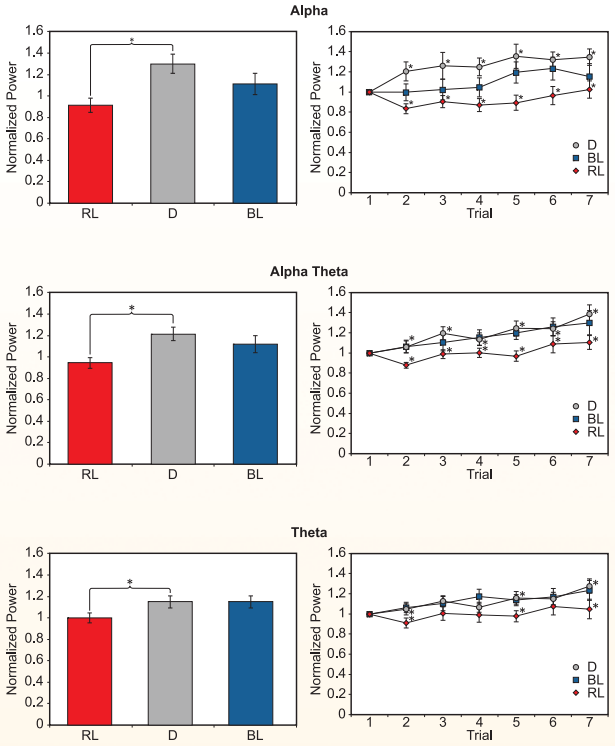
The Impact of Red and Blue Lights on Alertness in the Afternoon

Light has an acute effect on neuroendocrine responses, performance, and alertness. Most studies to date have linked the alerting effects of light to its ability to suppress melatonin, which is maximally sensitive to short-wavelength light. Recent studies, however, have suggested that the melatonin pathway is not the only light-sensitive pathway that can affect alertness at night. Furthermore, other studies have shown alerting effects of white or narrowband short-wavelength lights during daytime, when melatonin levels are low. While the use of light at night to promote alertness is well understood, it is important to develop an understanding of how light impacts alertness during the daytime, especially during the post-lunch hours. This study investigated how 48-minute exposures to short-wavelength, blue light (λ_{max} = 470 nm), or long-wavelength, red light (λ_{max} = 630 nm), close to the post-lunch dip hours affect electroencephalogram measures in participants with regular sleep schedules.

Results

Power in the alpha, alpha theta, and theta ranges, all measures associated with sleepiness, was significantly lower ($p < 0.05$) after exposure to red light than to darkness. Exposure to blue light reduced alpha and alpha theta power compared to darkness, but these differences did not reach statistical significance ($p > 0.05$).



Average ± standard error of the mean normalized alpha (8-12 Hz) power (top), alpha theta (5-9 Hz) power (middle) and theta (5-7 Hz) power (bottom) for red light (RL), dark (D) and blue light (BL) conditions. Compared to remaining in darkness, alpha, alpha power and theta (all measures of sleepiness) were significantly reduced ($p<0.05$) after red light exposures, but not after blue light exposures.

Conclusions

The results extend those performed during the nighttime, and demonstrate that light can be used to increase alertness in the afternoon, close to the post-lunch dip hours. These results suggest that the intrinsically photosensitive retinal ganglion cells, which are the primary photoreceptors mediating the effects of light on acute melatonin suppression, are not the only photoreceptors mediating the alerting effects of light during the daytime, because they are not sensitive to red light.

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