LEDucation

Designers Light Forum

Shall we meet by the elevator at 3000K…?

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March 13, 2018

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Credit(s) earned on completion of this course will be reported to AIA CES for AIA members. Certificates of Completion for both AIA members and non-AIA members are available upon request.

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

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Learning Objectives

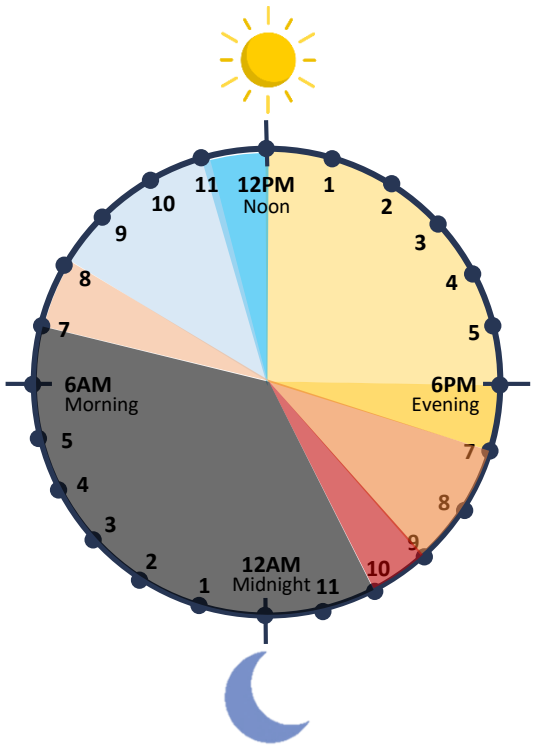
At the end of the this course, participants will be able to:

1. Learn how to tell time by color of your environment, not a clock on the wall; spectral changes related to 24 hour circadian support or team activity offer a glimpse into time of day

2. Gain perspective on how to characterize multi-channel systems in office and patient room applications – new ways to assess energy, efficacy, and people's response

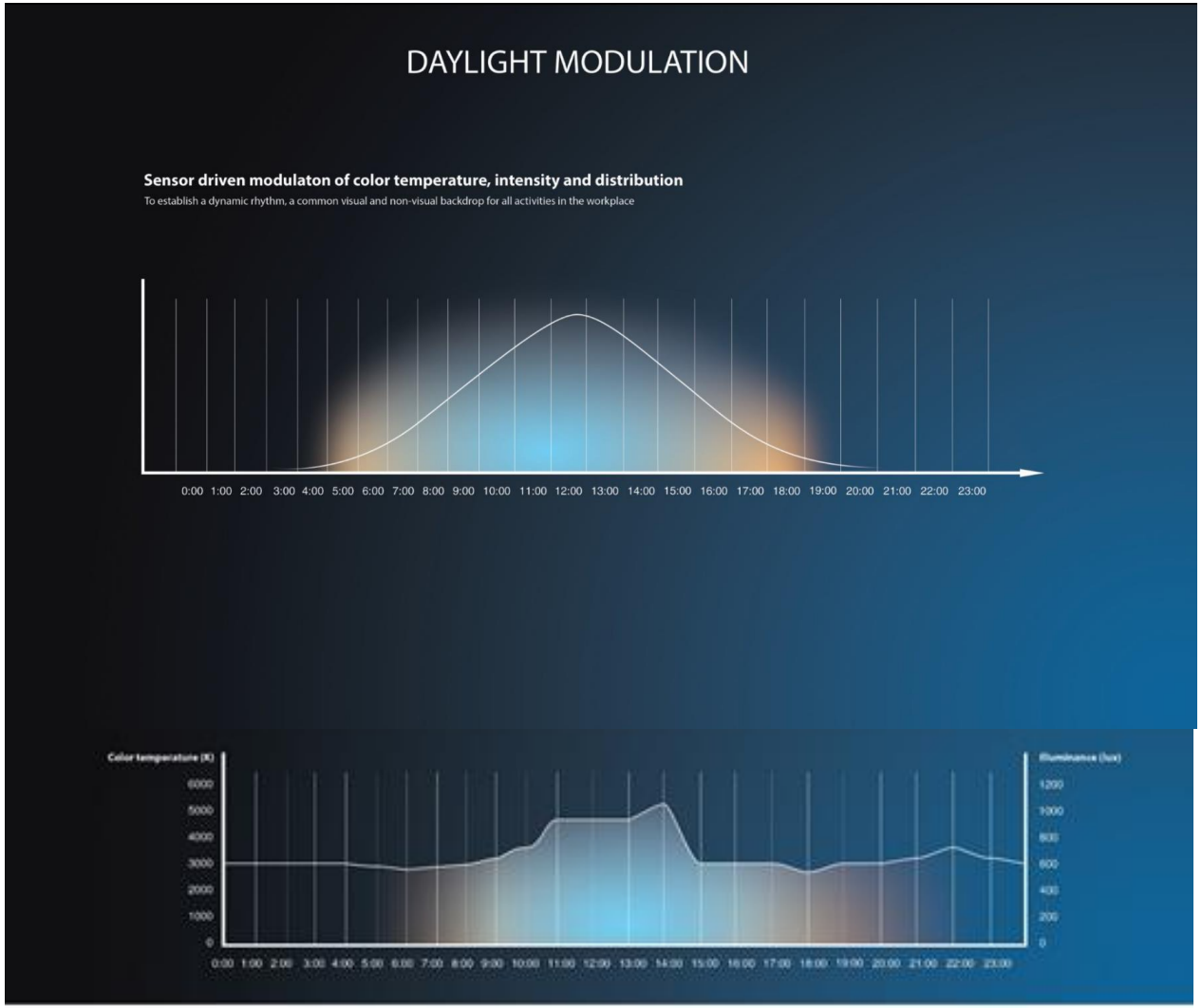
3. Understand the utility and how- to- apply of new metrics describing non–image forming lighting and lighting quality; how to fine tune and tailor lighting to take full advantage of tunable systems

