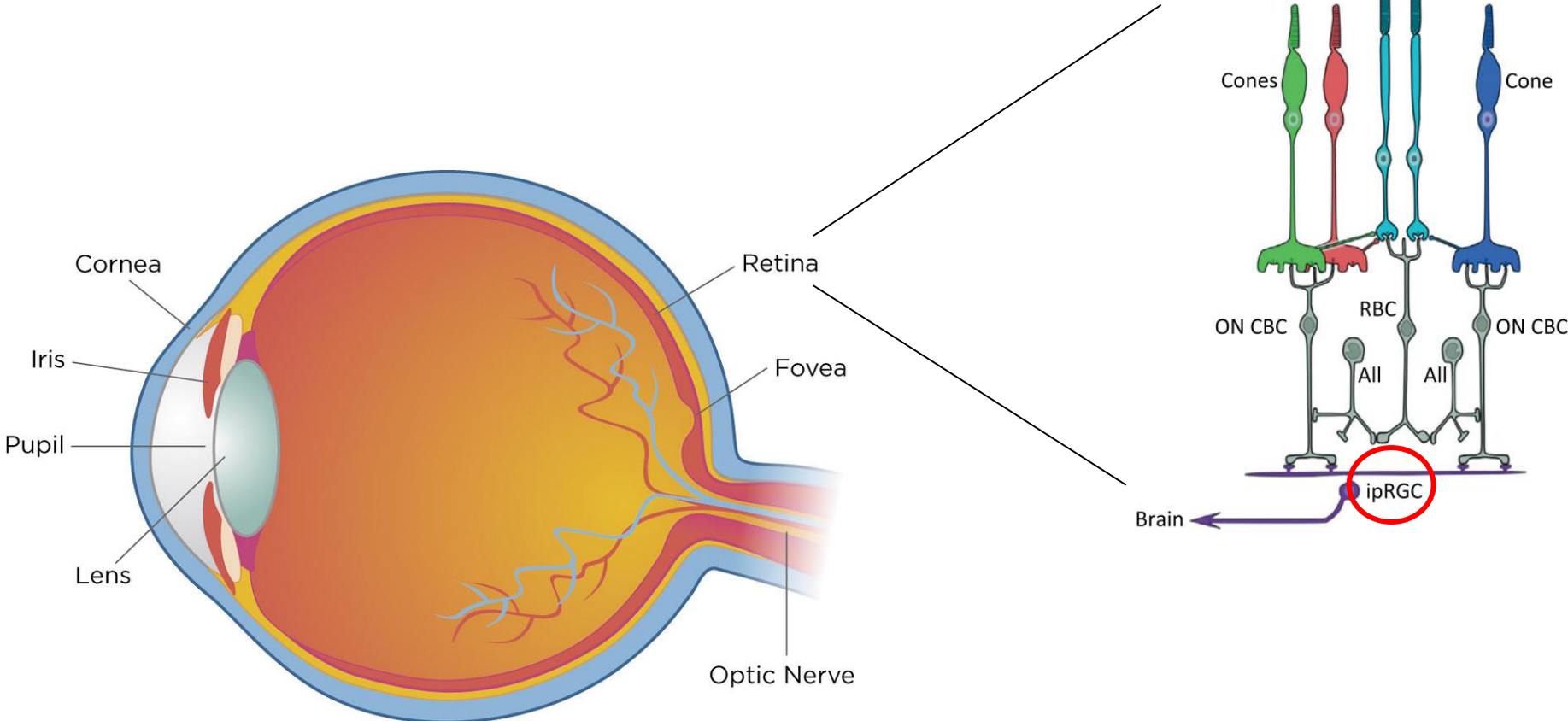


Comparison between daylight and electric lighting: Spectral effects on visual and atmosphere perceptions



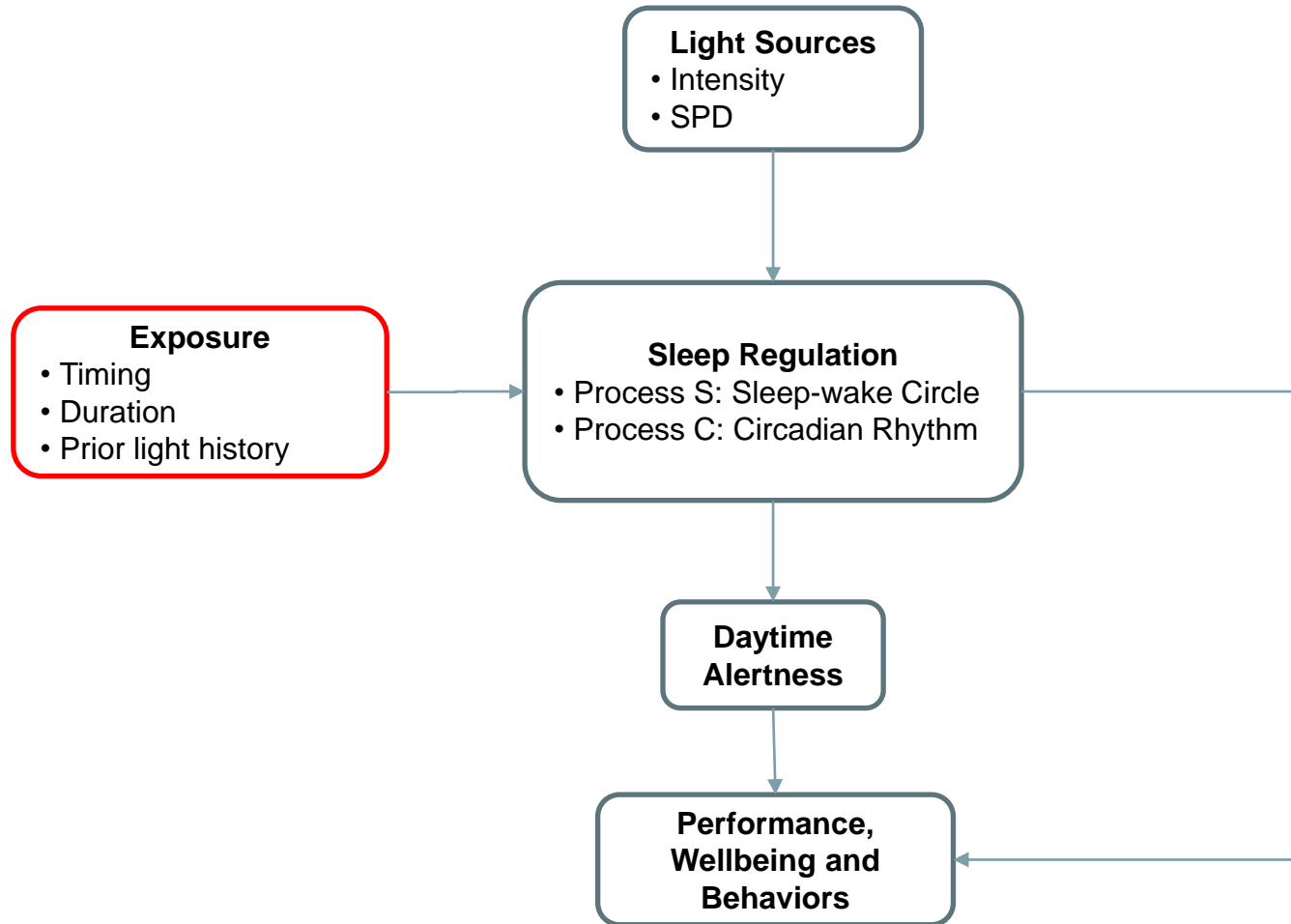
Chengpeng Zhao
PhD Candidate
University College London

