

Office Lighting and Personal Light Exposures in Two Seasons: Impact on Sleep and Mood

The goal of the study was to obtain personal light-dark and activity-rest patterns of people working in a building designed to maximize daylight availability in the space during winter and summer. It was hypothesized that individuals working in an office building designed to increase daylight availability would exhibit high circadian entrainment, good sleep quality, and improved mood, especially in summer.



Methods

The study was conducted at the Wayne N. Aspinall Federal Building in Grand Junction, Colorado, a three-story Second Renaissance Revival style building constructed in 1918 and managed by the U.S. General Services Administration. LRC obtained personal light exposures from volunteers who agreed to wear the Daysimeter as

a pendant for seven consecutive days in winter and again in summer. Participants were also asked to fill out subjective questionnaires about sleep and mood.

Results

Key findings include:

- In summer, subjects received significantly more circadian light (both at work and outside work), slept significantly more, and had significantly greater efficiency and significantly lower sleep latency than in winter (see table).

	Actual Sleep (min.)	Actual Sleep (%)	Sleep Efficiency (%)	Latency (min.)
Winter Mean	340.89	90%	70%	92.75
Winter SEM	15.87	2%	2%	8.35
Summer Mean	373.14	89%	79%	18.33
Summer SEM	18.08	3%	3%	5.05
t-tests	0.014	0.640	0.001	<0.001

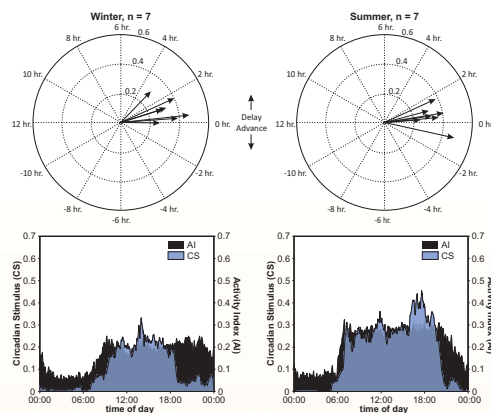
Mean ± standard error of the mean (S.E.M.) of sleep parameters.

Citation

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Sponsor

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Phasor distributions (upper panels), and average activity (AI) and light exposures (CS) over 24 hours (lower panels) for winter (left panels) and summer (right panels).

- Although not statistically significant, self-reports of sleep and mood were also improved in summer compared to winter.
- Phasor magnitudes (mean of 0.35 in winter and 0.36 in summer) were slightly lower than what the LRC has measured in other dayshift workers (e.g., teachers or nurses), which had mean phasors of 0.4 to 0.5. A high phasor magnitude suggests circadian entrainment.
- Phasor angles (mean of +1.10 hours) were slightly higher in the winter and closer to those observed in other populations in the summer (mean of +0.51 hours). The phasor angles for teachers and dayshift nurses, for example, were +0.94 and +0.68 hours.
- Workers tend to pull the shades closed whenever sunlight hits their face or desk spaces, and the shades remain down for much or all of the day.
- Furniture placement impacts circadian stimulus (CS) levels. Workers can be seated with their backs to the windows, thus reducing the amount of light at the eye.

Conclusions

Increased circadian light exposure in summer increased workers' sleep duration, but did not affect self-reports of mood. The data show a relationship between calibrated light exposures in two seasons and sleep quality and thus may provide useful insights to architects and designers. Strategies to increase circadian light exposures in buildings via daylighting and electric lighting should be a consideration in architectural design.