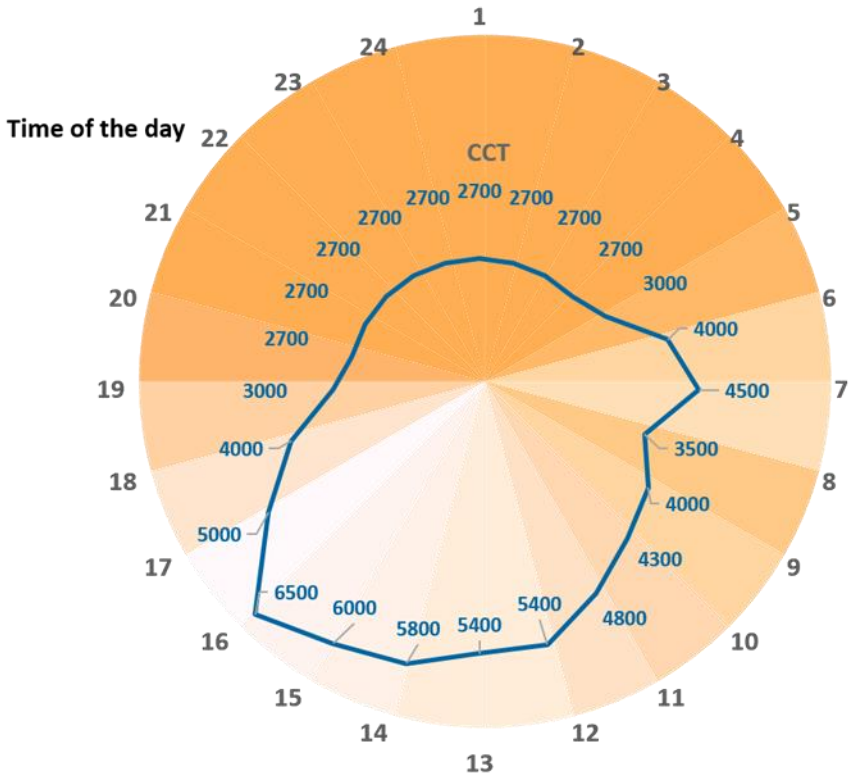
4. Apply evidence-based design guidelines for retrofit, substantial renovation and new construction commercial offices – improving the employee environment in spaces ranging from 1970 to 2020



Learning Objective 1.
Learn how to tell time by the color of your environment

Dynamic Rhythm





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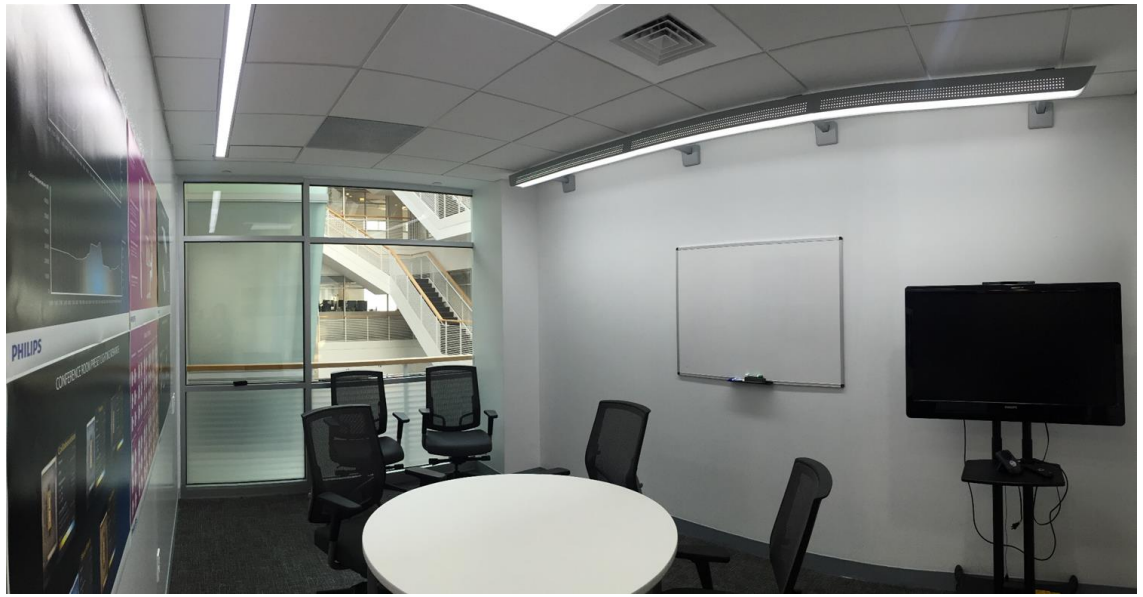
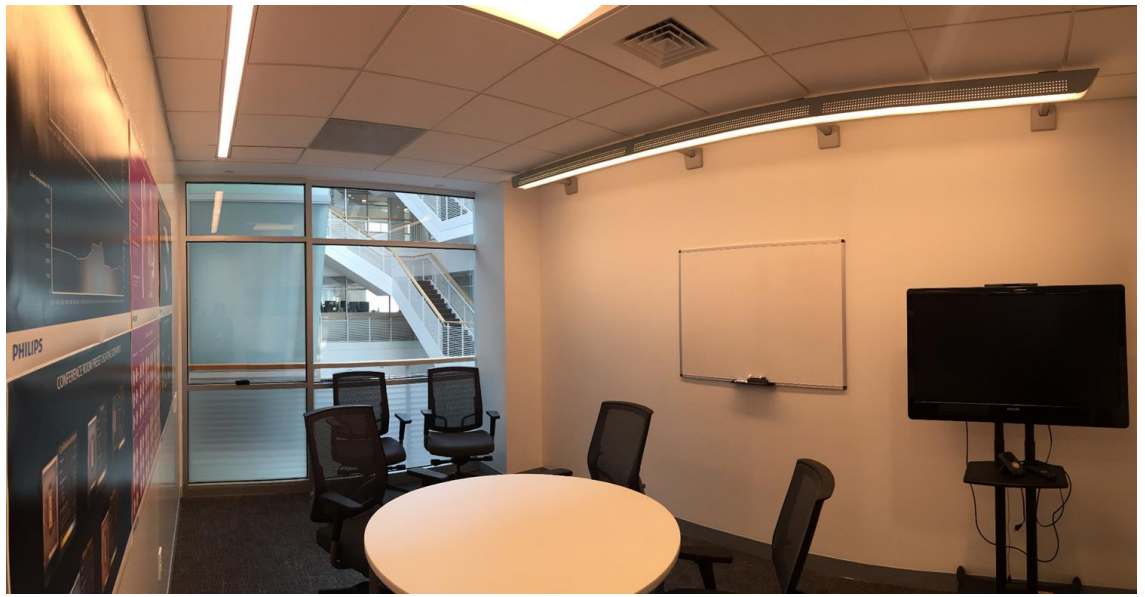
Time constrained Alerting scenes





