

Impact of Sleep Duration and Light Exposure on Sleepiness and Performance

Studies have shown that light can affect biomarkers, performance, and subjective sleepiness; however, these effects are not very well understood. The effect of light on biomarkers was examined in a preliminary study. The goal of this study was to better understand the role of short-wavelength (“blue”) light on subjective sleepiness and performance over 27-hour sessions, with and without sleep.



Subjects were exposed to 50 minutes of 470 nm “blue” light every four hours throughout the 27-hour sessions.

Results

Results showed that performance and self-report of sleepiness follow a circadian pattern and are affected by sleep duration. Each outcome had distinct rhythms, but each rhythm showed a clear transition from nighttime to daytime. This suggests that humans have two distinct modes of operation — day/activity and night/rest. There is a systematic, coordinated transition between these states in people who have normally synchronized circadian rhythms.

There was a positive effect of blue light exposure on performance at certain times of day and night. These results can have applications in both traditional and non-traditional work environments, where controlled light exposures could be used to increase performance and alertness.

Experiment

Ten participants took part in a within-subjects laboratory study. Subjects participated in three sessions that were each 27 hours long. In each session, they either slept for seven hours, three hours, or did not sleep at all; all participants experienced each condition. They were exposed to 50 minutes of 470 nm “blue” light every four hours throughout each 27-hour session. Participants were also tested for performance and asked to report subjective sleepiness at these times.

Personalized digital assistants (PDAs) were used to record self-reported sleepiness and three measures of performance. The Karolinska Sleepiness Scale (KSS) was presented first to assess subjective sleepiness. Three psychomotor vigilance tests were given: a simple reaction time (SRT) test, a two-alternative forced choice reaction time (FCRT) test, and a matching-to-sample (MTS) test.

Publication

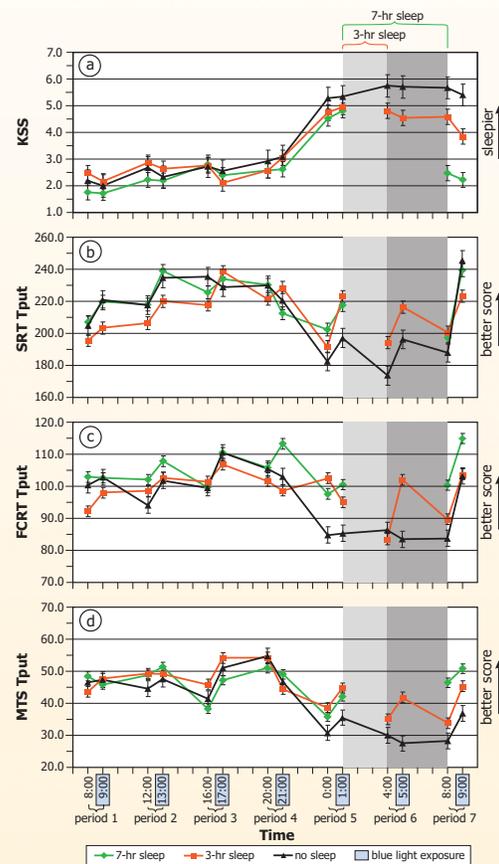
Figueiro MG and Rea MS. 2011. Sleep opportunities and periodic light exposures: Impact on biomarkers, performance, and sleepiness. *Lighting Research & Technology*, 43(3):349-369.

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Normalized KSS scores (a), throughput (Tput) scores for SRT test (b), FCRT test (c), and MTS test (d) over the course of the 27-hour experiment for the three sleeping conditions.

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