

Lighting for Health and Energy Savings: Human Factors

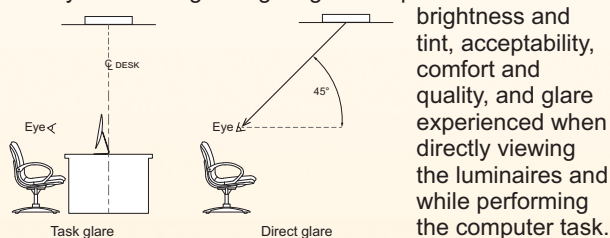
Based on the results of the luminaire survey and photometric calculations conducted in the first phase of this study, this human factors experiment further evaluated the luminaires that provided the best circadian stimulus (CS) to lighting power density (LPD) ratio. The 2x2 troffer and direct/indirect pendant were chosen for the study, and a desktop luminaire was also included to explore its viability as a CS delivery method.



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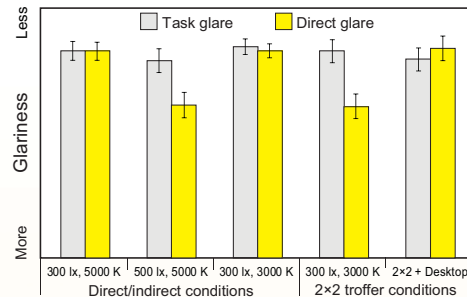
Methodology

Twenty participants in an office environment mockup experienced five lighting conditions: (1) direct/indirect pendant (300 lx, 5000 K), (2) direct/indirect pendant (500 lx, 5000 K), (3) direct/indirect pendant (300 lx, 3000 K), (4) 2x2 troffer (300 lx, 3000 K), and (5) 2x2 troffer (300 lx, 3000 K) supplemented with a desktop luminaire (blue light, target CS = 0.3). For each condition, the participants performed a typing task at a computer and filled out surveys evaluating the lighting. Participants evaluated



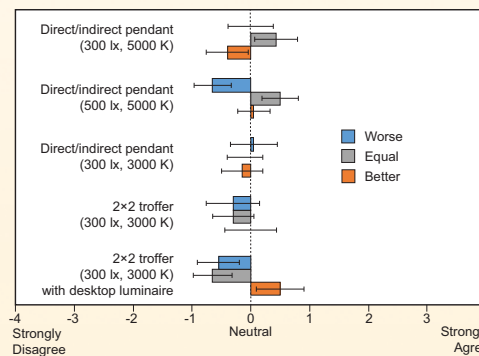
Results

- The participants rated the brightness and tint of the illumination as being close to “just right,” but there were no significant differences between the experimental conditions in respect to these factors.
- All participants tended to agree that they would feel comfortable working under all of the lighting conditions.
- The direct/indirect pendant (500 lx, 5000 K) and the 2x2 troffer (300 lx, 3000 K) had the least-favorable glare rating when directly viewed, with a De Boer Scale score of about 5 (“just permissible”). A De Boer Scale score of 1 represents “unbearable” and a score of 9 represents “just noticeable.”



Participants mean \pm standard error of the mean (SEM) glare ratings for the experimental conditions while performing the computer task and directly viewing the luminaires at a 45° angle.

- The 2x2 troffer plus desktop luminaire condition was rated as having the highest lighting quality, though again, there were no statistically significant differences between any of the experimental conditions.
- In addition to this high lighting quality rating, the photometric calculations identified the 2x2 troffer (300 lx, 3000 K) supplemented with the desktop luminaire as the most efficacious way to deliver CS at the eye while using the least energy (i.e., highest CS:LPD ratio).
- The desktop luminaire had the most-favorable glare rating and was judged as “satisfactory” (De Boer Scale score of about 7.5) when viewed directly.
- Lighting manufacturers and designers therefore should consider using desktop luminaires for delivering CS to office workers when energy, light level, and/or CCT constraints pose challenges to meeting CS design targets using ceiling luminaires alone.



Participants' mean \pm SEM responses to: “The lighting is [worse, equal, or better] than/to similar workplace lighting in other buildings.”

Sponsors

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Lighting Research Center