UIUC case study

Learning Objective 2.

Gain perspective on how to characterize multi-channel systems in office and patient room applications – new ways to assess energy, efficacy, and people's response

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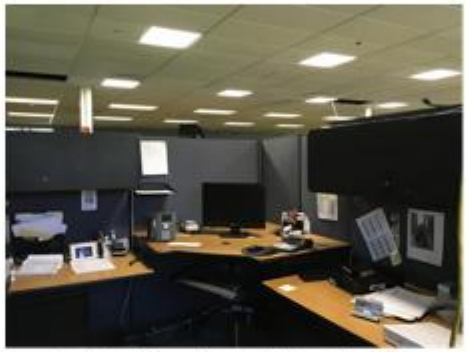
System level

ENERGY SAVINGS

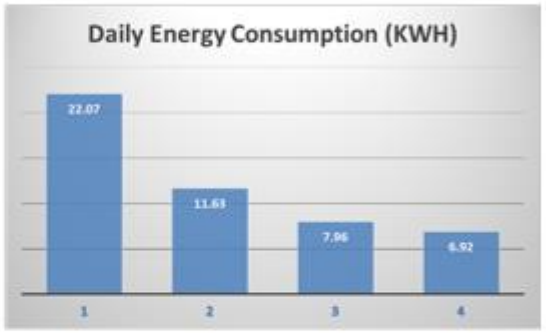
70% Energy Savings in Open Office Existing Buildings

70%



Cubicle before the instalaltion of task lights.

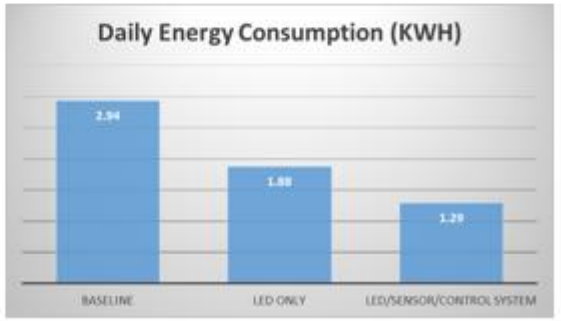
Cubicle after the installation of task lights.



Energy consumption comparison of different technologies, 1: Baseline; 2: LED only; 3. LED/Task; 4: LED/Task/Sensor (Pilot installation).

