

## Opinion: A changed understanding of light and lighting



The Society of  
Light and Lighting

The General Council of Weights and Measures (CGPM) defines seven fundamental units of physical measurement from which all other units are derived. These units are the metre, second, kilogram, Kelvin, Ampere, mole and candela. Six of them are defined purely in terms of physical measurement but the candela is different as it is based on a human psychophysical response – the  $V(\lambda)$  function defined by the CIE in 1924. This function is sometimes described as specifying human visual sensitivity to light but that is incorrect. It is based on brightness responses for a small light field focussed entirely onto the fovea and represents the responses of just two of the five types of retinal photoreceptors. There is far more to human visual sensitivity than is indicated by  $V(\lambda)$ , and more again when the full scope of lighting practice is taken into consideration.

Lighting practitioners have been content to adopt the lumen, which is derived from the candela, for specifying quantities of light although they recognise it is inappropriate for non-visual applications such as providing for therapeutic, photosynthetic or germicidal effects, or for assessing potential for photochemical damage. However, this reliance upon the lumen is currently coming under pressure as practitioners seek to incorporate non-visual human responses, notably circadian effects, into their lighting solutions. These practitioners are developing lighting proposals concerned with human responses such as alertness and sleep cycles which involve diurnal variations of spectral power distribution (SPD) for response functions that are very different from  $V(\lambda)$ . As they engage with options offered by ‘tunable lighting’ they have also to address how the resulting variations of SPD affect visible responses

such as colour rendition, now defined by multiple TM-30 metrics.

The notion of a fundamental unit of light is no longer tenable and revision is needed. Lighting practice should be recognised as the application of radiant power to stimulate various visual and non-visual responses, where the purpose for which radiant power is being applied determines the appropriate spectral response function for assessing light flux. Some of these functions would be defined by specific data files, but response functions such as on-axis or off-axis acuity, mesopic or photopic brightness, or circadian stimulus, may be specified as weighted summations of some of the five retinal photoreceptor responses. Whenever illuminance is specified it would be necessary for the spectral response function to be identified and new lighting standards would be needed. Lamp and luminaire performance would be specified as SPD data files (W/nm, or W/nm.str) and practitioners would need climate-based spectral daylight data in order to incorporate diurnal variations of daylight SPD into their proposals. While the notion of multiple illuminance units might seem confusing, it would rid us of ‘scotopic lumens’ and other such proliferating confusions. These proposed changes would enable lighting practitioners to evaluate illumination according to the purposes it is to serve as well as putting them in the role of delivering the range of benefits that advanced lighting technology offers to the community.

*Christopher Cuttle, PhD, FSSL FIESANZ,  
FIESNA  
Wellington, New Zealand  
Email: kit.cuttle@xtra.co.nz*