

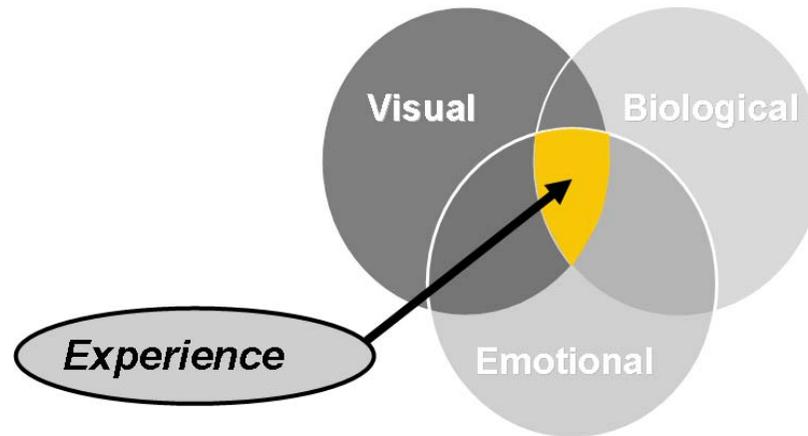
Lighting retrofits: yes! but what about the users?

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The experience of light

- Visual impact of light
- Biological impact of light
- Emotional impact of light

The total experience



METHODS

Psychological techniques

Neuro-psychological techniques

Physiological techniques

Physical techniques

Combine two or more measurement techniques

Psychological techniques

Semantic differential

LIGHTEX – Lighting Experience Indoor

POLQ – Perceived outdoor lighting quality

Questionnaires

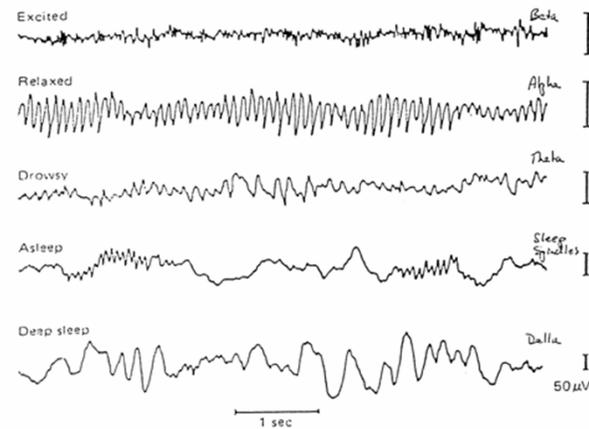
Interviews

Focus groups

Systematic observations

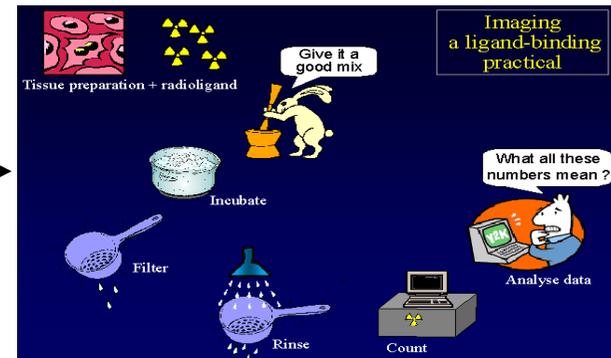
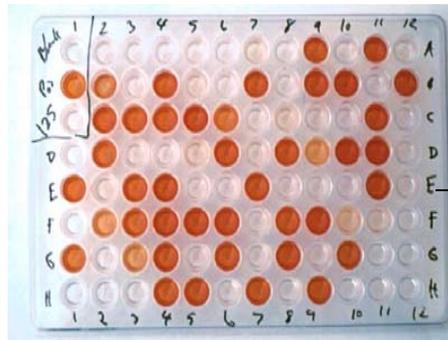
Neuropsychological techniques