60% Energy Savings in team spaces and conference rooms

60%



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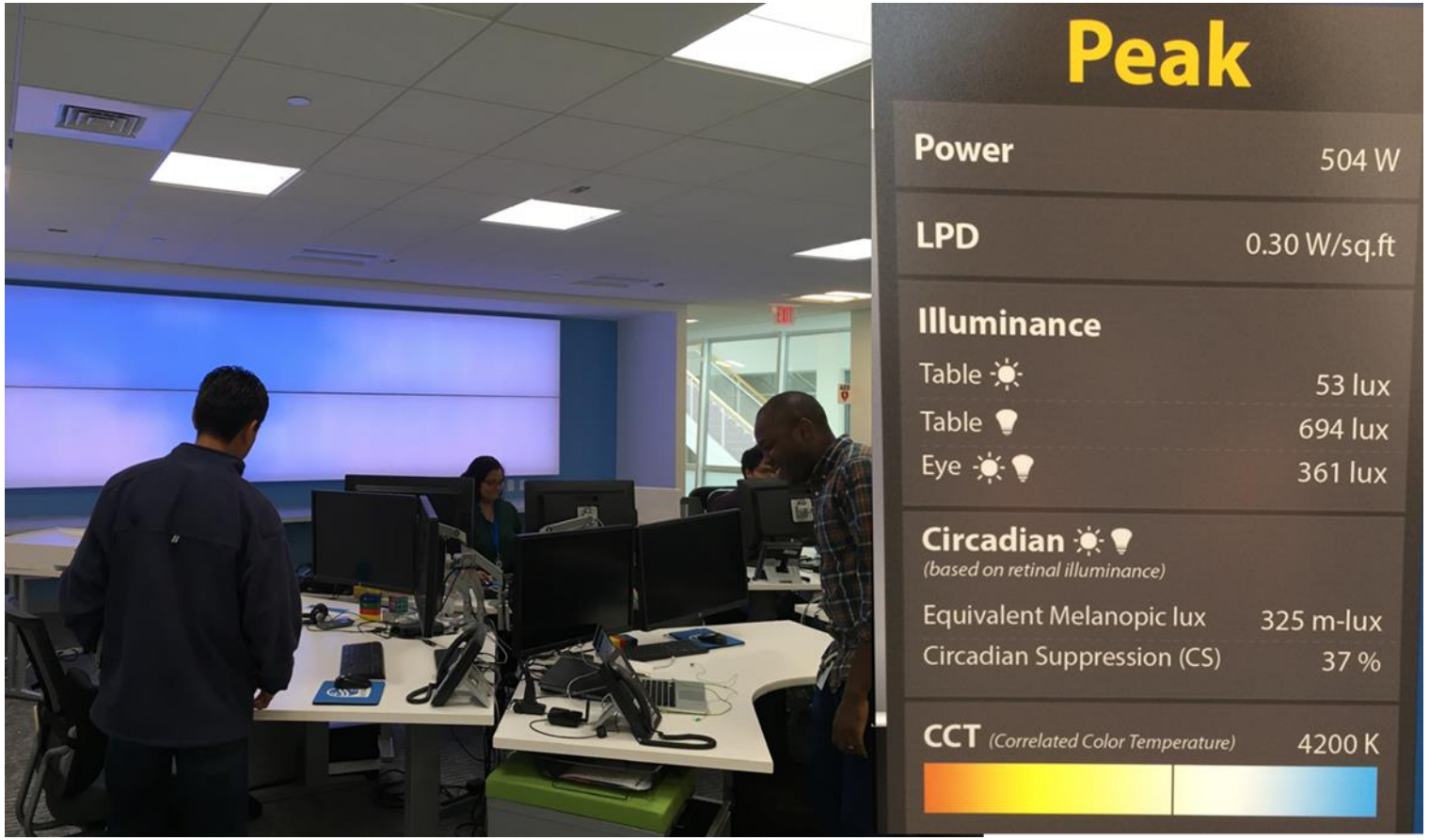
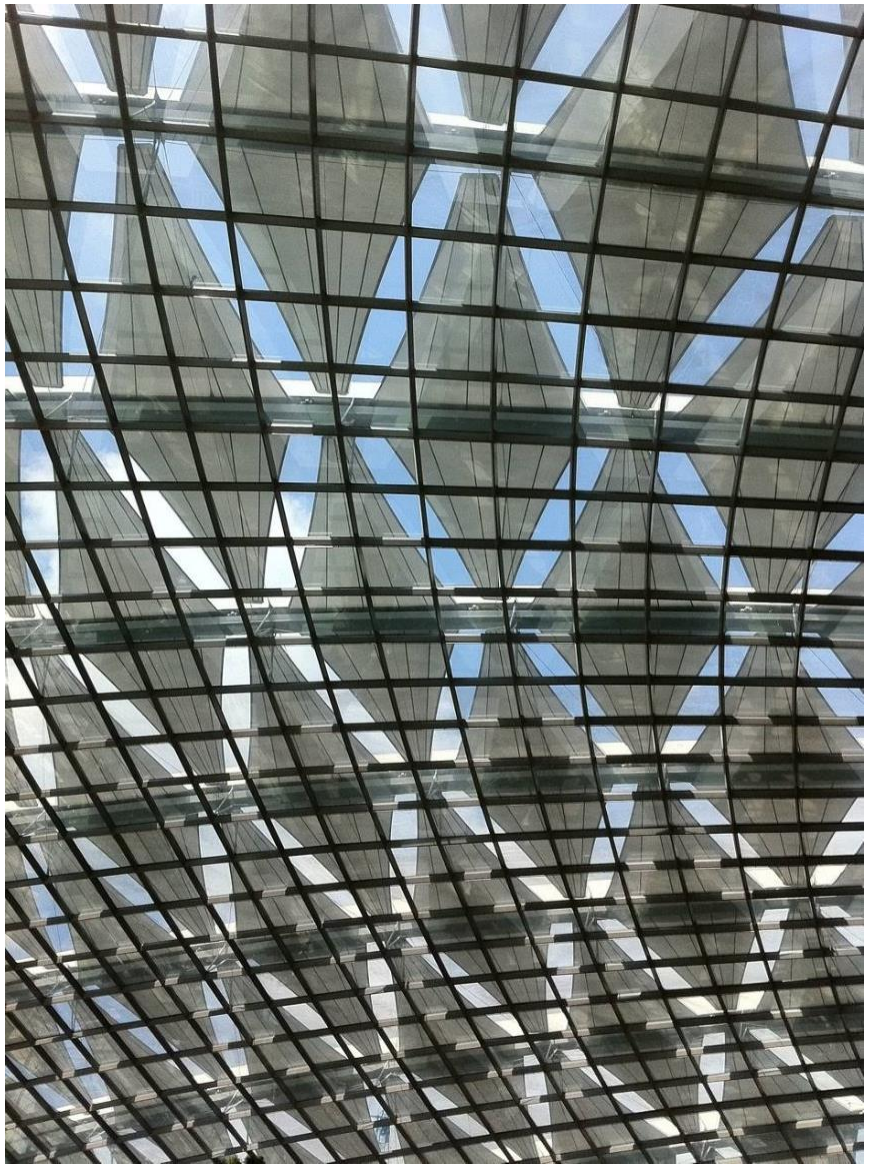
Time for a new Lighting Facts Label?

