Vision and Contrast
Part 2

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Image Optimization for Contrast

A truck driver failed to see an obstruction on the concrete next to the railroad tracks. The illumination at scene at the time of the incident was a combination of mercury vapor and the headlight of a locomotive. To determine the visibility of the obstruction, it was necessary to recreate the lighting conditions and measure the relative contrast between the obstruction and the background.

On our planet, the sun is the main light source. It illuminates everything the human eye can discern and transmit to the brain for analysis and recognition. If nature's light source is diminished by the onset of night or by the subject's entry into the shade or indoors, it may be necessary for vision and photography to be reinforced and enabled by the use of a supplemental light source(s). Accomplished portrait photographers realize that as in nature, in order for a portrait to look natural and as the subject would look to the human eye, there must be only one main light source of illumination. There can be an infinite number of secondary light sources depending upon the effect or detail the viewer is attempting to see or the photographer is attempting to reproduce. As long as the rest of the light sources remain secondary to the main, they will cause no visual confusion to the viewer of the image.

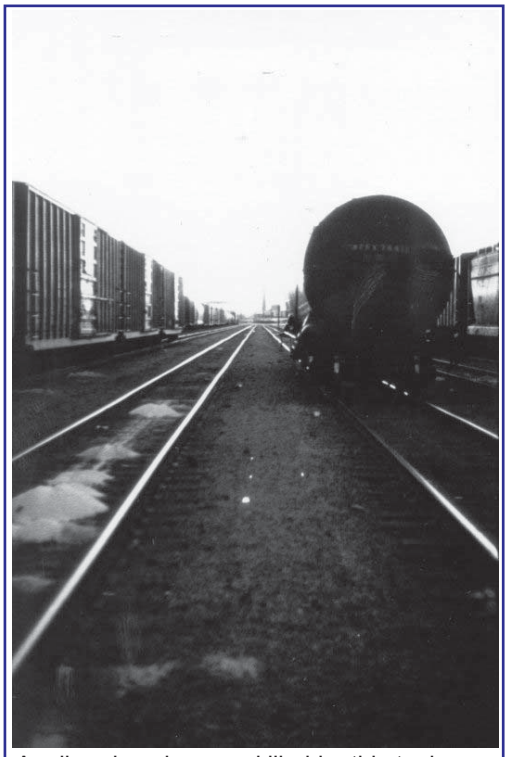
Consider people performing on a stage in front of an audience. The stage lighting often consists of multiple main light sources. On the stage floor, the viewer will observe multiple shadows originating from each member of the cast. This lighting is not possible in nature but is not confusing to the viewer because the effect is expected in this situation. However, a photographer in the audience documenting the play with a camera may capture images of the cast member's faces that are evenly illuminated from all sides and therefore appear unnatural and flat. The detrimental effects of multiple main light sources may be less noticeable when observing objects less familiar to humans than another human face. In some cases multiple main lights may be an advantage, through the use of the lighting to eliminate shadows and lower subject contrast.

In low-light vision, the eye discerns a subject and relays a message to the brain, allowing a person to attempt to identify the subject. Given sufficient time, accommodation for the low light level by the pupil in the eye, and the use of the senses of hearing and smell may also be helpful in the visual identification process. It must be remembered that in any attempt at visual recognition, it is the contrast between an object and its background that affords recognition, no matter what the level of illumination. Camouflage clothing allows a hunter to disappear in the forest in broad daylight. A red tomato may be difficult to perceive when placed upon a red background if there are no shadows. Objects too small to see when viewed on their own may be visible through the contrast they create when viewed in front of a specific background. Movement is also used in recognition; a stationery object blending into the field of its background can be very difficult to both discern and photograph.

A low-light situation also negates the use of color in recognition. When light levels are sufficiently low (<.034 cd/m^2), the receptors in the human eye are unable to discern color. The brightest safety yellow appears gray to an observer in low light. It is the visual contrast of either the different colors or the variance in tones between figure and background, and not simply a low level of ambient light, a vision expert will attempt to determine when analyzing the visibility of a particular object under specific lighting conditions.

The same rules of lighting and vision apply to both film and digital photography. The photographic subject must have sufficient inherent contrast to allow identification, but too much subject contrast is more often the problem than not enough. There are no existing camera films or digital image capture devices able to capture the wide range of contrast often encountered in natural situations. When the subject contrast range is high, photographers must use specific devices and protocols to reduce the range in order to create a more complete representation. The days of processing silver-based film, exposed especially to capture the optimum subject contrast range, are drawing to a close. Traditional black and white photography allows push and pull-processing to adjust the finished negative to the contrast range of the subject. However, all color negative films currently use the C-41 process, which has very little capacity for adjustments in process for contrast. Film manufacturers design C-41 films with built-in contrast correction so the photographer may choose the proper film for the subject and the processor of the film does not need to vary from set process parameters. The contrast of the resultant C-41 processed negatives is irretrievably tied to the contrast of the subject at the time of exposure. The

background density of the negative may be slightly altered by changes in development time, but the separation of tones can never be extended or shortened.



