flash. That is the actual relative exposure level hitting Shadi, already accounting for the fact that that the flashes were ungelled. (The gel eats light from the key flash. So the rims might have actually been set 3 to 3 1/2 stops down in terms of absolute power settings.)
- 

If I were talking to another pro about this photo, I would likely just say this:

*"We dropped the ambient two stops, shot on tungsten, CTO'd the key light (plus an extra quarter cut) and left the rim lights ungelled, about two stops below the main."*

That sentence tells me everything I need to know, because it starts with an assumed reference: They properly exposed key light.

What were the exposure settings? Can't remember, and don't care. It's just not that important.

What is important is the relationship between the flash exposure and the ambient exposure: About two stops. And, just to make things more complex, the fact that we did the tungsten-ambient shift, overgelled the key and left the rims straight.

Understanding this shorthand way of thinking drills into your head that it is the relationships between the lights that matter -- not the absolute settings.

There are two power ratios to think about here: The relationship between the key light and the ambient, and the relationship between the key light and the fill (and/or background) flashes.

Given that our first example was a little complex, lets walk through some familiar photos, thinking and talking in shorthand about the balance.



*"Sodium vapor ambient. Shot on daylight, underexposed the wind tunnel by 1 2/3 stops, bare flash behind the fan blades about a stop hot."*

So, this tells us that the reference point for the exposure was actually *between* the exposures for the flash and the ambient. This photo is underexposed by 1 2/3 stops for the ambient, and the flashed area is one stop overexposed.

My ambient is 1 2/3 stops down -- on the wrong color balance -- and my flash is a stop overexposed. This photo should really suck, right?

Honestly, if one area of the frame were "correctly" exposed, it would not be as interesting. The important thing is that I chose these relative brightness levels, without being chained to my camera's ambient meter or the "proper value" of some incident flash meter.

(You can read more about this photo, including those unimportant f/stops and shutter speeds, [here](#) )

---

Let's try it again:

*"Shot on daylight setting in a tungsten room. Exposed for the flash under the orange bowl on Chris' face and dropped the room by a stop and a half."*

What's my reference point? The flash's exposure on [Chris's](#) face. I put the flash under the bowl on low power, shot a couple of frames until I got the aperture right. (Easier than adjusting that flash.) And then dialed in the shutter to set the ambient to a stop-and-a-half down.

Technically, I supposed I should have shot in tungsten, but why get rid of all of that surreal color? Besides, have you *seen* Chris Hurtt's natural skin



tone at midnight in a bar in a Dubai hotel?

I'm just sayin'.

Thinking about your flash and ambient in terms of their relative (as opposed to absolute) values not only makes you quicker at reverse engineering photos, but makes you quicker at pre-visualizing and creating them, too.

---

Sometimes you are working so far above the ambient that it is not a component of the exposure at all. Yes, you need to communicate that. But given that you are far enough above the ambient for it not to be an issue it really doesn't matter if you are five stops over, or twelve:



*"We killed the ambient; umbrella at camera left, gobo'd to control the reflection on the locker; ring light fill about two stops down."*

What was the ISO? The f/stop? The shutter speed? The flash's power settings?

Don't remember, don't care. Because all you need to know to reproduce that look is in the short description above. And if you start thinking about your photos this way, you'll find that the lighting design comes easier and easier.

(More on this assignment [here](#) )

---

Okay, one more:

*"Exposed for flashes in chopper -- one in front cabin, two in back -- and dropped the ambient by three stops."*

That is all there is to it, and tells you everything you need to know about lighting and exposing photo.

Again, the absolute settings do not really matter, from a reverse-engineering point of view. They are yours to choose based on what depth of field (or rotor-stopping shutter speed) you want.



(More on this assignment [here](#) )

So, does this stuff make sense? It had better, because you are going to be seeing a lot more of this lingo in the future around here.

Don't worry, it is not like the posts are going to be three sentences long from here on out. (You wish...) There is still a lot of stuff to think about when you are creating and lighting a photo. It's just that we do not really need to re-invent that wheel any more.

Instead, I'll just give you the info in a way that helps you to think on your feet better and link to this page for the newbs.

I realize that the vast majority of the people who read this site are amateurs. But as many times as we'll be going through this process, we should start talking and thinking like pros. And if you just dropped in and this is all Greek to you, definitely give the [Balancing Flash and Ambient](#) posts another read...