EEG - Electroencephalography



Physiological techniques

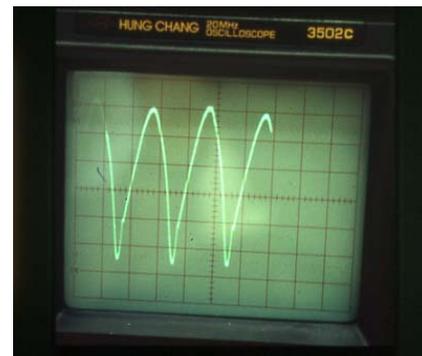
Endocrine measurements f. ex chronobiological markers such as *melatonin* and *cortisol*



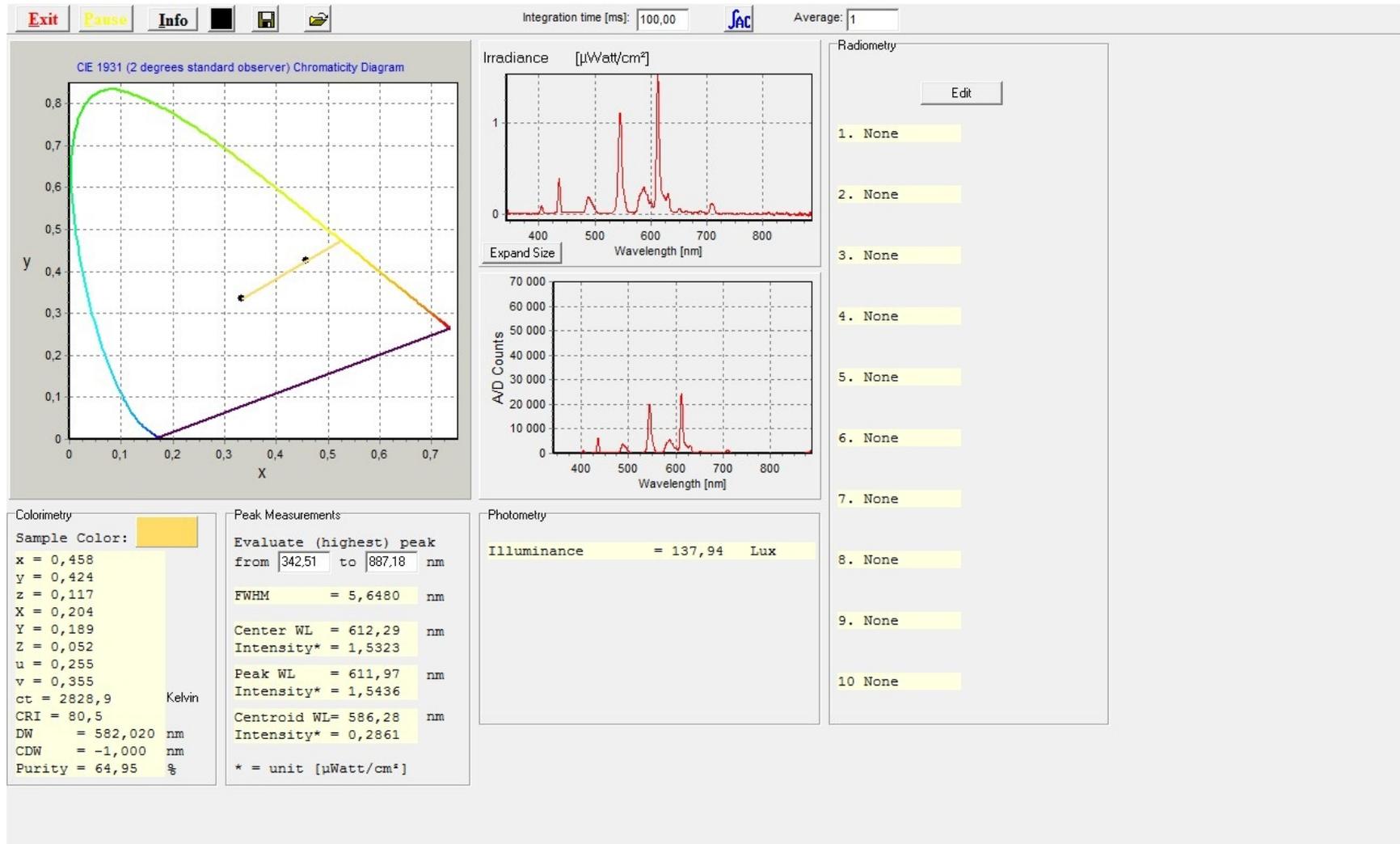
