

# Temporal integration of light flashes by the human circadian system

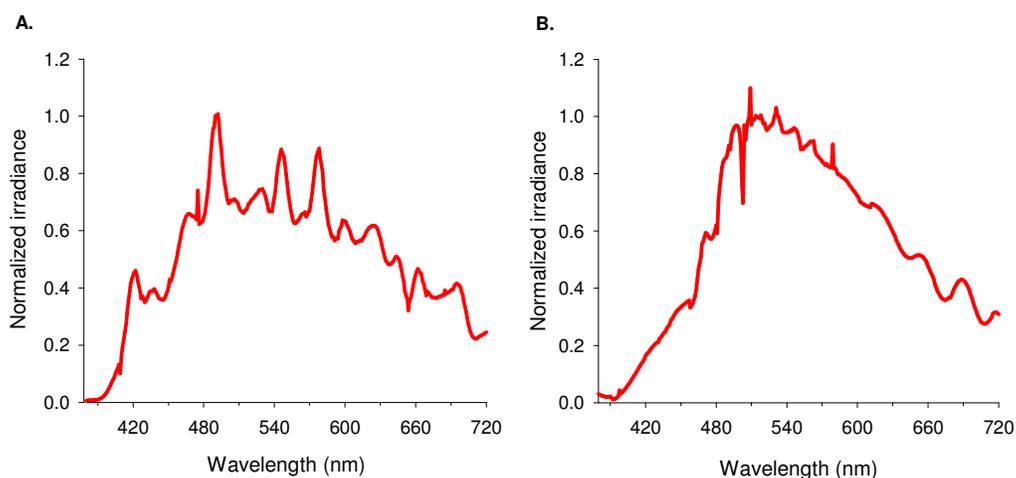
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## Supplemental material



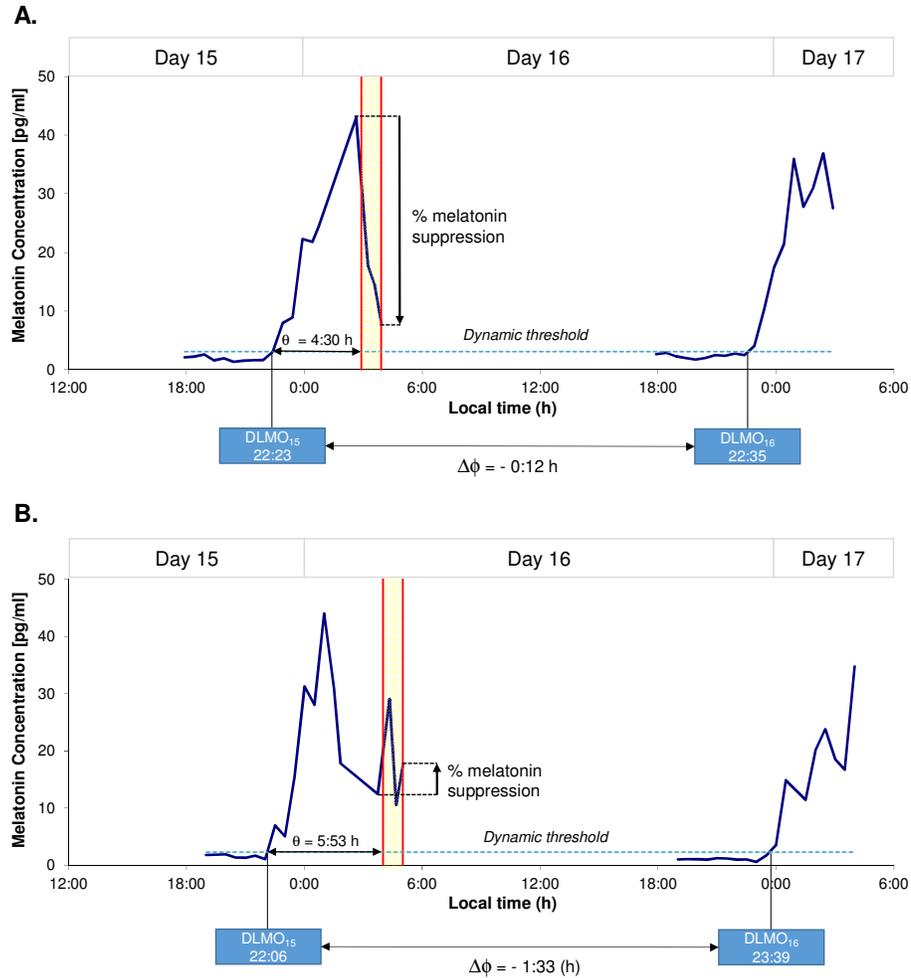
### Supplementary figure 1. Spectra of the continuous (A) and flash (B) light exposures.