Background: Photoreceptors in Human Retina

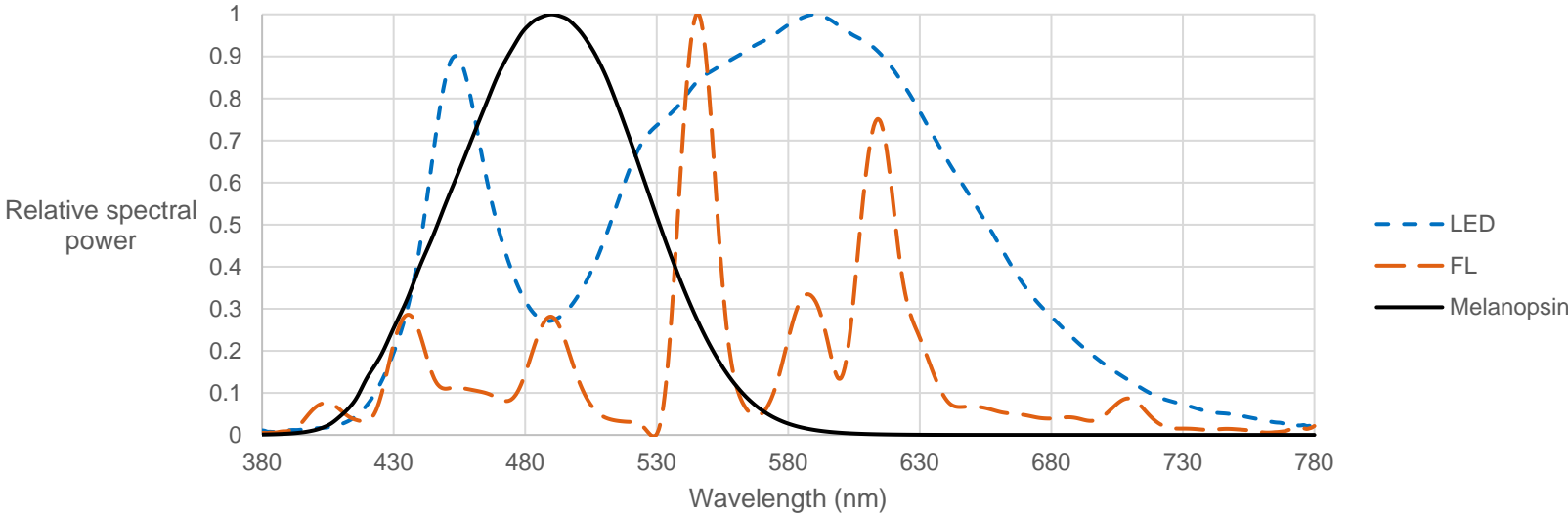
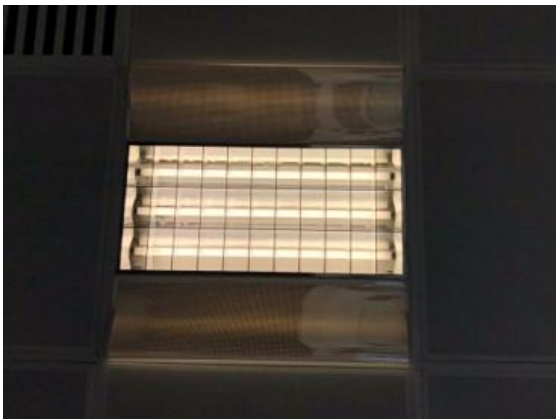


(Adapted from Lucas *et al.* (2014))

