Pedestrian Contrast in Black and White

When a vehicle strikes a pedestrian at night, assessing the driver's liability may hinge on characterizing the visibility of the pedestrian. Quantifying pedestrian visibility, however, is not simple. Photographs, which can more accurately depict visibility in daylight, have severe limitations depicting visibility at night. Photographic media (films and digital sensors) have different color and light sensitivities than the human eye and camera settings can be adjusted to generate artificial levels of visibility. In addition, photographs are typically viewed under different conditions from those facing a driver confronted unexpectedly by a pedestrian at night.

Rather than relying on photographs, there are valid scientific techniques for quantifying nighttime pedestrian visibility using light measurements at the incident scene. These light measurements are then used to calculate the distance at which most drivers would be expected to detect the pedestrian.[1]

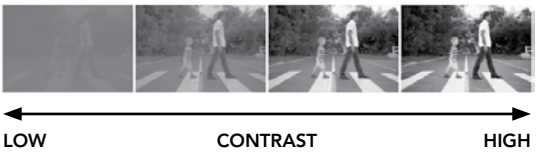
There are three important concepts in understanding nighttime visibility: illuminance, luminance, and contrast.

Illuminance refers to the light falling onto the pedestrian and surrounding environment, such as the light cast by a streetlight or vehicle headlights. Illuminance alone, however, may be insufficient to determine visibility. For example, a pedestrian wearing camouflage clothing and standing against a bush would be difficult to see regardless of how much light was shone upon him.

Luminance is a measure of the light reflected back from a surface. The luminance of a pedestrian is an indication of how bright they appear to an approaching driver. At night, brightness becomes a more important detection cue than color. As our environment darkens, we are less sensitive to color and increasingly reliant on differences in luminance. Reflective clothing (either white or retro-reflective) will result in a higher luminance than dark clothing for the approaching driver.

Contrast is the difference in luminance between the pedestrian and the background. Pedestrians with reflective clothing are typically conspicuous because their background is much darker than their reflective clothing. A pedestrian dressed in black, however, would reflect less light resulting in a lower contrast against a dark background. By measuring the luminance of a pedestrian's clothing and the luminance of the background, the contrast between the pedestrian and the background can be calculated and used to estimate the distance at which a driver would be expected to detect the pedestrian.

The graphic below demonstrates how changes in luminance result in changes in contrast and visibility. A photograph of pedestrians is shown in various degrees of relative luminance between the pedestrians and the background. Intuitively, when there are large differences in luminance between the pedestrian and the background there is high contrast and the pedestrians are more visible.



There are a number of factors that must be considered when using contrast to quantify visibility. First, contrast may change based on environmental conditions, such as fog. Fog reduces contrast, and thus makes pedestrians less visible. Second, pedestrians wearing black clothing are not necessarily less detectable than pedestrians wearing white clothing. The visibility of each pedestrian depends on his contrast with the surrounding environment. Thus, a darkly-clad pedestrian standing against a white surface, such as the man's pant leg against the white crosswalk, would be detectable from a greater distance than the child's lighter leg against the same white crosswalk.

MEA's engineers and scientists have the equipment and expertise to assess pedestrian contrast and advise on its ultimate effect on driver liability.

[1] Ising KW (2008) Threshold visibility levels required for nighttime pedestrian detection in a modified Adrian/CIE visibility model. Journal of the Illuminating Engineering Society of North America 5:1.