A broad spectrum 400 W blue metal halide bulb (Eye Hortilux, OH, USA) with an adapted ballast and a custom-built light box fitted with ultraviolet light filtration, neutral density filters, and diffusers (Rosco, Sun Valley CA, USA) was used to deliver continuous light (A). Flashes were delivered using the broad spectrum xenon flash unit of a ColorDome (Diagnosys, MA, USA) (B). Presented are the normalized spectral irradiances of the two lights sources measured in 4 nm increments by a PR-650 SpectraScan Colorimeter (Photo Research, CA, USA) and confirmed with a ILT 900 spectroradiometer (International Light Technologies, MA, USA).

	<b>Blue metal halide</b>	<b>Xenon light</b>
<b>Peak spectral irradiance (nm)</b>	490.00	510.00
<b>Photopic illuminance (lux)</b>	1720.50	1801.19
<b>Cyanopic (<math>\alpha</math>-opic lux)</b>	1148.75	711.87
<b>Melanopic (<math>\alpha</math>-opic lux)</b>	1681.70	1540.72
<b>Rhodopic (<math>\alpha</math>-opic lux)</b>	1726.60	1683.94
<b>Chloropic (<math>\alpha</math>-opic lux)</b>	1746.77	1782.14
<b>Erythropic (<math>\alpha</math>-opic lux)</b>	1680.62	1717.63
<b>Irradiance (<math>\mu\text{W}/\text{cm}^2</math>)</b>	651.96	582.23
<b>Photon flux (<math>1/\text{cm}^2/\text{s}</math>)</b>	1.87E+15	1.67E+15
<b>Log photon flux (<math>\log_{10}(1/\text{cm}^2/\text{s})</math>)</b>	15.27	15.22

**Supplementary table 1.** Characteristics of the experimental light exposures. Illuminances were measured with an ILT1700 radiometer (International Light Technologies, MA, USA). Spectra were measured in 4 nm increments by a PR-650 SpectraScan Colorimeter (Photo Research, CA, USA), confirmed with a ILT 900 spectroradiometer (International Light Technologies, MA, USA), and converted to the  $\alpha$ -opic lux and irradiance measures with the Microsoft Excel workbook available from Lucas *et al.* 2014 (1).

1. Lucas RJ et al. Measuring and using light in the melanopsin age. *Trends Neurosci.* 2014;37(1):1–9.



**Supplementary figure 2. Example of melatonin secretion profiles on in-lab days 15, 16 and 17 in a participant exposed to continuous light (A) or flashes with 5 s ISI (B).** An objective dynamic threshold was calculated for each participant. Onset of melatonin secretion represents the time at which salivary melatonin concentration is above that threshold. DLMO were estimated on days 15 and 16 and circadian phase shift ( $\Delta\phi$ ) elicited by the light exposure (yellow area) was calculated as  $\Delta\phi = \text{DLMO}_{15} - \text{DLMO}_{16}$ . The phase angle of light exposure ( $\theta$ ) represents the time between DLMO on day 15 and the experimental light onset. Light induced melatonin suppression was calculated as percent change between the sample taken at the end of light exposure and the sample taken immediately prior to light exposure.