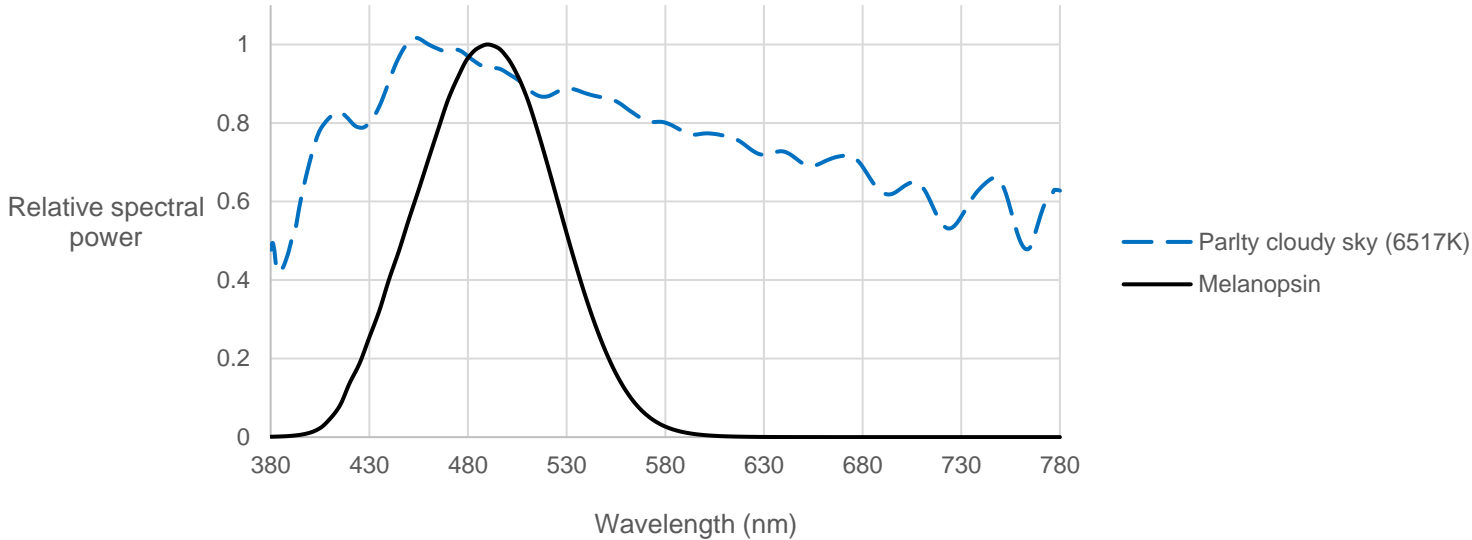
Background: Sufficient daytime light exposure



Background: Electric light sources in the offices



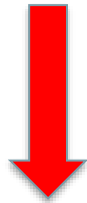
Background: Skylight



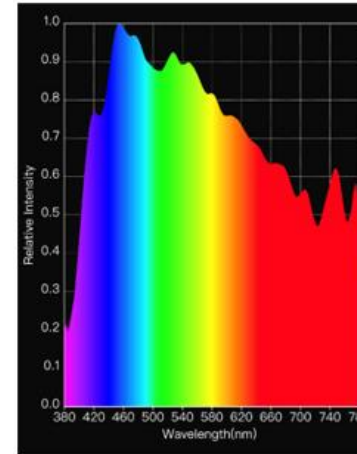
Biophilia: SPD of Daylight?

Evolutionary hypothesis:

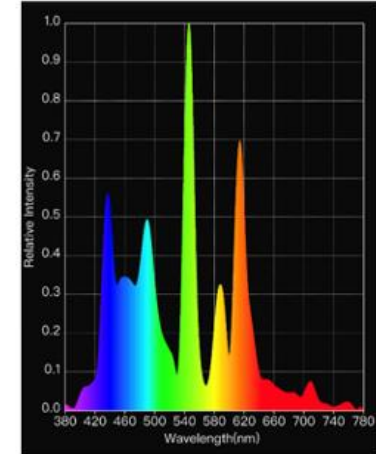
“Spaces lit with Full Spectrum Fluorescent Lamp (FSFL) should be judged as more attractive and appealing than when lit with other electric lamps because of their alleged similarity to daylight.....” (Veitch & McColl, 2001)



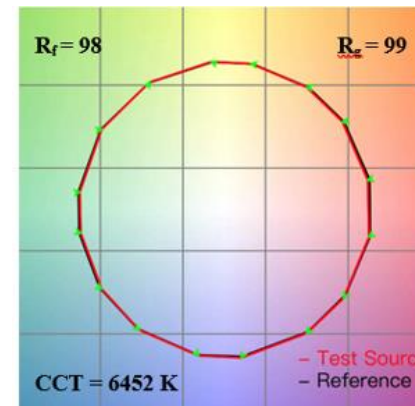
This hypothesis assumes that people remember the colour of daylight and response positively to it.



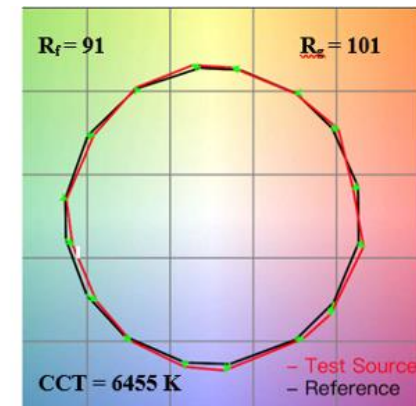
(a)



(b)



(a)



(b)

Aim:

To investigate the spectral effects of daylight and Blue-enriched artificial light sources on natural preference and perceived atmosphere

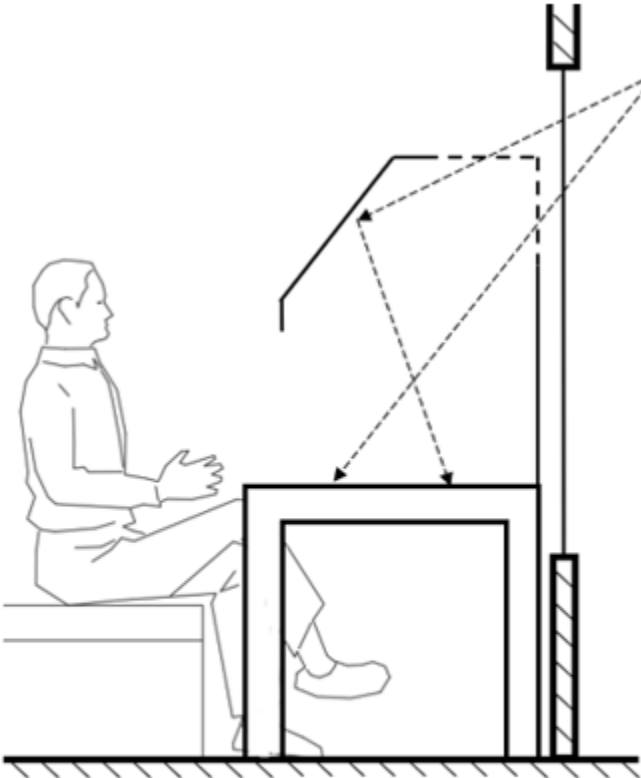
Question:

Can daylight SPD alone induce natural preference?