Physical techniques

Photometric measurements

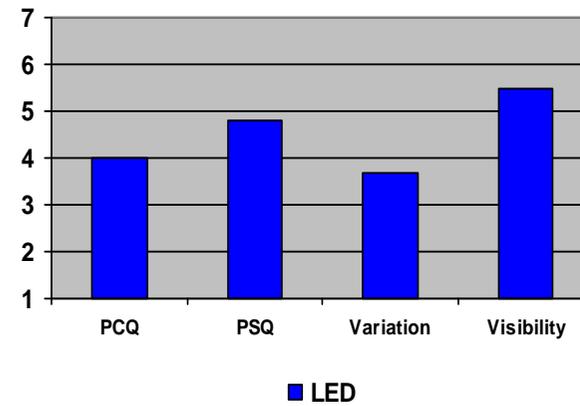
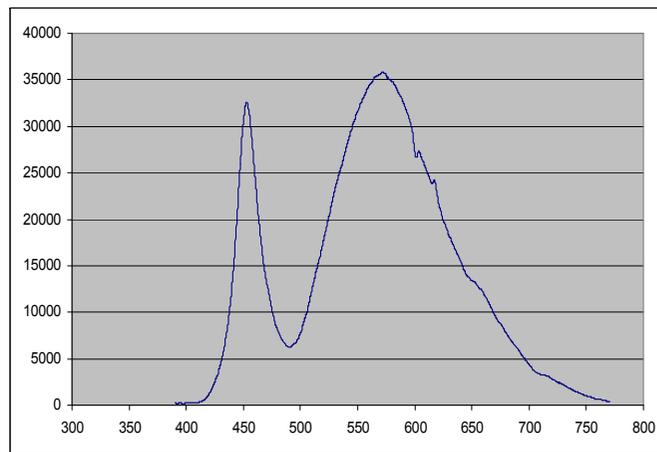
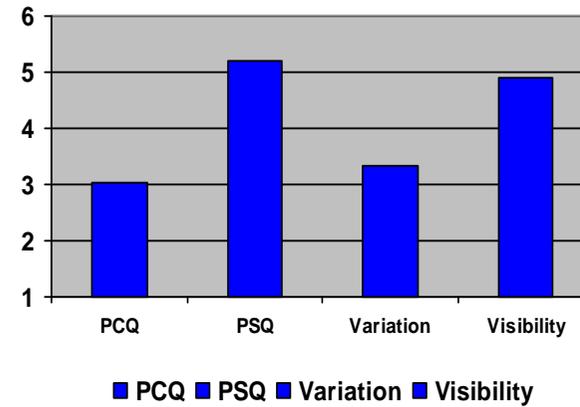
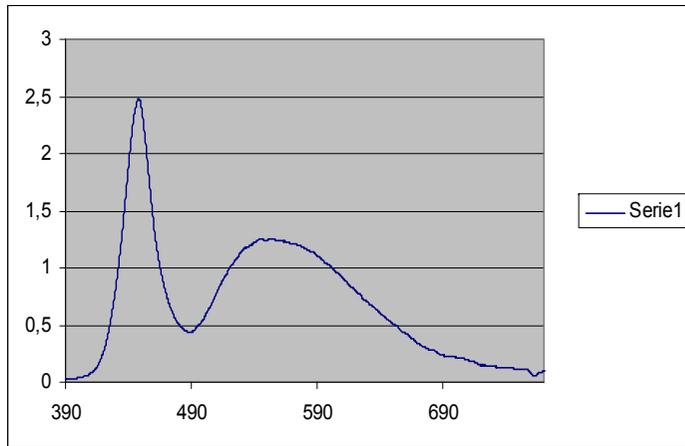
Flicker measurements



