Blue Light Hazard: New Knowledge, New Approaches to Maintaining Ocular Health

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This Position Paper is signed by an expert panel that met in NYC in March 2013 to evaluate what is known about blue light hazard and the means of ocular protection available. This report summarizes the roundtable discussion and:

- Provides an overview of the interaction between light and the eye;
- Describes the current understanding of the role blue light plays in health and vision;
- Reviews the present state of knowledge about blue light hazard and the mechanisms by which blue light may damage retinal cells;
- Discusses a recent research study identifying a specific, narrow band of blue light that is phototoxic to the retinal pigment epithelium cells; and
- Introduces a new spectacle lens solution that for the first time offers a way to reduce exposure to both UV and damaging blue light without affecting either color vision or blue light’s beneficial effects.

Short wavelength visible light, the spectrum from 380 to 500 nm that includes violet, indigo, blue, and some blue-green light, plays a paradoxical role in health and vision. Not only is blue light essential for color vision, recent research has found that light in this band triggers critical physiological responses, including pupil constriction and circadian rhythm synchronization. However, blue light may also be damaging to the eye, and the term “blue light hazard” has been coined to describe the danger this light presents to critical structures within the eye.

Blue light can induce formation of toxic reactive oxygen species that cause photochemical damage, leading to the death by apoptosis first of critical retinal pigment epithelial (RPE) cells and then photoreceptors. This slow process, in which damage accumulates over a lifetime, has been implicated in the pathogenesis of retinal degenerative diseases such as age-related macular degeneration (AMD).

The fact that blue light is both beneficial and toxic raises a critical question: Can we protect the eye from harmful blue light without simultaneously denying it the physiologically necessary blue light? One way to accomplish this would be with a lens that selectively filters out the harmful wavelengths while transmitting the beneficial ones. Recent work has enabled this by more fully defining the range of harmful blue light.

To determine whether specific bands within the blue-violet spectrum are responsible for blue light’s phototoxic effects on the RPE, researchers from Essilor’s Paris research and development laboratories joined forces with scientists from the Paris Vision Institute to develop a unique illumination system that allowed cultured porcine retinal cells to be exposed to narrow (10-nm) bands of light at moderate irradiances normalized to typical retinal sunlight exposure. Using this test system, it was discovered that RPE phototoxicity was concentrated in a relatively narrow band, with little overlap of the wavelengths necessary for the beneficial physiological effects of blue light. This finding paved the way for selective photofiltration: the creation of lenses that reduce the level of exposure to the harmful portion of the blue-violet spectrum while permitting the rest of the visible spectrum to enter the eye at a normal level. Thus, the eye’s necessary visual and non-visual functions can be maintained while exposure to hazardous wavelengths is reduced.

With the creation of Crizal® Prevencia™ No-Glare lenses, Essilor has turned this concept into a reality. These lenses reduce exposure to ultraviolet (UV) light — coming from in front or reflecting
off the back surface of lenses — and they attenuate the harmful wavelengths of blue light. Because they reduce (but don’t fully block) transmission of just a narrow band of blue-violet light, excellent color transmission, as well as transparency, are maintained, providing superior clarity of vision. Because the damaging effects of blue-violet light are cumulative, wearing Crizal® Prevencia™ No-Glare lenses may help protect the eye by reducing lifetime exposure to harmful UV and blue-violet light. With more and more clinicians prescribing spectacle lenses from the chair, Crizal® Prevencia™ No-Glare lenses provide a helpful tool for patients to protect themselves from UV and the harmful wavelengths in the blue-violet spectrum.