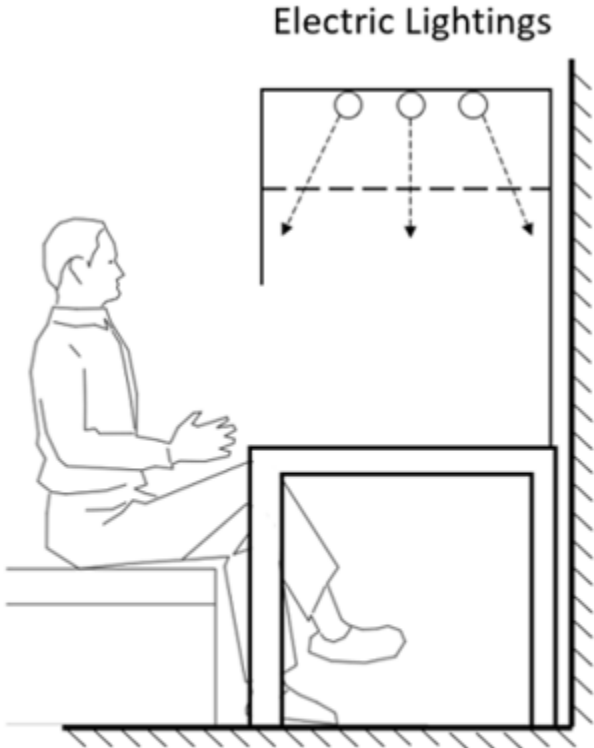
Hypotheses:

- 1) Daylight will be recognised and preferred over electric lighting even without a view of the light source.
- 2) Daylight from cloudy sky will be preferred over clear sky. (i.e., lower CCT).