## Reverse Engineering Other Shooters' Light



So, you've worked your way through most of Lighting 101 (seriously, you're in the home stretch) and you are hopefully starting to get a grasp of basic photographic lighting.

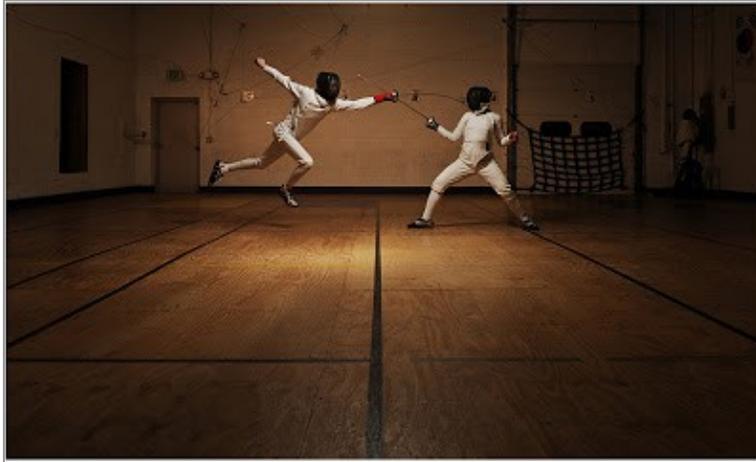
You might not think you are an expert, but you also bring a lifetime of subconscious light analyzing experience to the party. When you see someone standing out in the sun, you pretty much know where the sunlight is coming from just by instantly processing the way the surfaces on their body and face are reacting to the light.

You know whether it is a cloudy day, or a sunny one, or noon, or late evening or whatever. So really, you are reverse-engineering light all of the time. In this same way, you can learn a lot about how a photograph was lit just by looking at it.

That's because light has to obey the laws of physics. You cannot hide how you lit something. Everything about the light — style, color, direction, size, beam spread, etc., — is on display for any shooter with the willingness to figure out.

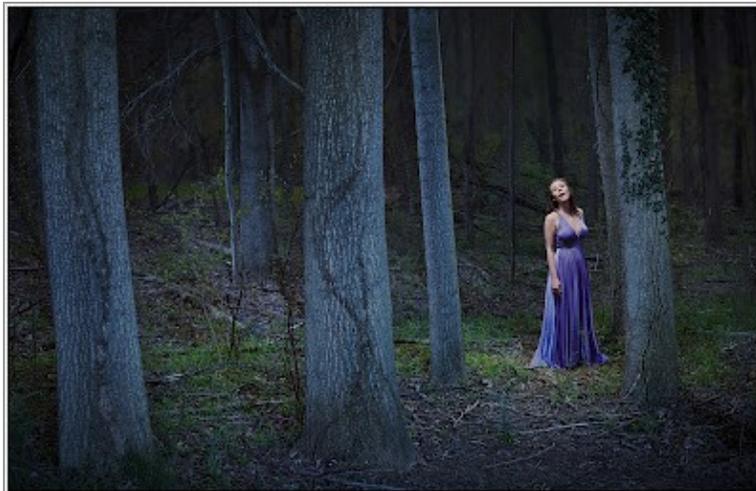
It may take a little effort at first, but you'll get used to it. And stick to fairly simple photos at first, or just try to reverse-engineer the main (or "key") light in the frame.

True, sometimes photos will be composites or heavily Photoshopped and the light won't make sense. But don't feel bad, as that is likely more of a bad reflection on the photographer who shot the photo than on your engineering skills.



Sometimes when you are creating light you want to have a logic to it. That is to say, you are creating light that *could* have existed and makes sense. That's the case in the fencing photo, above.

But sometimes you can go off the beaten path and create light that has no real logic but just looks cool, or theatrical or even ethereal:



The key light in those two photos is the same — a speedlight stuck in a large paper Japanese lantern and suspended overhead by fishing line. But the fencer light is believable and logical and the soprano in the woods is more theatrical. i.e., that light is probably not really going to exist in the woods at night.

Either way, most of the time you should be able to analyze and figure out the light that has been used by others. Just look at it and ask questions.

Here are some starters.

Q: What direction is the light coming from?

A: The shadows will tell you.



Q: Were there multiple sources?

A: (Okay, this one is pretty easy.) If the light appears to be coming from multiple places and/or directions, yeah, probably multiple sources. As you progress further into lighting, you'll likely become interested in using multiple lights.

