

The effect of spectral power distribution on task performance

Some scientists believe that we could reduce the amount of light used in many commercial and industrial applications, while maintaining similar visual performance, if the applications used light sources that produced smaller pupil sizes. This argument is based on the belief that smaller pupil sizes will improve the performance of visual tasks, even with less retinal illuminance, because smaller pupils lead to a greater depth of field and a better quality retinal image. This Lighting Research Center (LRC) study tested this belief under realistic task and lighting conditions.

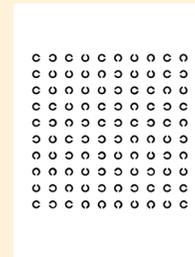


Experimental office setting

Experimental Conditions

Two groups of subjects, one aged 18 to 28 years and a second aged 61 to 78 years, performed a Landolt ring task. For this task there were

- Eight different gap sizes (1.5 to 14 minutes of arc),
- Two different illuminances (344 and 500 lux), and
- Two lamp spectra: scotopic/photopic ratios of 1.3 and 2.1 having correlated color temperatures (CCT) of 3000K (warm) and 6500K (cool), respectively.



Example of the Landolt ring task

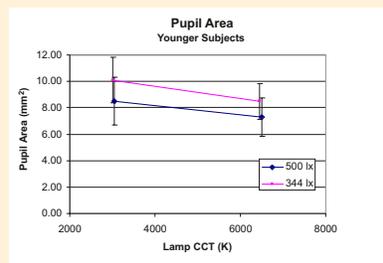
Results

For both age groups

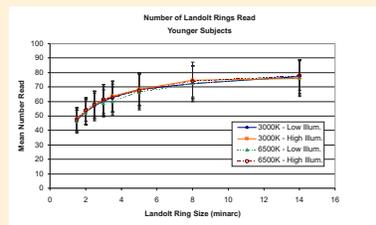
- Illuminance and lamp spectrum modify pupil size,
- Speed and accuracy of task performance were determined by Landolt ring gap size and, to a much lesser extent, by illuminance,
- Lamp spectrum does not affect task performance, and
- The lamp spectrum with the higher scotopic/photopic ratio was perceived as brighter at the same illuminance.

Conclusion

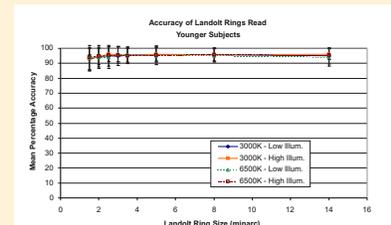
There is no support for the belief that smaller pupil sizes lead to better task performance under realistic task and lighting conditions.



Pupil area for younger subjects decreases as the lamp's correlated color temperature and illuminance increase (CCT is an indication of spectrum). Older subjects' pupil areas change in a similar way.



The number of Landolt rings read in 20 seconds increases as the size of the gap in the ring increases. However, number read does not increase with changes in lamp spectrum or illuminance. (Trends for older subjects were similar but showed a small interaction between illuminance and gap size.)



Accuracy improves as the size of the gap in the Landolt ring increases but does not improve with changes in lamp spectrum or illuminance. (Trends for the older subjects were similar.)



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