Spectral measurements

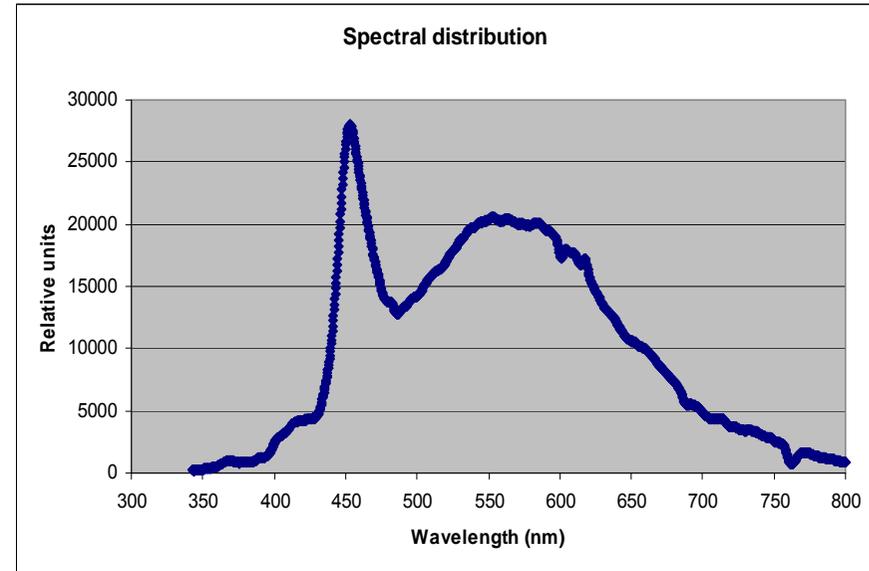


Combinations of techniques



■ LED

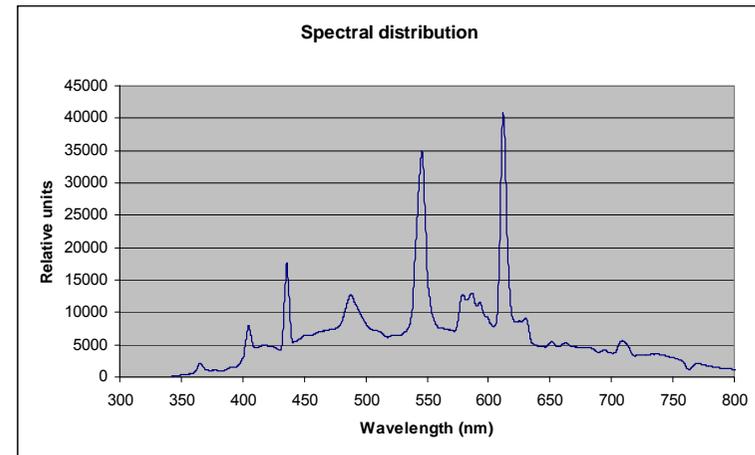
Item	Distribution		Rotated factor loadings (varimax)	
	<i>M</i>	<i>SD</i>	Perceived Comfort Quality (PCQ)	Perceived Strength Quality (PSQ)
Dark - Light	4.45	1.67		.805
Pleasant - Unpleasant	3.45	1.65	-.636	-.414
Uncoloured - Coloured	3.29	1.65	<i>Not included</i>	<i>Not included</i>
Strong - Weak	3.86	1.55	.190	-.810
Scattered - Concentrated	3.85	1.66	<i>Not included</i>	<i>Not included</i>
Warm - Cool	3.84	1.70	-.826	-.142
Uneven distributed – Even distributed	4.59	1.64	.214	.582
Hard - Soft	4.37	1.60	.851	
Unfocused - Focused	4.21	1.52	.182	.611
Natural - Unnatural	3.82	1.74	-.812	-.260
Flicker – No flicker	5.76	1.48	<i>Not included</i>	<i>Not included</i>
Clear - Drab	3.19	1.63		-.768
Varied - Monotonous	4.51	1.54	<i>Not included</i>	<i>Not included</i>
Mild - Sharp	3.73	1.68	-.784	.282
Glaring - Shaded	4.76	1.71	.763	
Subdued - Brilliant	4.35	1.68	-.200	.790
Eigenvalues			3.83	3.57
% of variance			33.85	27.86
α			.88	.83



