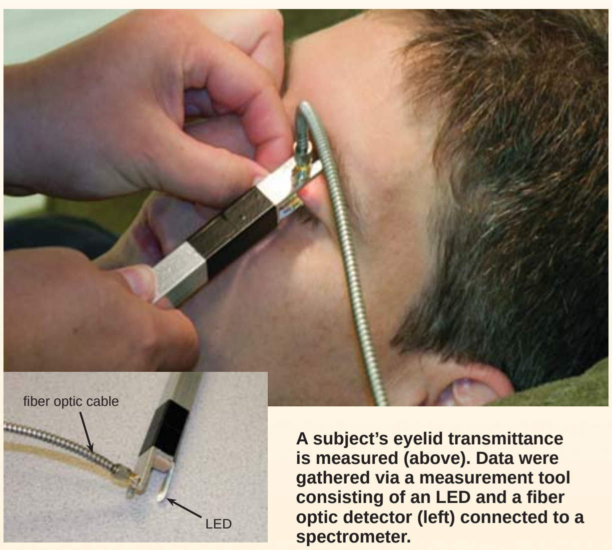
Measuring the Spectral Transmittance of the Human Eyelid

Retinal light exposures can affect non-visual systems like those controlling alertness, hormone production, and timing of the sleep-wake cycle. The human eyelid shelters the eye from light, but the eyelid is not opaque; therefore, eyelid-filtered light could potentially also stimulate some of these non-visual effects.

Researchers at the Lighting Research Center developed a technique to practically and accurately measure eyelid transmittance across the visible portion of the electromagnetic spectrum, paying particular attention to decreasing stray light and increasing the signal-to-noise ratio in the eyelid spectral transmission measurements. Directly placing a very small, calibrated source behind the eyelid with a fixed detector in front (see photos, below) provided greater measurement sensitivity than could be obtained from previously reported methods.



A subject's eyelid transmittance is measured (above). Data were gathered via a measurement tool consisting of an LED and a fiber optic detector (left) connected to a spectrometer.

Bierman A, Figueiro MG, Rea MS. 2011. Measuring and predicting eyelid spectral transmittance. *J Biomed Opt.* **16**(6):067011.

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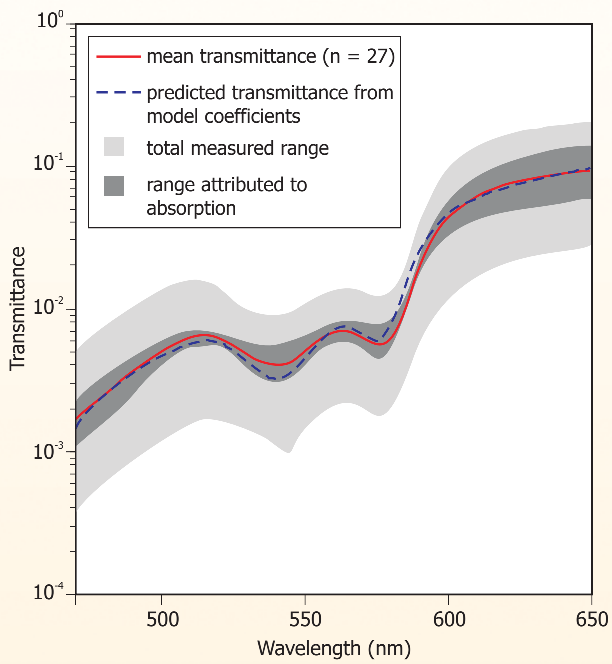
Eyelid transmittance was measured from 27 subjects. Results showed that the eyelid has a much higher optical density at short wavelengths than was previously published. The mean ± s.d. optical density of the eyelid from 450 nm to 650 nm was 2.1 ± 0.3 with an optical density range among subjects of approximately 1.0 across the entire spectral range. The mean transmittance at 630 nm was approximately 9%, while the mean transmittance at 550 nm was approximately 0.5% and 0.4% at 490 nm.



Furthermore, researchers found that skin pigmentation is poorly correlated with eyelid transmission. In fact, eyelid transmission is most likely affected by eyelid thickness and wavelength-independent macromolecules in the eyelid, such as keratinocytes, collagen, and fat. Together with data on the absorption and scattering characteristics of the constituents of the skin, a method for predicting relative eyelid transmission at any wavelength was developed (see figure, above).

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