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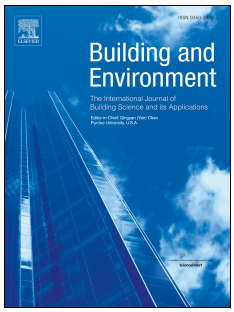

Lighting simply made better: Providing a full range of benefits without much fuss

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Lighting simply made better: Providing a full range of benefits without much fuss

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Abstract

The effective application of lighting depends upon a definition of light that captures the full range of wavelengths to which the human retina is sensitive. The current definition of light, based upon the photopic luminous efficiency function, V(λ), does not. Rather, V(λ) is biased against short wavelengths that are important for some of the benefits that lighting can provide to people such as brightness perception and circadian regulation, thereby compromising the effective application of lighting. Neuroscience has revealed several visual and non-visual channels that emanate from the retina to different centers in the brain influencing our physiology and behavior. This research has also elucidated the spectral and the absolute sensitivities of these different neural channels. Since the definition of light and the many lighting standards do not reflect the neuroscience, they compromise the beneficial application of lighting. A new definition of light based upon the universal luminous efficiency function, U(λ), would be unbiased with respect to the full range of wavelengths to which the retina is sensitive. Coupled with scientific insight into the spectral and absolute sensitivities of the various neural channels, lighting can easily become more effective for delivering the benefits people expect.

Keywords: light; lighting; brightness; circadian; visibility; measurement

1. Introduction

The delivery of the benefits that lighting can provide to people in the built environment such as safety, comfort, health, visibility and wellbeing, must begin with a definition of light. If the light stimulus is not tangibly related to the expected benefits, one cannot expect lighting to provide those benefits.

The international authority, the Commission Internationale de l'Éclairage (CIE), defines light as "any radiation capable of causing visual sensation directly" [1]. In defining light more precisely for photometry, the CIE sanctions the photopic luminous efficiency function, V(λ) (equation 1; dashed curve in Fig. 1)[a] [1]. This function is based upon experiments conducted nearly a century ago attempting to measure the human visual sensitivity to different wavelengths. From our current scientific perspective, however, the CIE definition of light is much too limiting. Not only does optical radiation incident on the human retina evoke important *non*-visual, and completely unconscious responses like circadian regulation [3,4] but V(λ) significantly misrepresents the spectral sensitivity of these non-visual responses to optical radiation [5,6]. Moreover, we now know that V(λ) misrepresents the spectral sensitivity of several important visual sensations, such as brightness perception [7,8].

[a] The CIE actually sanctions several luminous efficiency functions [1,2] but these functions are never used in lighting applications.