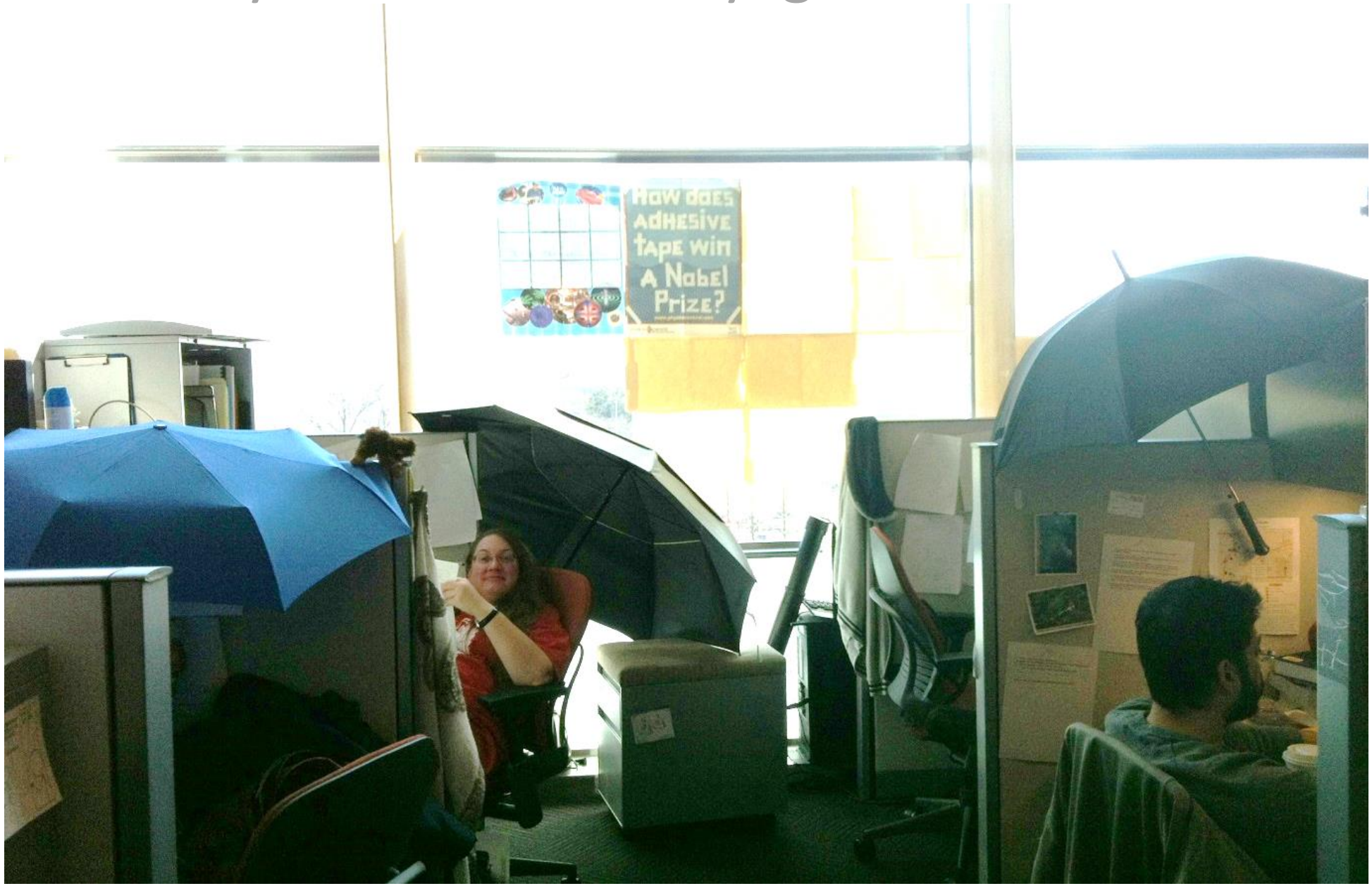


Solar Control



Gardens By the Bay
Wilkinson Eyre+ Grant Associates, 2014

Visually Comfortable Daylight



- Big Data

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- Big Data

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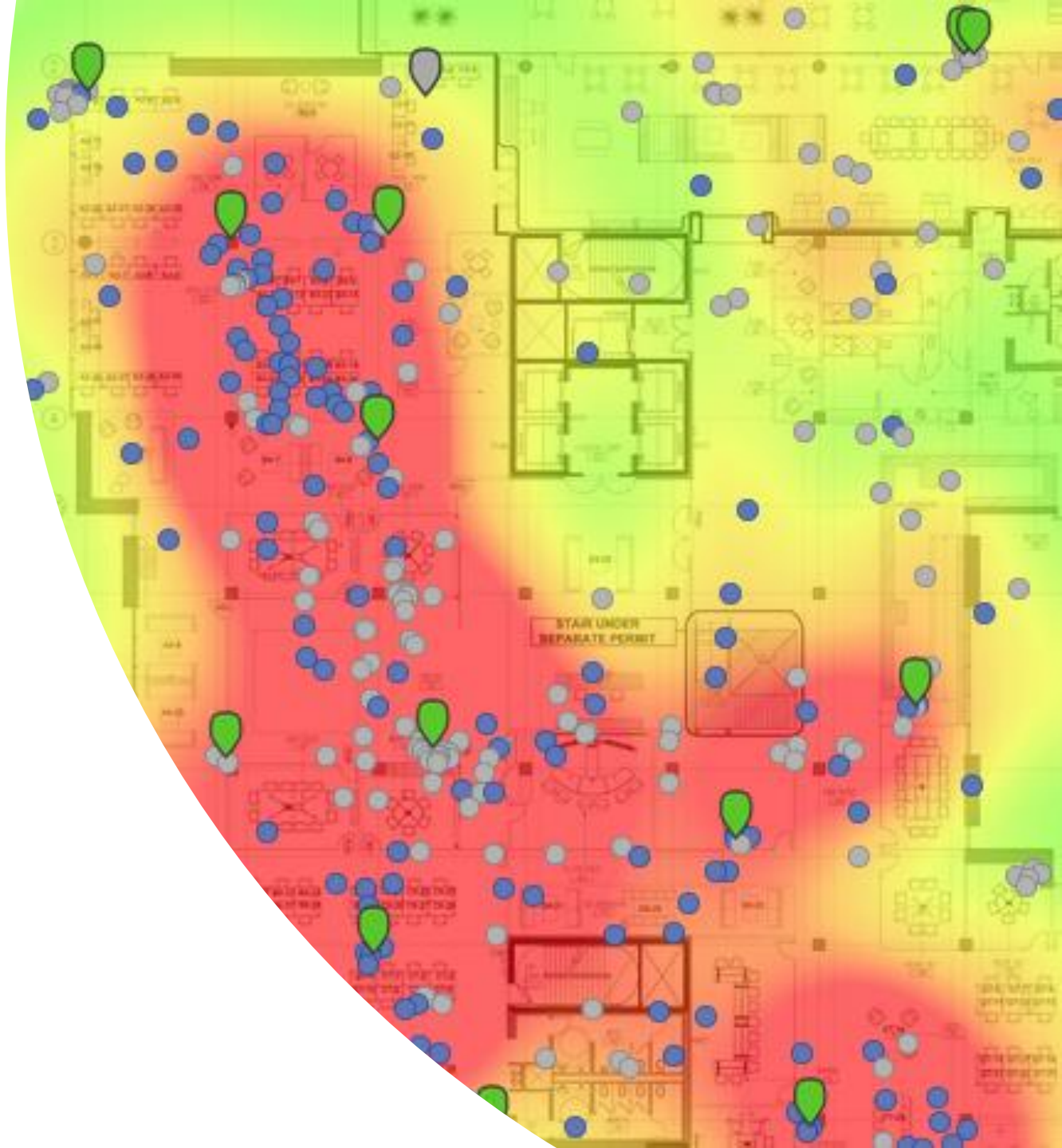
- Client installed IOT controls and now has sensors every 10 Feet..
- Once we get the data we can correlate it to human responses

Visitor traffic



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What can the new sensors and systems do?

- ENERGY SAVINGS
- Task tuning and high-end trimming
