

New Pathway to Alertness

Scientists have long agreed that retinal light exposure regulates our body's circadian rhythms such as the sleep/wake cycle. LRC scientists recently uncovered new information that may chart a new, additional course in our quest to understand how light impacts human health and well-being.

Out of the blue

It is well accepted that the circadian system is maximally sensitive to short-wavelength (blue) light and is quite insensitive to long-wavelength (red) light.

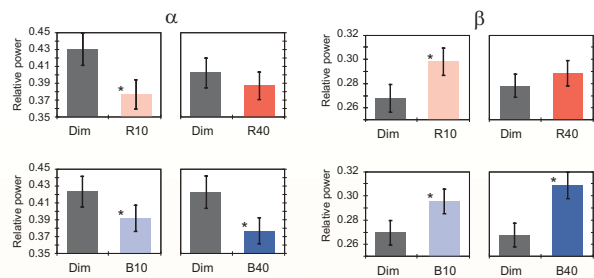
In a study sponsored by the Office of Naval Research examining the effects of different lighting conditions on alertness and performance, LRC scientists found that not only blue light but also moderate levels of red light increased alertness at night.

Method

Fourteen subjects participated in a within-subject two-night study. On both nights, the subjects were each presented a high (40 lx at the cornea) and a low (10 lx at the cornea) diffuse light exposure condition of the same spectrum (blue, $\lambda_{\max} = 470$ nm; or red, $\lambda_{\max} = 630$ nm).

Prior to each lighting condition, the subjects remained in the dark (< 1 lx at the cornea) for 60 minutes.

Electroencephalogram (EEG) measurements, electrocardiogram (ECG), psychomotor vigilance tests (PVT), self-reports of sleepiness, and saliva samples for melatonin assays were collected at the end of each dark and light period.



Relative alpha and beta power densities after exposure to the four dim and the four experimental lighting conditions (* $p < 0.05$).

Results

- Exposures to red and to blue light resulted in EEG rhythmic activity changes reflecting increased alertness (increased beta power frequency) and a reduction in relaxation (reduced alpha power frequency) relative to preceding dark conditions.
- Exposures to high, but not low, levels of red and of blue light significantly increased heart rate relative to the dark conditions.
- Only the higher level of blue light resulted in a reduction in melatonin levels relative to the other lighting conditions.
- Performance and sleepiness ratings were not strongly affected by the lighting conditions.

This study suggests that the circadian system is not the only light-sensitive pathway involved in determining alertness at night, and that other mechanisms may exist.

Sponsor

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