Method: Experimental Set up

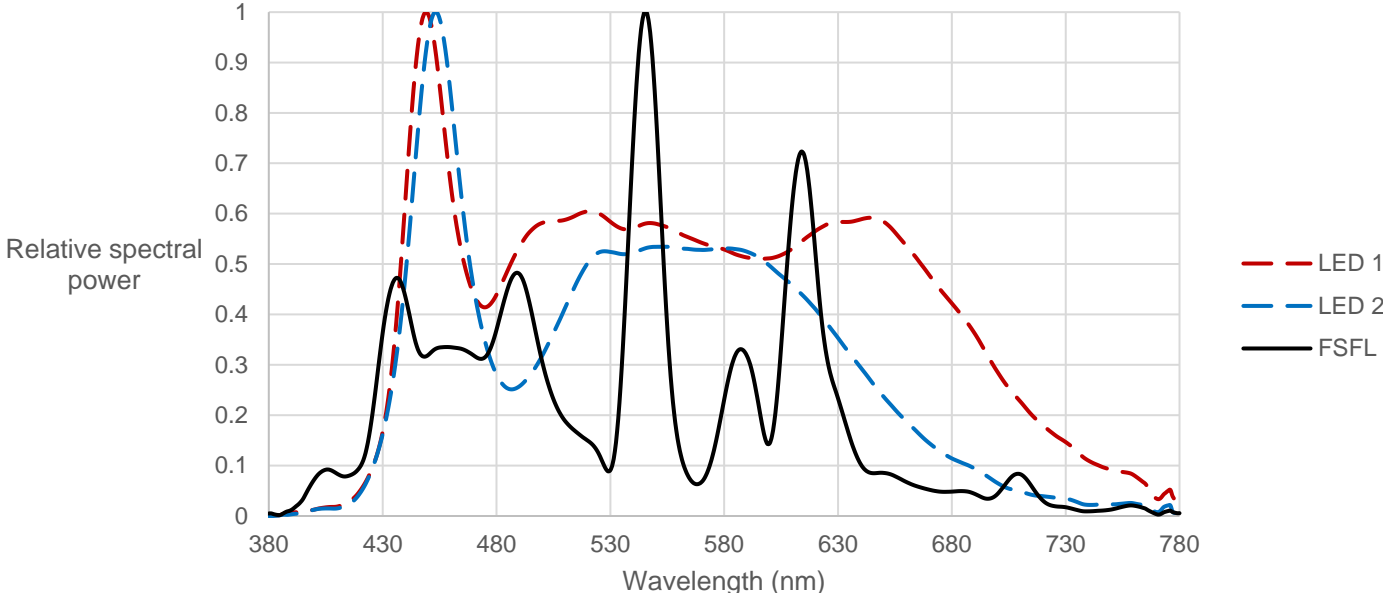


a



b

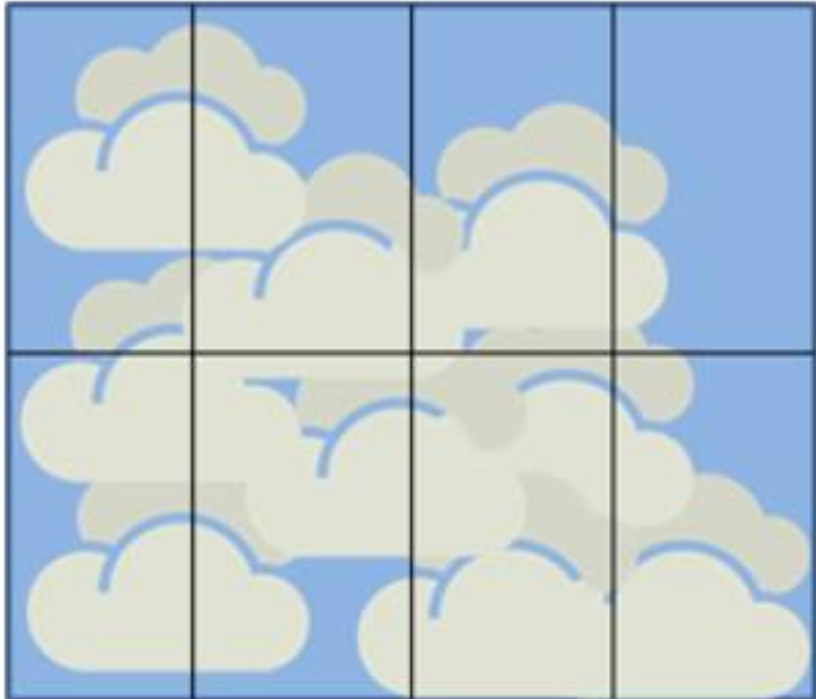
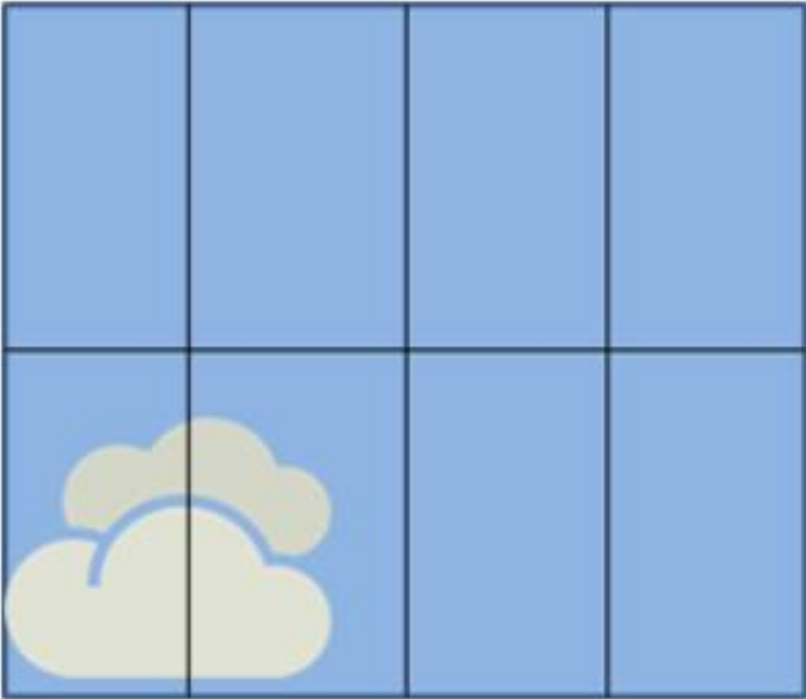
Method: Electric light sources



Light source	Nominal CCT (K)	Measured CCT(K)	Duv	CQS	GAI	CIE		IES TM-30-18			
						Ra	R9	Rf	Rg	Rcs,h1	Rcs,h16
LED 1	6000	5707	0.0007	96	101	92	83	93	104	5%	4%
LED 2	6000	6175	0.0012	84	92	86	27	85	97	-9%	-4%
FSFL	6500	6642	-0.0014	93	107	94	81	92	102	-1%	5%

Method: Sky conditions

Daylight conditions:



Methods: Experimental Design:

Session 1: Categorical Rating:

- Pro: sufficient chromatic adaptation
- Limitations: Start with daylight booth first

Session 2: Forced choice side-by-side comparison:

- Pro: Do not have to rely on memory
- Limitations: Could not do all-possible pairs comparison.

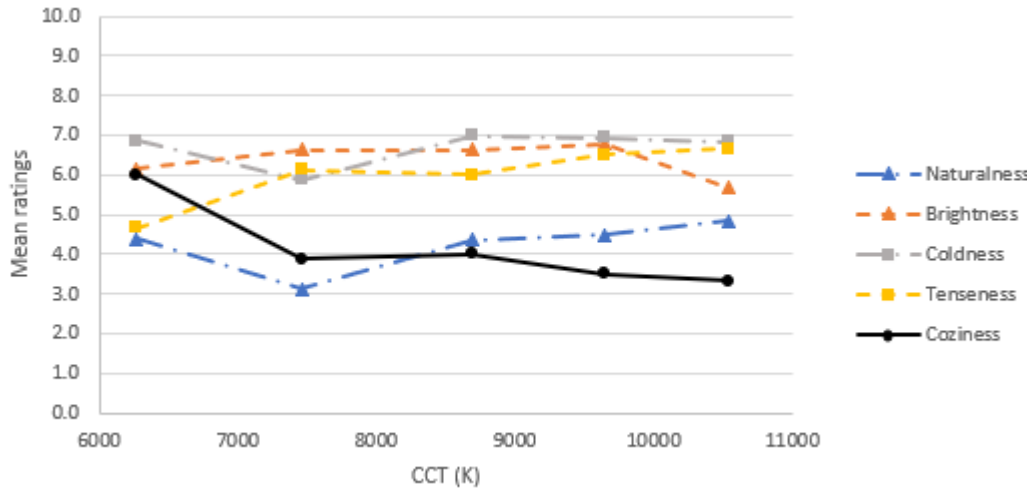
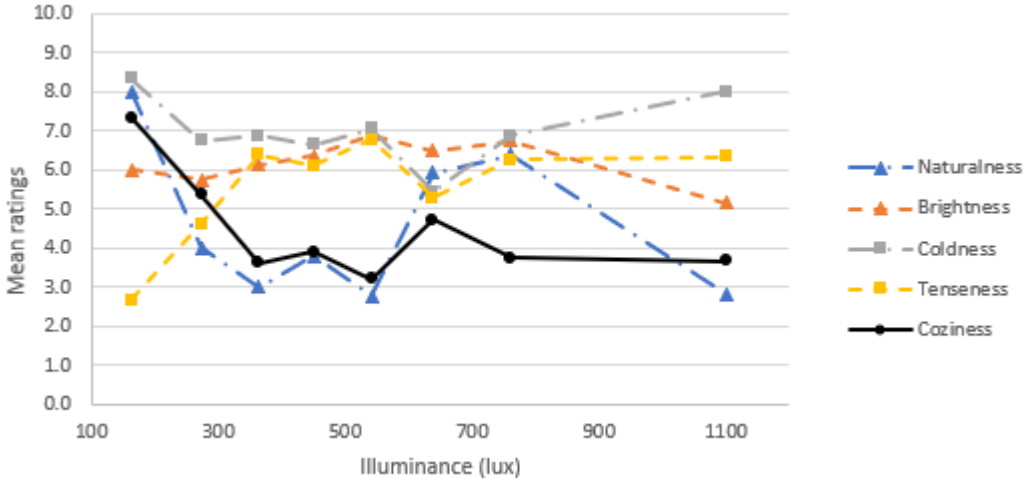
Method: Measurements

