

## Supplementary Information for

High sensitivity and interindividual variability in the response of the human circadian system to evening light

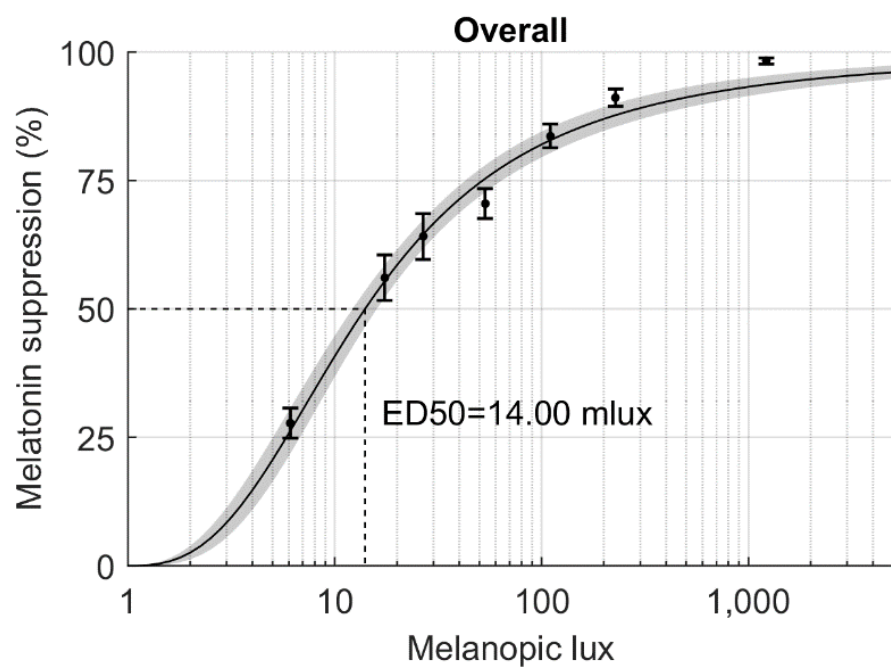
Andrew J.K. Phillips, Parisa Vidafar, Angus C. Burns, Elise M. McGlashan, Clare Anderson, Shantha W.M. Rajaratnam, Steven W. Lockley, Sean W. Cain

Sean W. Cain

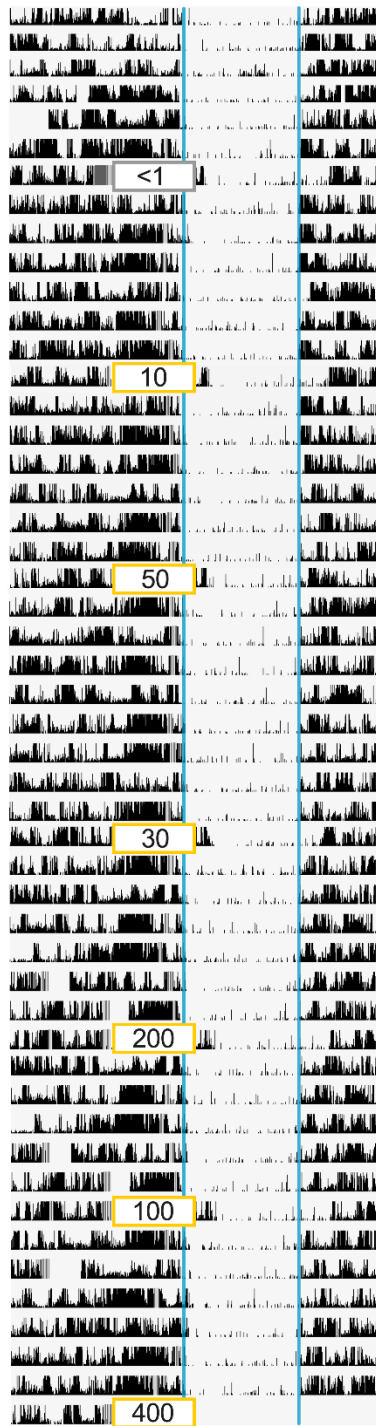
Email: [sean.cain@monash.edu](mailto:sean.cain@monash.edu)

**This PDF file includes:**

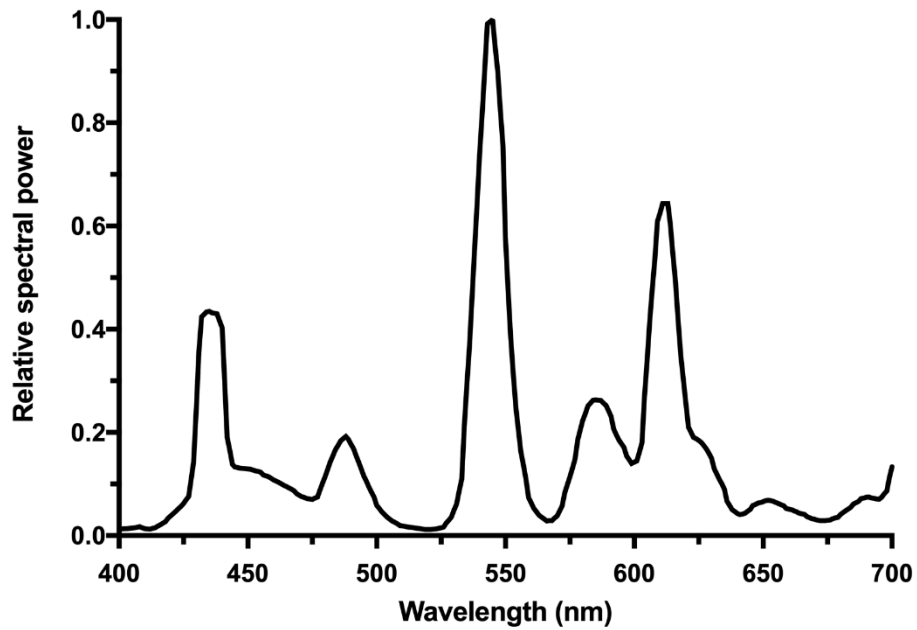
Figs. S1 to S3  
Tables S1 to S2



**Fig. S1.** Overall group level dose response curve to light using melanopic lux values. Effective dose for 50% suppression (ED50) value is indicated. Error bars represent mean  $\pm$  SEM. Gray shaded areas represent 95% confidence intervals for the fitted logistic curve.