Light source LED

Illuminance horizontal 220 lux

Luminance (white paper) 33 cd/m²



Low energy lamp

Illuminance horizontal 220 lux

Luminance (white paper) 23 cd/m²



Illuminance horizontal middle of the
room 5 lux

Subjects

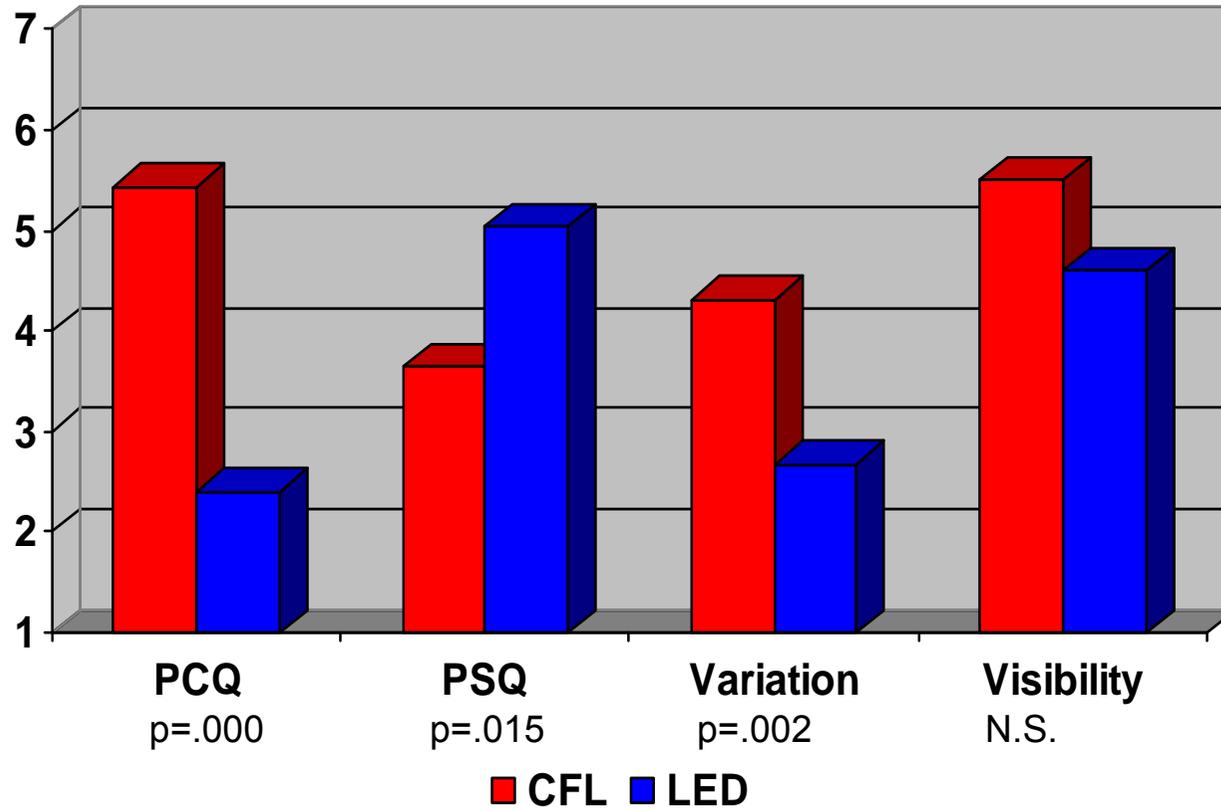
3 males 9 females