- Daylight harvesting
- Occupancy/vacancy detection
- Auto and advanced demand response programs
- Time-of-day dimming schedule
- Real-time energy savings report
- COMFORT & CONVENIENCE
- Advanced occupancy detection
- Light-level stability
- Configurable dim-and-linger occupancy
- Personalized setting profile
- Stay-with-me lighting effect
- Fixture outage report

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- You wouldn’t buy a stereo without a volume knob

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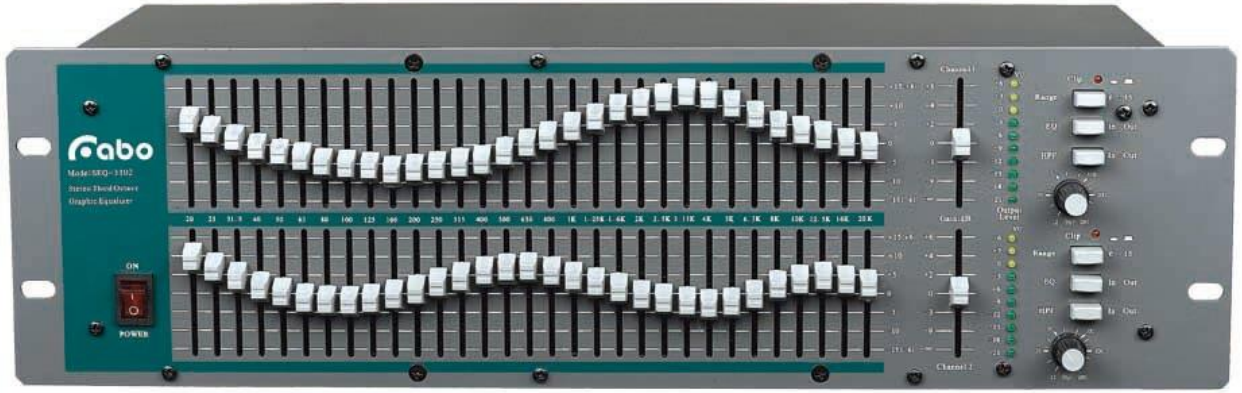
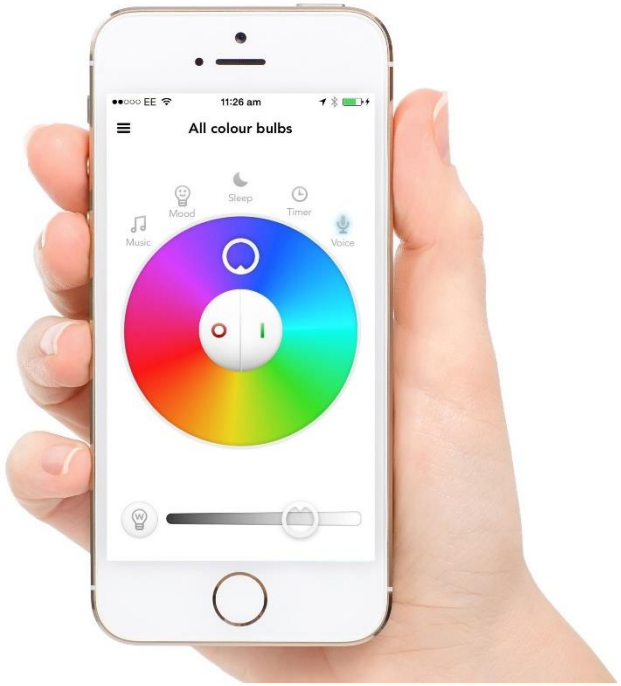