- **Visual perceptions:**
 - Brightness and Colour tone

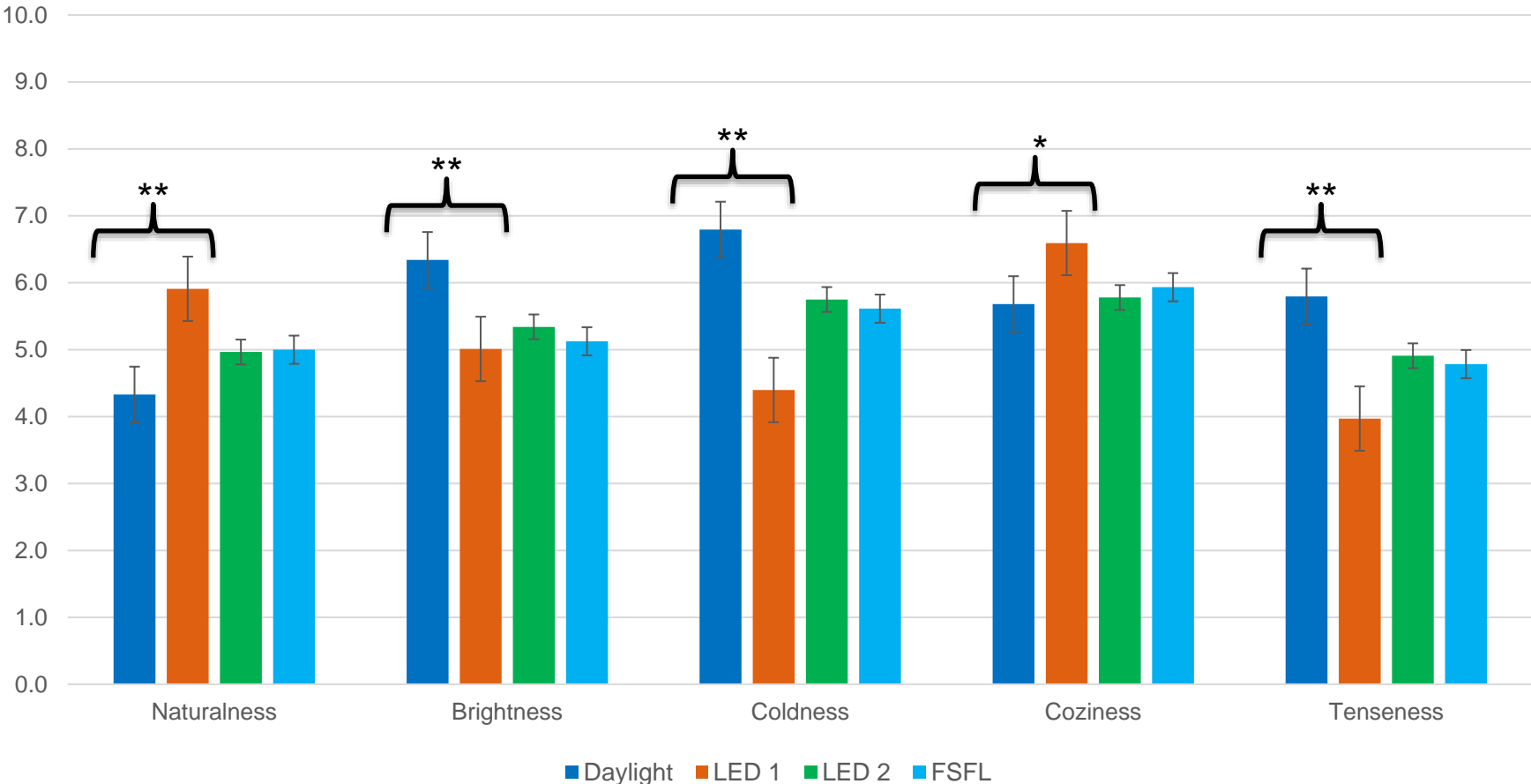
- **Atmosphere perceptions:** (Vogels, 2008)
 - Cosiness: Comfortable, safe, pleasant, etc.
 - Liveliness: Stimulating, lively, exciting, etc.
 - Tenseness: Terrifying, tense, oppressive, etc.
 - Detachment: Business-like, formal, etc.