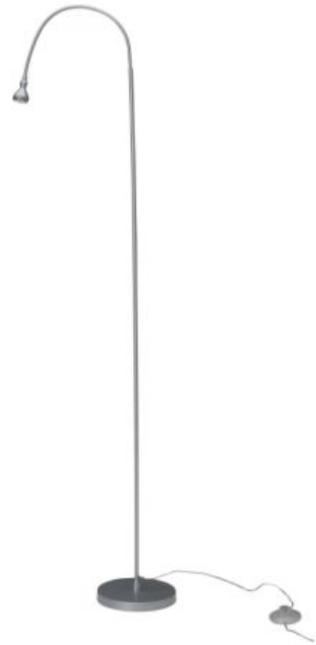
20-36 years

Mean age 25

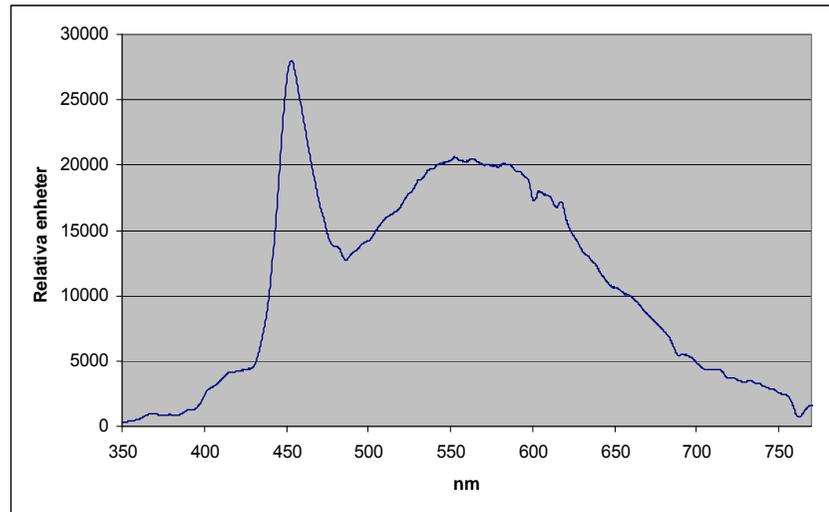


Results

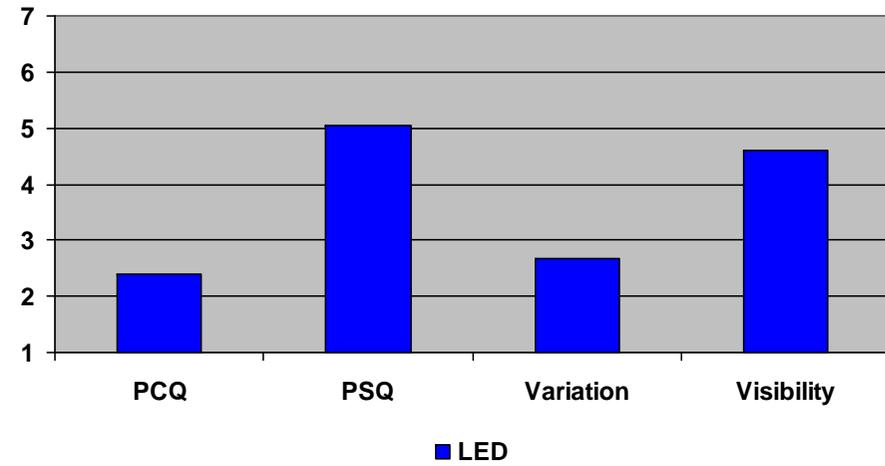




LED Ljuskälla

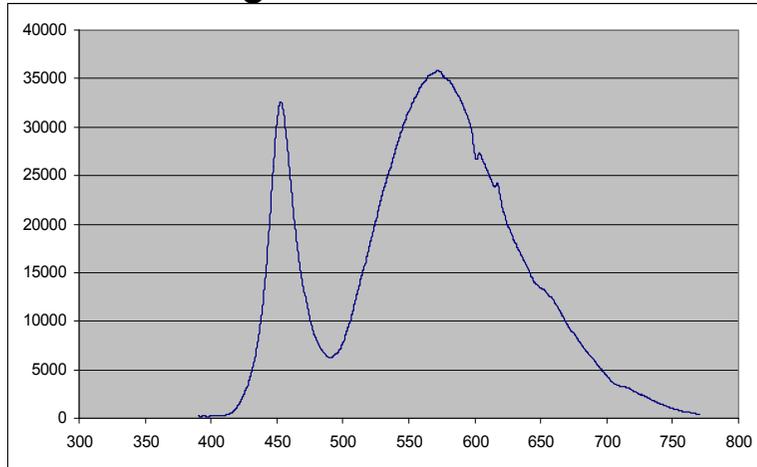


Quotient Blue 454 nm/highest: 1.38