Q: Is the light falling over a small, restricted area?

A: Suspect a snoot, or a grid.





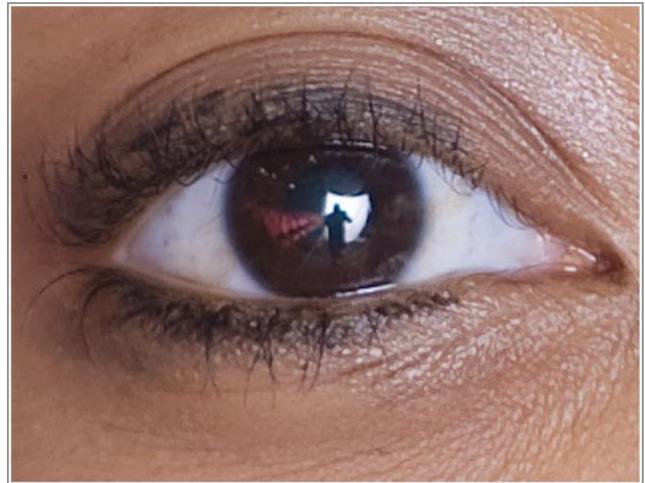
Q: What is the easiest way to check the style of the front light in a portrait?

A: Reflections in the subject's eyes will tell you a *lot* about the frontal lighting:

Looking at photos can intuitively tell you other things, too.

Q: Was the light nearby?

A: Check how fast it falls off as it travels across the subject. Falls off fast? Probably pretty close. Falls off slowly or not at all? Probably further away.



Q: Do the highlights transition smoothly to the shadows?

A: It was probably a soft light source. Hard transitions signal harder light sources.

Q: Is that light strobe or continuous?

A: Trick question. Unless there is movement over time involved, *you can't tell*. Light is light.

And you'll learn to use that to your advantage.

For instance, in the photo above (which was taken in a nearly pitch-black room) there are *six* light sources: a flash on his face, another filling the entire scene and two in the rafters bouncing off of the wooden ceiling. The other two are the fire and the red-hot metal he is working on. Those count, too.

Q: Whoa, how did they get that overcast sky so neon blue?

A: Set the camera balance to tungsten, which renders the formerly neutral clouds blue. Underexpose the sky (to, say, a stop below medium grey) for more of an effect. Then, CTO-gel the flash lighting your subject to render the light hitting it as white and you have the effect. Boom, instant moody atmosphere.



There are no secrets when it comes to light. Only physics.

And as for the light bulb image above, it was done completely in-camera — no Photoshop. If you want to take a little side trip and see how it was done, check out the On Assignment post on this image, [here](#).

## Pre-Visualizing Your Light

The big problem with flash is that for many photographers it is a leap of faith. It happens so fast you can't really see it — or what it's doing. Continuous light is so much more comfortable, because we can observe it real-time.

One workaround for this is to use a big, heavy expensive flash with a "modeling" light built in. The modeling light mimics the much more powerful flash (same location as the attached flash) and shows you what the flash will illuminate, and how.

I am going to try to talk you out of that, to start. Why? Because flashes with modeling lights are bigger and more expensive. And either they have to plug into the wall or they need pretty heavy batteries.

And besides, with a little experimenting you'll find you don't need that crutch of a modeling light. Here's why.

You know what hard light looks like. Sunny day. You know what soft light looks like. Cloudy day. You already have a lot more intuition about light than you think. You just have to hone it a little, as we talked about in the last post about reverse-engineering others' lighting.

It's the same thing; we are just approaching it from the opposite direction. You are trying to visualize what your light will look like (i.e., what it will illuminate) *before* the fact, not after.

You'll want to know things like, a) where will the light fall, and b) will there be reflections?

Reflections are pretty easy. Light works like a pool shot. Light will reflect off of a subject at the same angle (but in opposite direction) that it struck.

That is why we learned to light eyeglass wearers at an oblique angle. The reflections are still there. They are just diverted to bounce harmlessly away from the camera viewing angle.

You can also pop the flash and "eyeball" the scene - especially shiny or glass areas - to check for reflections, too. Just make sure you are looking from the same position from which you will be shooting.

It is easier than you think. Try it.

Now, where will the light fall? What will be illuminated? That one is different, and is the main reason most people use modeling lights. And there is a really easy workaround to this question.

You are already used to walking around a looking at your scene from a few different points of view to choose your camera angle. (You should be, anyway.)