- When we have control over spectra as well as intensity, how does that affect the space.

- Like an audio equalizer



Learning Objective 3. Understand how to apply new metrics – and how to fine tune tunable systems

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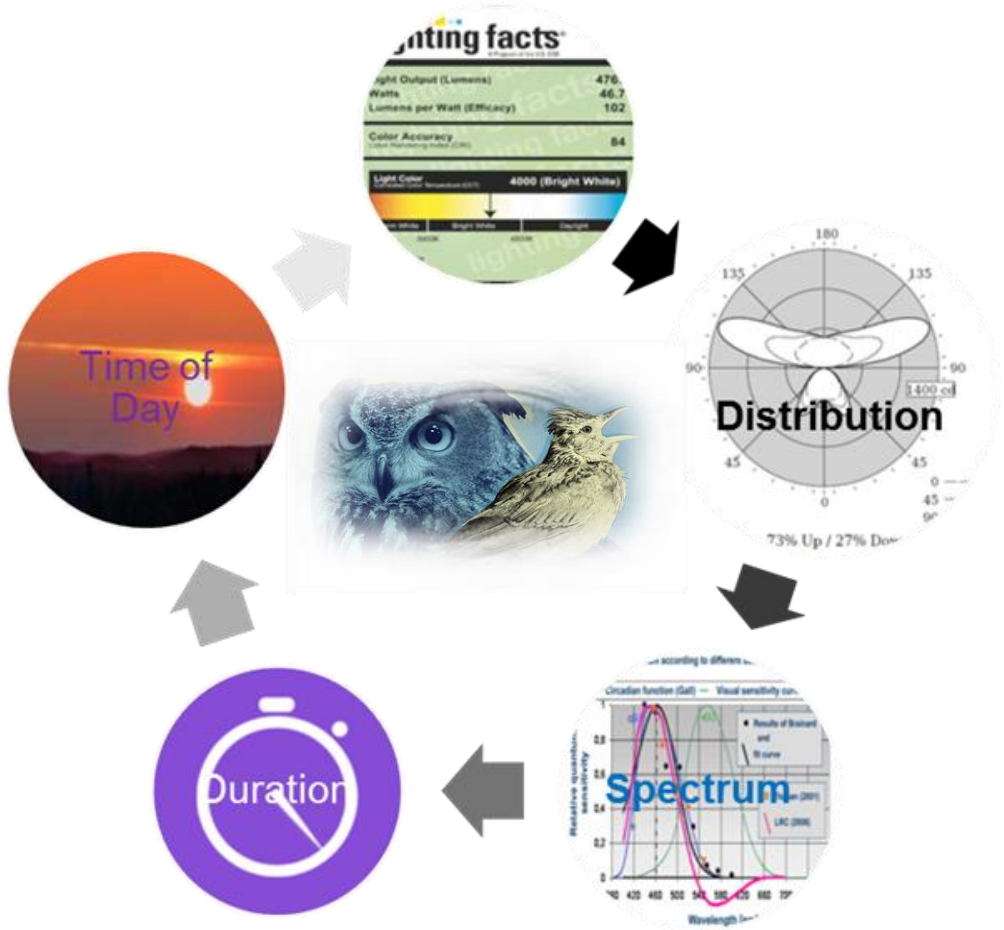
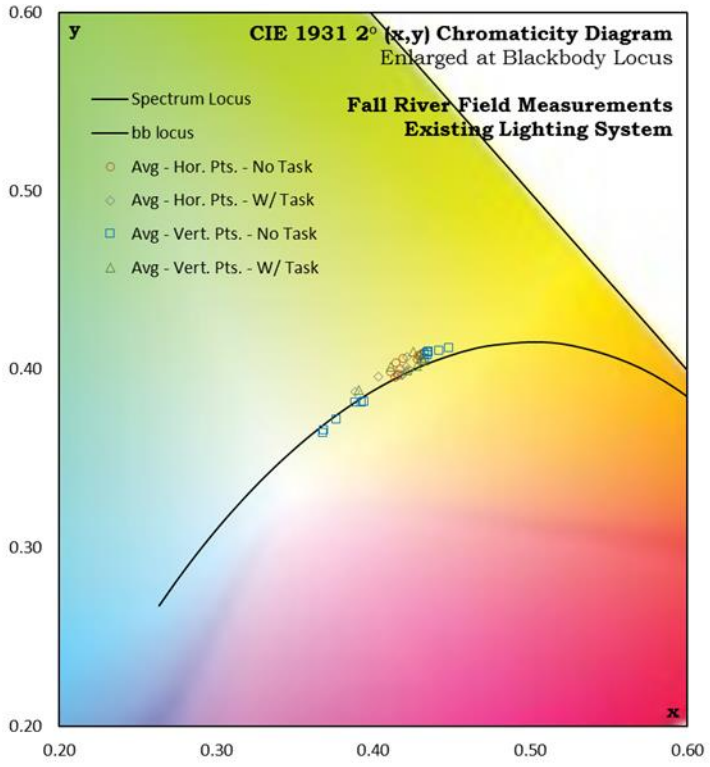
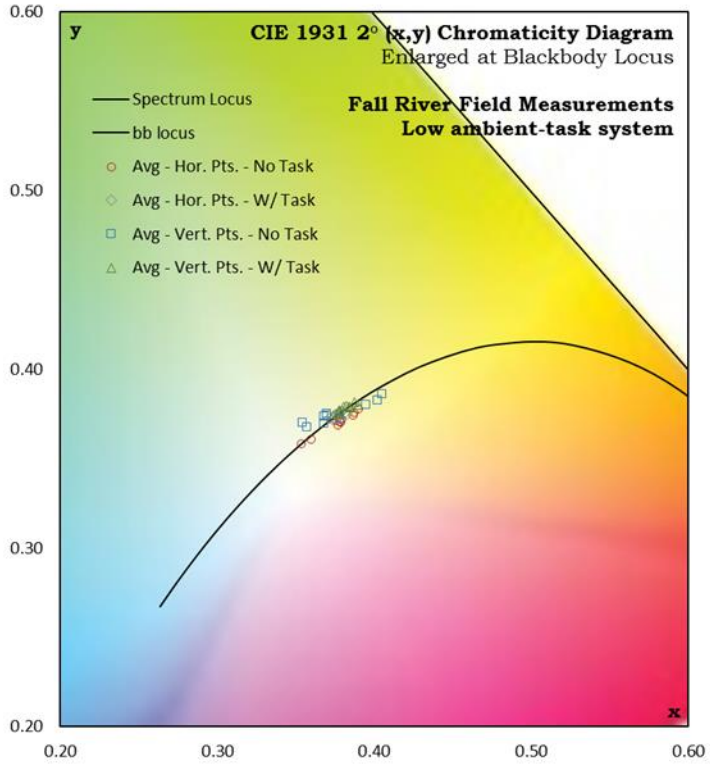
How to get the right light?