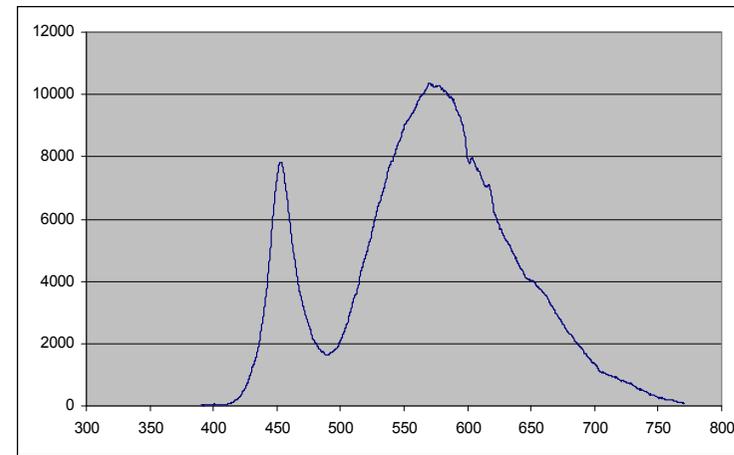


Light source



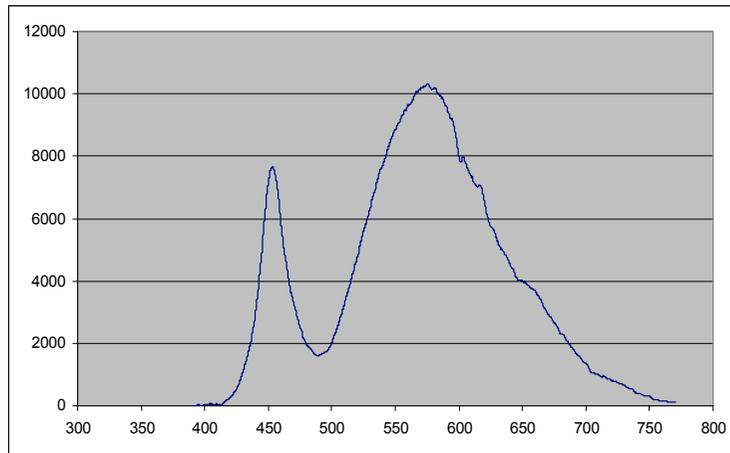
Quotient: Blue 454 nm/highest: .91

Table

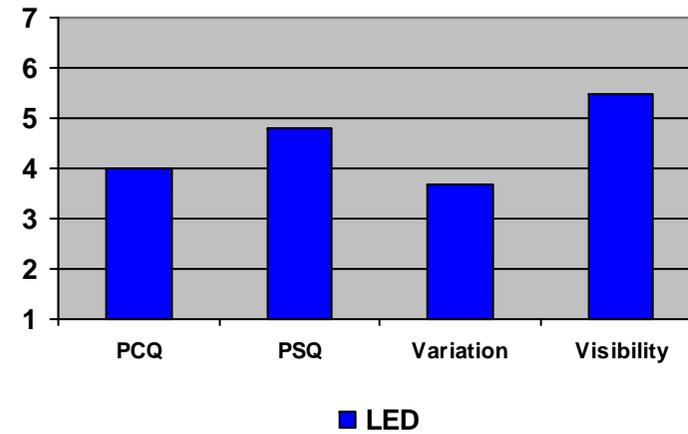


Quotient: Blue 454 nm/highest: .76

Wall

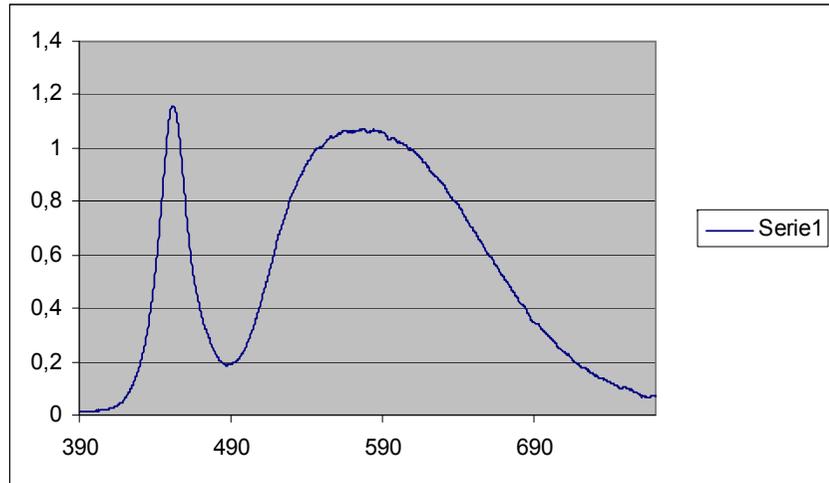


Quotient: Blue 454 nm/highest: .73