You need to get in the habit of doing this with your light, too. A good time to do it is while you are setting up your lights. Simply view the subject from the position of your light.

When you are looking at the scene from your light's position, *you see exactly what the light*

*will see*. Makes sense, right? And with a little practice, this will eliminate your need for a modeling light.

It is a very fast procedure. Especially if you are folding the process into that of setting up the lights.

I know it may sound a little weird. But just try it.

## It's Not (All) About Flash



Guess what? You made it all the way through Lighting 101. This is the last lesson.

And you are probably a little stoked about your new-found skills. You might even already be playing with your starter kit. (If not, you are totally ready to.)

So I am going to suggest something to you that may sound a little strange:

It's not about flash.

Photo-*graphy* is, literally, writing with light. That's what we do. And you have just enough flash and lighting knowledge right now to be pretty dangerous. Because your photos are going to look better, more polished, more professional, etc.

But don't make your your photography all about off-camera flash — or even all about light. It's also about content and moment and emotion and gesture and setting and, yes, light, But the point is that it is not*all* about light. And certainly, it's not all about flash.

I say this because since starting Strobist in 2006 I have seen literally thousands of talented (and otherwise perfectly normal) photographers become infatuated with their newfound

lighting skills to the point where all they thought about was the light.

So off-camera flash is all they are paying attention to. Which is not good.

Lighting is a tool. And you are learning how to use it. At this point, you already have more education and training than the average photographer. And that's great.

But it is important to make your lighting knowledge light *additive* to your previous existence as a photographer and not a substitute for all of those other cool skills you used to bring to the table.

In other words, use your new and growing skills to nurture your own existing skills as a photographer. Don't let lighting take over and subsume your creative vision.



The very last thing I want to do is to kill that individuality you had before you got here. Just let lighting make it better.

---

Also, take time to just look at light. I mean real, ambient light. Daylight. Industrial light. Blue hour light. Golden hour light. All kinds of light. Discover it. Study it. Wallow in it. And make sure you keep shooting with natural light, too.

The photo at the top of this page, taken on my first night in Havana, is natural light. But I saw (and continue to see) it differently because I am a lighting photographer. There's a base-fill of blue-hour evening light, a couple of stops down. And the unseen hidden street light (at upper back right if that wall wasn't there) is very warm. And it's dominant over the blue — as far as it reaches anyway.

The the fluorescent lights coming from inside the building at left are just as rich and green as you'd expect fluorescent lights to be. And if you were *creating* this light (which you'll soon be able to do with a little practice) hopefully you'd have the sense and good grace not to "fix" those fluorescent lights. The green is beautiful in this context.

The palette in this picture works because it could literally be a painter's palette — some blue paint, some yellow, and a section of the two mixed together to make a goopy green.

And that's the point of observing and respecting and discovering beautiful light. Because any light you can see, or imagine, or remember can be created (or re-created) with flash. And that's freakin' *awesome*.

One Last Thing...

Only one in ten people who *start* Lighting 101 actually finishes it. So good for you for sticking with it. And your persistence earns a little-known perk.

In 2011 I produced a 6(+1) DVD set entitled *Lighting in Layers*, currently in its 6th printing:

It's an immersive ride-along on several shoots of varying levels of difficulty and all lit with small flash. The DVDs are not for total beginners. But you are not a total beginner. Having completed L101, you know enough to dive into these if you want some more detailed and visual training.

They sell for \$159.99, and you can get much more info (and a preview video) [here](#) . And as an L101 grad you can purchase the hard-copy DVD set, shipped free anywhere in the world, for USD \$100 instead of the regular \$159.99. Just order them from [Midwest Photo](#) and use the code "L101GRAD" (no quotes, please) at checkout.

And please, don't post this discount code. It's an "atta-boy" (or -girl) just for the people who made it all the way through L101.

*UPDATE: August 2013: If you are a member at Lynda.com, you already have access to the videos, [here](#)*

Thank You for Reading Lighting 101

I hope you enjoyed it, and learned a lot.

You have the basics that you need to be a lighting photographer now. And I also hope you'll join us regularly now to follow and participate in the ongoing conversation we are having about light. We're nearly 2,000 posts in now, and counting. And you certainly understand enough to follow along and learn more.

New posts go up once or twice a week. You can just show up (always welcome) or subscribe via [email](#) (we'll never spam you) or follow via [RSS](#) to keep up automatically.

Thanks for reading,  
David Hobby