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THE EFFECT OF YELLOWING HUMAN CRYSTALLINE LENS ON THE MESOPIC VISION

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The issue of mesopic photometry has been discussed for many years. In this decade, many attempts had been made to develop performance base mesopic photometry systems bridging the photopic and scotopic luminous efficiency functions—e.g., the X-model (Rea et al., 2004) and the MOVE-model (Elholma and Halonen, 2006). The CIE Technical Committee 1-58 "Visual Performance in the Mesopic Range" has proposed an intermediate model between the above mentioned two models to ensure reasonably wide applicability (CIE TC1-58, 2008).

It is obvious that the use of these mesopic photometry systems results in much better agreement with true visual performance than the use of the current photometry (i.e., $V(\lambda)$) for the peripheral visual filed under mesopic lighting conditions. It should be noted, however, the unified system of photometry cannot directly replace the current photometry. One of the questions while implementing the unified system of photometry to the real street lighting applications is whether the same mesopic photometry can be applied to both young and older people. Based on the mesopic photometry systems, for instance, it is recommended to use metal halide lamps instead of high pressure sodium lamps for street lighting. However, it is unclear whether the elderly obtain merits of replacing a high pressure sodium lamp with a metal halide lamp. Since yellowed human crystalline lenses of older people filter out short wavelength radiation, benefits of lamps with short wavelength radiation at mesopic light levels can probably be ignored.

Prior to the implementation of the unified system of photometry to the real transportation lighting, it is important to consider the effect of yellowing human crystalline lens on the mesopic vision. To this end, this study conducted a target detection study under cyan and yellow LED lighting conditions while comparing between young and older subjects.

Experiment: The laboratory study took place using a target presentation setup in a windowless room. The setup was composed of a partition with a reflectance of 5%, six peripheral targets, a manual switch to signal target detection, and a personal computer system to control the peripheral targets and record subjects' responses. The detection targets were located at 5 degrees, 10 degrees, and 20 degrees to both the right and left sides from the central visual field. Each detection target was a 13 mm diameter disk and was flipped electromagnetically from a black side (reflectance: 5%) to a white side (reflectance: 80%). Each of the six targets was presented ten times for each lighting condition.

The experiment used cyan LEDs (with a peak wavelength of 505 nm) and yellow LEDs (590 nm) to vary spectral power distributions (SPD), illuminating the targets and the background. By dimming these LEDs, the experiment provided three light levels (0.04 cd/m^2, 0.4 cd/m^2, and 4 cd/m^2 for photopic target luminance levels). To simulate lens yellowing as aging, this study used yellow glasses developed by Okajima (Okajima and Iwata, 1998) based on the two-factor lens-density model (Xu et al., 1997). This experiment used twelve young subjects (22 years old on average) and three older subjects (65 years old on average). When a 22 year old subject wears the yellow glasses, the

spectral transmittance characteristics of the subject are equivalent to the spectral transmittance characteristics of a 72 year old person.

In the experiment, each of the twelve young subjects was asked to signal target detection immediately upon detecting one of the six presentations of the peripheral targets under each of the 12 lighting conditions (2 yellow glass conditions×2 SPD conditions×3 luminance levels). The older subjects participated in the experiment under 6 lighting conditions without using the yellow glasses.

Results: As has been shown in a number of previous studies, this study showed that off-axis response times under the cyan LED lighting condition were shorter than they are under the yellow LED lighting condition at the same photopic light levels. This study demonstrated that the task performance of the young subjects improves as a function of unified luminance in which the spectral transmittance characteristics of the yellow filter are considered. This implied that the sensitivity of the experiment was high enough to examine the effects of lens yellowing on the responses under different SPD conditions at mesopic light levels. The results for the older subjects suggested that the older subjects showed a similar tendency to the young subjects who wore the yellow glasses. More subjects in the older age group will be examined and their data will be reported at the conference.

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