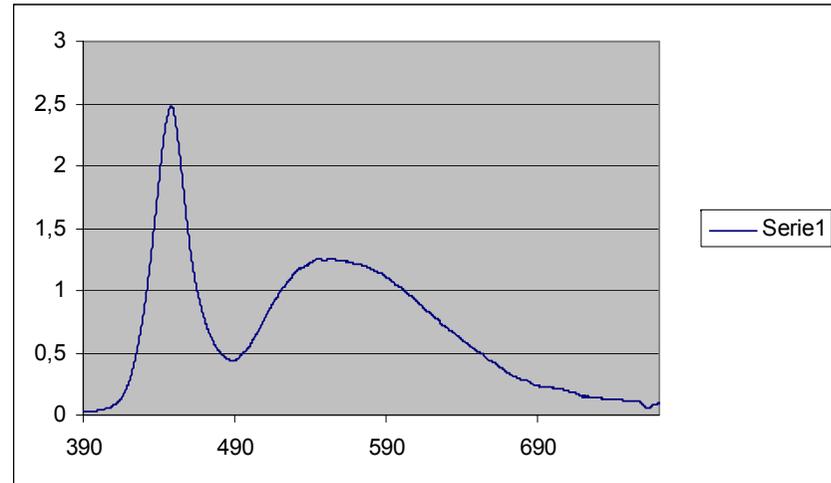


LED General lighting

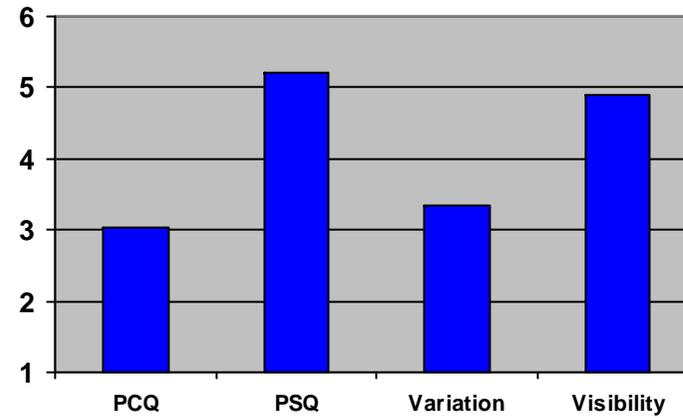


Quotient: Blue 452 nm/highest: 1.07

LED site lighting



Quotient: Blue 450 nm/highest: 1.94



Results three studies regarding Perceived Comfort Quality