- **Preference and naturalness of overall scene**

Results: Perception of daylight from different weather conditions

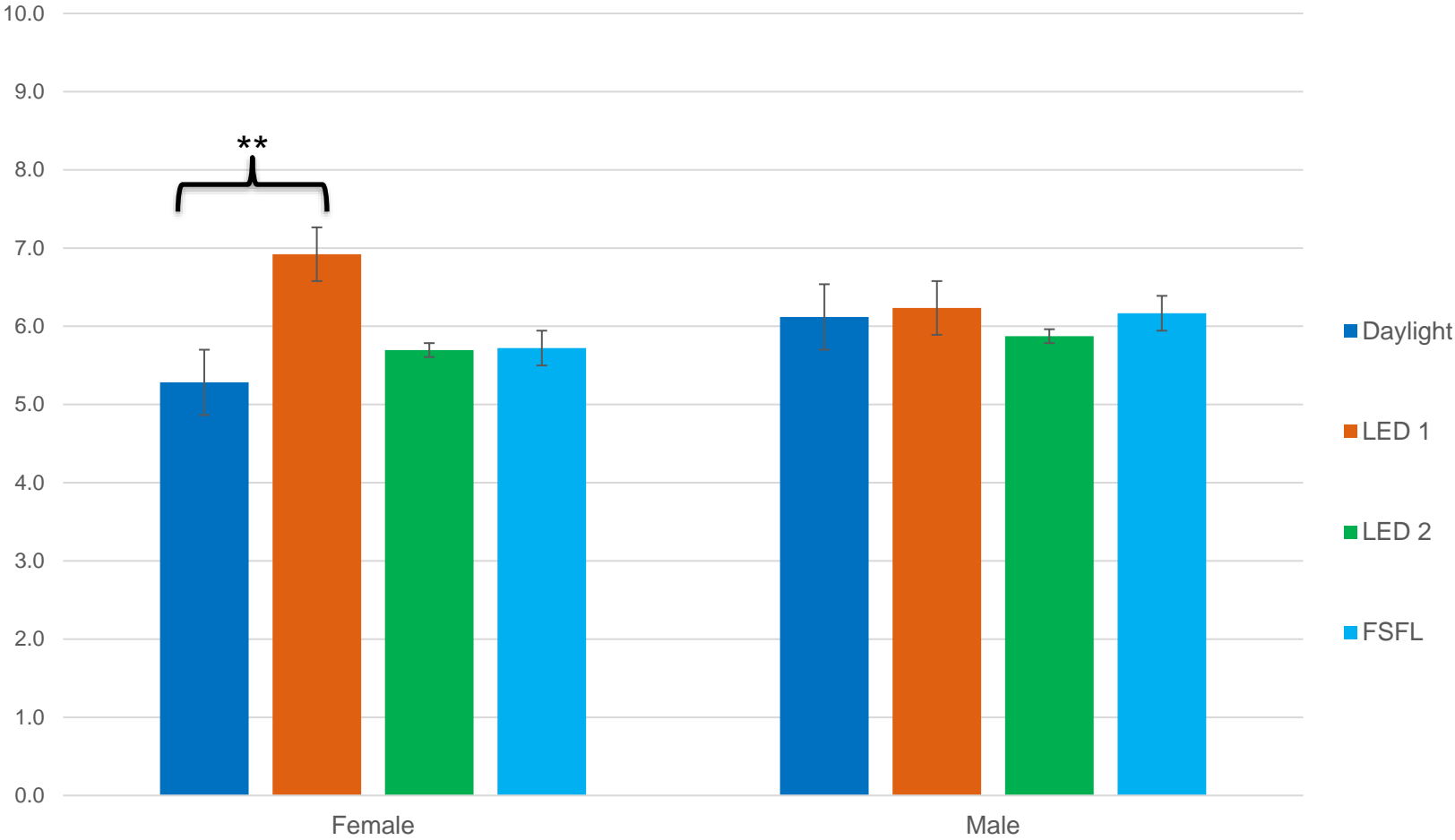


Results: Direct comparison between daylight and electric lighting



(Note: ** p < 0.01, * p < 0.05)

Results: Effect of gender on *Coziness*

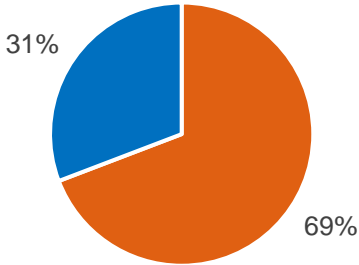


(Note: ** p < 0 .01, * p < 0 .05)