**Fig. S2. Protocol design.** Representative actigraphy data from one participant. Labeled boxes indicate in-lab light exposures, with light level in photopic lux given. Black traces show activity counts from wrist-worn actigraphy. Blue lines indicate scheduled sleep and wake times.



**Fig. S3.** The spectral power of the light source across wavelengths for light exposure conditions relative to the peak wavelength (~545 nm).

In order to assess whether there may be a relationship between light exposure history and the measured level of light sensitivity, we performed additional analyses on the actigraphy data. Light data from wrist-worn actigraphy were taken from the 7 days prior to the baseline DLMO, during which time participants were free to expose themselves to their typical lighting conditions, recorded by wrist-worn actigraphy. Devices reported photopic illuminance in 1-minute epochs. Epochs were assigned to 30-minute clock-time bins across days and averaged within clock-time bins. Five summary metrics were computed: (i) mean lux, (ii) mean log lux (taking a  $\log_{10}$ -transform, adding 0.1 to photopic lux values to handle zero values), (iii) median lux, (iv) hours per day above 100 lux, and (v) hours per day above 500 lux. Spearman correlations were computed against individual-level Overall ED50 values. Since participants wore differing actiwatch devices (n=31 with Actiwatch Plus, n=8 with Actiwatch Spectrum, n=15 with Actiwatch L, and n=2 with Actiwatch 2), correlations were performed first on the whole dataset and then only on those wearing the devices that include RGB sensors (Actiwatch Plus and Actiwatch Spectrum). Five participants were excluded from the analysis due to incomplete or corrupted data (n=2 with Actiwatch L, n=3 with Actiwatch Plus), and one participant (n=1 with Actiwatch L) due to no DLMO and consequently no individual-level ED50s.

In both the full dataset (n=50) and in the participants who wore devices with RGB sensors (n=36), all associations were non-significant ( $p > 0.05$ ), as shown in Table S2.

Light history metric	Full dataset (n=50)		RGB sensors only (n=36)	
	r	P	r	p
Mean lux	-0.02	0.90	-0.01	0.97
Mean log lux	0.12	0.42	0.24	0.16
Median lux	0.02	0.91	0.17	0.31
Time >100 lux	0.11	0.44	0.16	0.34
Time >500 lux	0.03	0.83	0.05	0.79

**Table S1:** Relationships between light exposure history and light sensitivity. Spearman correlations between light exposure history metrics and individual-level Overall ED50 values, with p-values for each correlation.

<b>Light condition</b>	<b>Hour one (M±SD)</b>	<b>Hour two (M±SD)</b>	<b>Hour three (M±SD)</b>	<b>Hour four (M±SD)</b>	<b>Hour five (M±SD)</b>
<1 lux	0.14±0.07	0.17±0.16	0.14±0.05	0.14±0.05	0.13±0.05
10 lux	10.07±0.53	9.97±1.14	9.79±1.84	10.13±0.53	10.25±0.53
30 lux	30.79±1.60	30.76±1.59	30.65±1.30	30.83±1.19	30.24±0.90
50 lux	49.43±1.78	49.96±0.76	50.20±1.10	50.31±0.73	50.36±0.64
100 lux	102.78±4.91	103.88±5.41	103.45±5.12	105.01±5.54	102.86±4.15
200 lux	201.74±7.90	202.14±8.93	201.30±9.14	202.04±9.24	202.95±7.65
400 lux	398.46±10.76	400.29±11.00	399.57±18.49	401.18±12.25	404.49±10.81
2000 lux	1949.20±92.93	1969.94±109.25	1971.08±93.51	1968.98±106.18	1967.40±132.77

**Table S2.** Stability of light exposures across the five-hour test sessions. Group averages and standard deviation (M±SD) of photopic lux at eye level and angle of gaze across the five-hour light exposures (columns) at all light intensities (rows), including the dim light control condition (<1 lux), illustrating the stability of lights delivered both within and between test sessions.

<b>Light condition</b>	<b>Irradiance <math>\mu\text{W}/\text{cm}^2</math></b>	<b>Photopic lux</b>	<b>Cyanopic lux</b>	<b>Melanopic lux</b>	<b>Rhodopic lux</b>	<b>Chloropic lux</b>	<b>Erythroptic lux</b>
<1	0.05	0.14	0.08	0.10	0.11	0.13	0.14
10	4.14	10.04	5.51	5.66	7.08	8.82	9.49
30	10.06	30.65	16.00	17.44	21.15	26.73	28.79
50	15.54	50.05	25.30	26.57	34.28	43.61	46.87
100	31.98	103.60	52.26	54.85	70.81	90.16	97.44
200	62.27	202.03	111.92	111.18	141.30	177.21	190.11
400	123.55	400.80	230.17	226.39	284.57	353.14	377.59
2000	566.60	1965.32	1126.15	1178.77	1432.42	1736.44	1874.80

**Table S3.** Irradiance and illuminances for each light exposure condition.