A railroad worker was killed by this tank-car, rolling silently downhill in a hump-yard. It was necessary to measure the contrast of tanker against the background to determine if the worker should have been able to see the car coming.

Digital camera image capture devices are improving in contrast capabilities (Dynamic Range/DR). The DR of a specific camera is proportional to the size of the photoreceptor. The larger the receptor, both physically and in number of pixels, the more accurately the digital camera will reproduce the range of contrast inherent in the subject. The catch-22 of digital image capture is that the higher the number of pixels, the broader the range of contrast capture capabilities—but, most photographers do not use the maximum number of pixels available for capture due to lack of need and/or difficulties in physically handling and storing the images. Discounting physical differences caused by camera quality, lens quality, and other hardware characteristics, it is uncertain whether a 3-megapixel image exposed by a camera with a capability of 13-megapixels will contain a more complete contrast representation of a subject than will a 3-megapixel image exposed by a camera with a 3-megapixel capability. If the image from the 13-megapixel camera is captured at the maximum 13-megapixel setting, the resultant image will display a broader DR than a similar image from a smaller file, but once the larger image is down sampled through processing to either view or print, it may be slightly superior or essentially the same in quality to the smaller image captured on the smaller camera. Differences in image quality are also dependent upon the method and media of image presentation and the sight capabilities of the viewer.

Low contrast subjects are the easiest to photograph using any medium. The low contrast subject allows the most latitude for exposure error. A reasonable amount of under and over-exposure, will yield an image with tonal separation proportional to the subject, as long as the image fits within the contrast capabilities of the light receptor or film.

It is a certainty that any successful efforts the photographer can make to decrease the contrast or DR of a high contrast subject will lead to a more complete representation of that subject, at least as far as tonality and color are concerned. Some digital cameras have a built in contrast reduction option, that may be set to minimum contrast on bright sunny days. The use of outdoor fill-flash is another method used by photographers to lower subject contrast in both traditional and digital photography. There are certain parameters to follow when using flash outdoors.

■ The camera, if it does not synchronize with flash at all speeds, must be set to the speed optimum for synchronization. If the shutter speed is set too fast, the shutter will open and close during or before the flash event. If the shutter speed is set too slow to achieve a good exposure when using the smallest available lens aperture, the photographer must switch to a film with a lower ASA/ISO. This should not be necessary except in the cases of film cameras with very slow flash sync speeds. Remember, the proper film to use in high contrast lighting situations has the lowest possible ASA/ISO.

■ The flash must be used within its operable distance range. On very sunny days, in large rooms, and in dark enclosures or rooms blackened by fire, the flash will not operate properly to the furthest reaches of its capacity.

■ On sunny days, there is an optimum distance for each particular flash. Shooting past the optimum range and to the distant capability of the flash, the sun will be the main light and the flash will be the fill. Shooting inside the optimum range, the flash is the main light and the sun will be the fill. It is important to always be aware of which light is the main light source and which is the secondary (fill) light source, to eliminate existing shadows and not create new ones.

■ Use of automated flash operation will only work properly to the optimum flash distance. Past that distance, the automation is useless because the flash will fire at full power for each exposure. Some flashes are easy to set manually and some have variable power manual circuitry to override their animation. Consult the flash instruction manual for a particular unit and its optimum mode of operation.

Using artificially generated fill lighting for subjects of high contrast is a recommended way to increase detail in otherwise impenetrable shadows. Multiple lighting can also be useful in certain circumstances where one main light

creates shadows and contrast is still too high for the capabilities of the capture medium to adequately resolve. Slave units that plug into electronic flash units will fire multiple flashes simultaneously. The flashes need to be placed close together to trigger a slave in bright conditions.

Reflectors, mirrors, floodlights, and filtration are further accessories to use for subject contrast reduction. A polarizing filter will reduce contrast about one full f-stop where the scene or subject is large. But, if the subject is large, dark shadows may not be an issue. It is the closer views of the same subject where the shadows need to be minimized. Certain software solutions are also available to allow visual analysis of shadow detail.

Overcast days require very little thought on the part of the photographer. On days where the lighting falls from multiple directions, the photographer can concentrate on content and not worry about contrast. The use of an oblique flash to illuminate texture can also be used indifferently on overcast days without too much worry about the creation of impenetrable shadows.

A woman spending the night in an unfamiliar place, turned left at the staircase and fell down the stairs, instead of walking straight through the kitchen on her way to the bathroom. The only illumination was the lamp over the sink in hte kitchen. To determine visibility, it was necessary to recreate the lighting conditions as they were at the time of the incident and measure the contrast between the head of the stairs and the kitchen floor.