Results: Side-by-side comparison

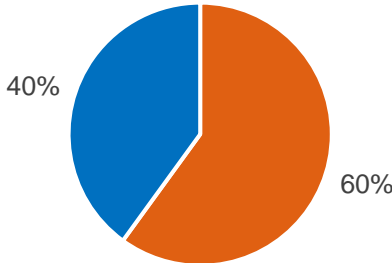
Overall Preference

Overcast sky



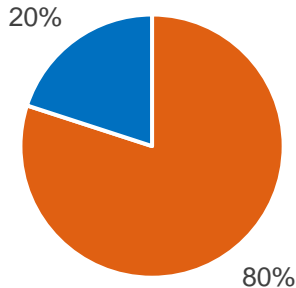
LED1 Daylight

Partly Cloudy sky



LED1 Daylight

Clear blue sky

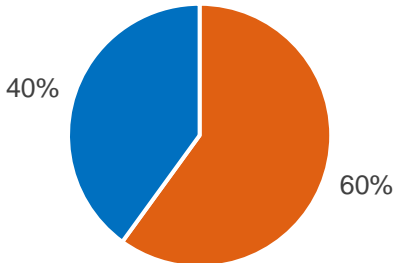


LED1 Daylight

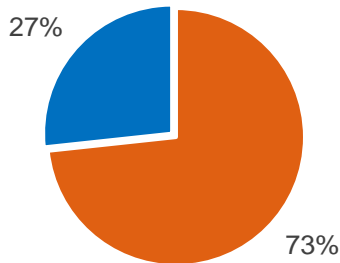
Overall Naturalness



LED1 Daylight



LED1 Daylight

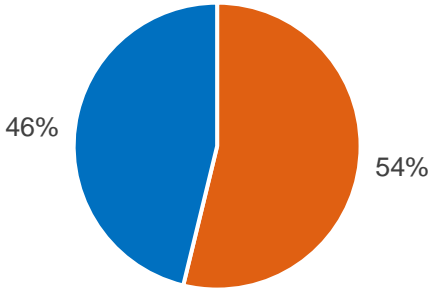


LED1 Daylight

Results: Side-by-side comparison

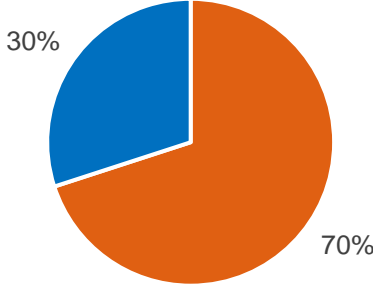
Overall Preference

Overcast sky



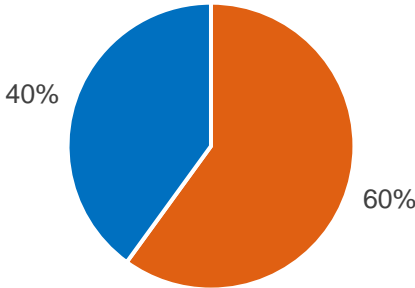
LED2 Daylight

Partly Cloudy sky



LED2 Daylight

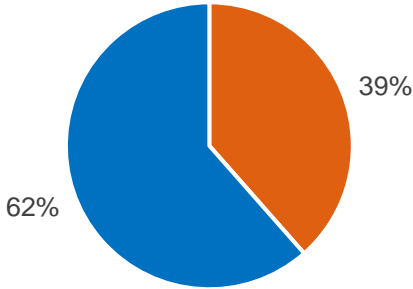
Clear blue sky



LED2 Daylight

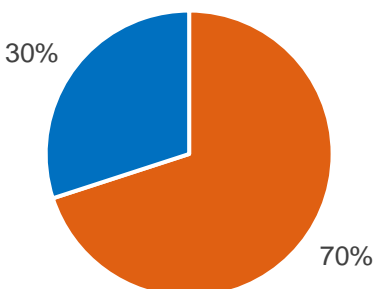
Overall Naturalness

Overcast sky



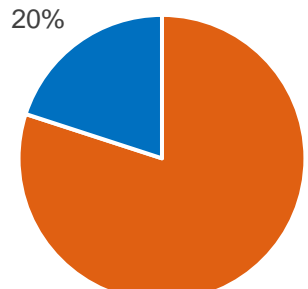
LED2 Daylight

Partly Cloudy sky



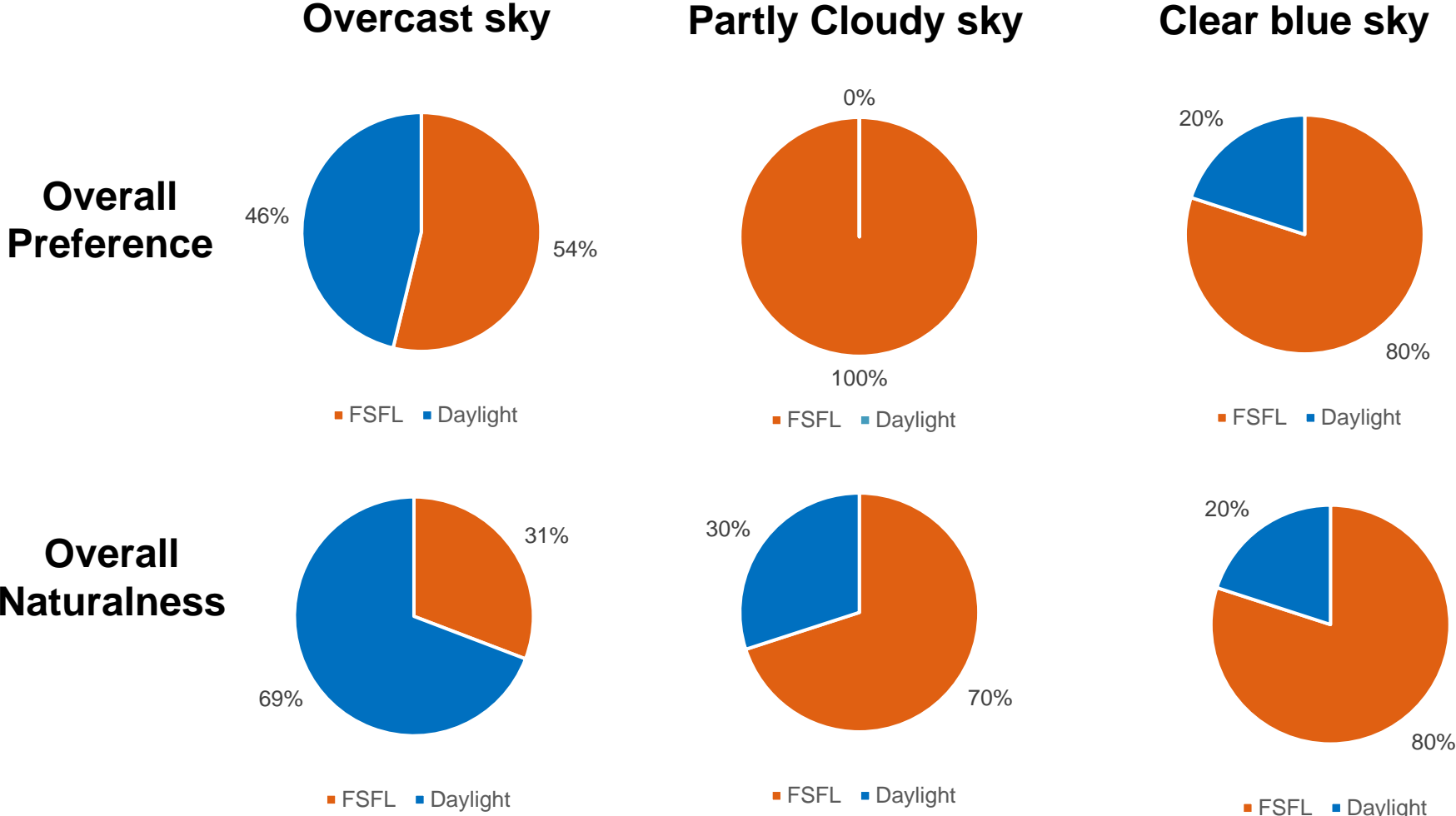
LED2 Daylight

Clear blue sky



LED2 Daylight

Results: Side-by-side comparison



Key findings:

- Most of the participants did not recognise daylight purely on the basis of SPD.
 - Daylight was not preferred over electric light sources and was considered as “unnatural”.
- SPD significantly influenced females’ perceived coziness but had no effects on males.
 - For females, electric light source with CCT 5707K was preferred and perceived as warm, more comfortable, interesting and satisfactory than other light sources.

Thank You!