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Mixed effect of time of day and correlated colour temperature on discomfort glare

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Daylight supports multiple visual and non-visual needs. With occupants spending significant portions of day indoors, lack of daylight can lead to circadian disruption and other adverse effects. Even for buildings with external views, blinds tend to be closed at first instances of glare and often not reopened. Additionally, the use of electric light during daylit hours has energy implications. Towards maximising daylight benefits, glare responses need to be better characterised. Yet, although models for glare prediction exist, they do not address the within- and between-subject variances deriving from personal and contextual factors. These variances need to be better framed toward enhancing glare tolerance.

Previous studies have established that source spectrum influences glare perception, with higher estimates of discomfort glare evoked by shorter wavelengths. Time of day (ToD) has also been found to influence glare evaluation, with increasing tolerance reported as the day progresses. Yet, no research has yet been done on the potential mixed effects of spectrum and time of day on glare assessments. To meet this gap, a laboratory experiment was designed, using a category-rating approach and tunable (intensity and CCT) LED luminaires. The setup, located in an artificially-lit semi-hexagonal chamber, included a dimmable light source subtending 0.009sr at the eye, and a background luminance of 65 cd/m2. A fixation-point was placed with a 15° vertical displacement below the glare source. With a sample size of 36 participants, the experimental procedure was organised across four IES-GI thresholds –corresponding to glare source luminance of 1627, 3860, 9150 and 21700 cd/m2 - three ToDs - Morning (09:00), Midday (13:00), and Afternoon (17:00) - and two CCTs - 2600K (warm) and 6200K (cool).

Demographic data, subjective chronotype, and perceived photosensitivity were collected prior to the first session. At each session, personal factors including perceived fatigue, caffeine ingestion, sleep quality, mood, and prior light exposure were also collected from test participants. At the start of the procedure, the subject was invited to place their head on a chinrest, and then they were blindfolded for one minute. Meanwhile, the scene was set to one of the two CCTs, and the source luminance was adjusted to one of the four IES-GI thresholds. The subject was then asked to stare at the fixation point for 30 seconds, following which they were asked to mark their glare sensation vote (GSV) and level of discomfort due to glare on two Visual Analogue Scales (VAS). The subject was then blindfolded again, while the scene was toggled to next state. The procedure was repeated for the remaining settings of CCTs and IES-GI values, across three ToDs.

The data collection was concluded in May, and the data is currently being analysed. The responses on the VAS will be converted to percentage sensation score (PSS). For each CCT/ToD/GSV group, an initial analysis of variance (ANOVA) will be conducted to detect any differences in PSS across independent variables. Since the PSS data for each GI are nested across ToDs and CCTs, the data will be analysed via mixed-effect multilevel modelling.

Keyword 1

Discomfort Glare

Keyword 2

Correlated Color Temperature

Keyword 3

Time of Day

Keyword 4

Multilevel Modeling

Keyword 5

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