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Daytime Light Exposure Advances Melatonin Onset in Humans

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Epidemiological studies demonstrated that earlier timing of sleep correlated with more time spent outdoors (Roenneberg et. al., 2003). Here, we tested whether outdoor light intensities on cloudy days in November in the Netherlands (sunrise 7:48 a.m, sunset 4:46 p.m) are sufficient to shift the circadian pacemaker. Two groups of 15 subjects each (age 21 ± 2) participated in the study for two days. On both days, subjects started with classes from 9:00 AM to 10:30 AM. One group subsequently went and stayed outside until 5:00 PM During the same interval the other group stayed inside in dim light. On the next day the conditions were reversed. On both days, from 5:00 PM. onwards, the subjects stayed in dim light and saliva samples were taken every hour from 6:00 PM. till midnight in the lab and at 3:00 and 6:00 AM at home. Salivary melatonin concentration was determined by radio immuno assay. Melatonin profiles were scaled relative to the maximum amount detected in any of the data points of each person. The time at which the 25% level was reached was taken as dim light melatonin onset (DLMO). Average DLMO was 14 minutes earlier (p=0.03) on the days the subjects had spend outside. These data show that moderate outdoor light intensities are sufficient to advance DLMO, suggesting that early sleep timing on free days could be partially due to outdoor light exposure. In contrast to our expectations, we observed a stronger effect in subjects with earlier melatonin onsets, suggesting higher sensitivity to light for early chronotypes.

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Blue-Enriched Versus White Light for Circadian Phase Delays

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The human circadian system is most sensitive to short wavelength (blue) light. We previously found that bright blue-enriched light produced larger phase advances than bright white light, when sleep/dark was advanced. This study compared the magnitude of phase delays induced by bright blue-enriched light and bright white light, when sleep/dark was delayed. Five 15-minute intermittent light pulses interspersed by 45 minutes of normal room light were delivered on each of two consecutive nights, from 00:45 to 05:00, to coincide with the delay portion of the PRC. Subjects received either blue-enriched light (17,000K, n=10) or white light, (5,095K, n=12). Subjects were exposed to similar luminance from the blue-enriched and white lamps (~3900 vs ~3500 lux), but more total photons (4.6 vs 2.9 x 1015 photons/cm2/sec), and nearly 3 times as many photons in the blue (400-490nm) range (2.0 x 1015 vs 7.4 x 1014 photons/cm2/sec) from the blue-enriched lamps. The dim light melatonin onset (DLMO) and offset (DLMOff) were assessed before and after the light pulses. Mean (± SD) phase delays for the white and blue groups were 3.2 ± 1.3 and 3.2 ± 1.4 hours for the DLMO, and 3.6 ± 1.6 and 1.4 ± 1.5 hours for the DLMOff. Thus, the blue-enriched and white light delayed the DLMO a similar amount, while the white light delayed the DLMOff significantly more. These surprising results will be discussed in terms of putative morning and evening oscillators.

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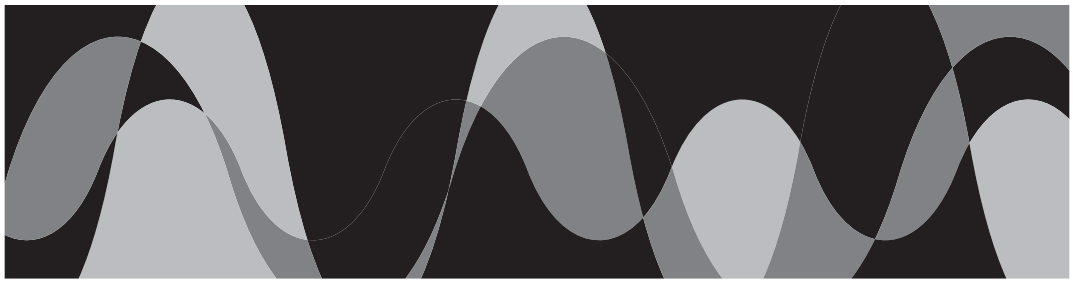

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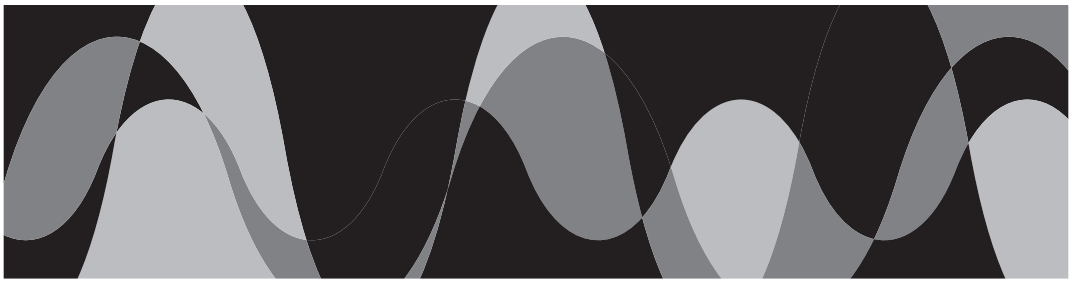

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