

Elementary School Children Have Better Near Acuity under High Color Temperature Lighting

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Near visual acuity (eye chart located at 40 cm distance for typical reading condition) of 27 children ages 10&11 years was measured by a licensed optometrist under 2 different fluorescent lamp spectra. The measurements were obtained in a room on the school premises outfitted with specially designed fixtures that simultaneously housed both lamp types.

One spectrum was provided by the standard school fluorescent lamp of correlated color temperature (CCT) 3500K while the other spectrum was provided by a readily available fluorescent lamp of a higher CCT value of 5500K. The fixtures were designed to provide equal luminance distributions with each lamp type separately controlled by a wall switch.

Acuities were measured under 3 lighting conditions, either both lamp types providing equal luminance or a condition where the luminance of the 5500K lamp was set to a 50% lower value. The equal luminance case had the luminance at the eye of the tested student (in the direction of gaze) adjusted to the value 85 cd/m^2 .

For that case, the Wilcoxon sign test applied to the results showed that visual acuity was significantly better ($p < 0.01$) under the higher CCT lamp with 24 of the 27 children having better acuity under the higher CCT lamp. There was 1 tie score while 2 scored better under the standard lamp. (Also noted, the tie student and one of reversals did better under the lower luminance condition than either of the other 2 conditions.)

Students T-tests comparing the lower luminance condition showed a significant difference for the 5500K lamps at the 2 luminances, but no significant difference when comparing the 3500K lamps at the higher luminance value with the 5500K lamps at the lower luminance. However there was a strong trend for the lower luminance condition to provide better acuity with the results showing 6 ties and 14 out of the remaining 21 having better acuity under the lower luminance condition of the 5500K lamps.

Pupil sizes of 4 children under the 2 different lamp types for the equal luminance condition were also measured based on averaging multiple frames of calibrated video camera images of their eyes. Average pupil size was significantly smaller under the 5500K lighting as compared to the 3500K lighting consistent with prior measurements of adults suggesting an explanatory mechanism based on the enhanced blue spectrum of the 5500K lighting causing greater pupil constriction and thereby improving visual optical quality.

Based on acuity as a criterion for light level, these results demonstrate a highly cost effective means for achieving improved vision and major energy savings by switching school lighting to higher color temperature lamps.

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