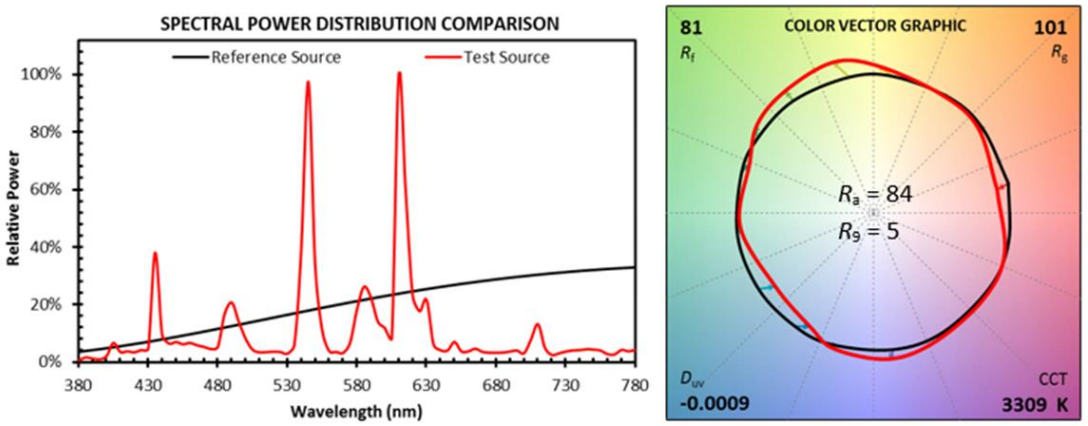


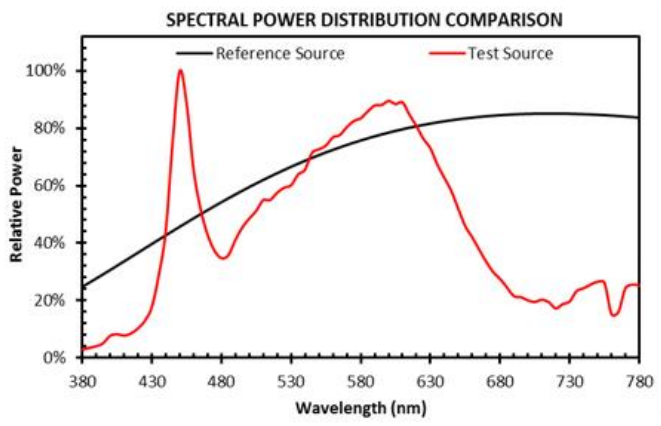
Towards a more nuanced approach to color metrics: system chromaticity

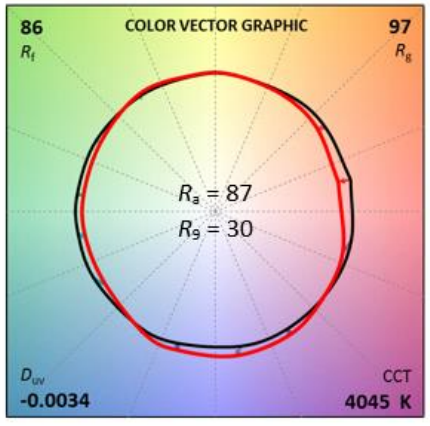




A more nuanced approach to color metrics: fidelity+ gamut







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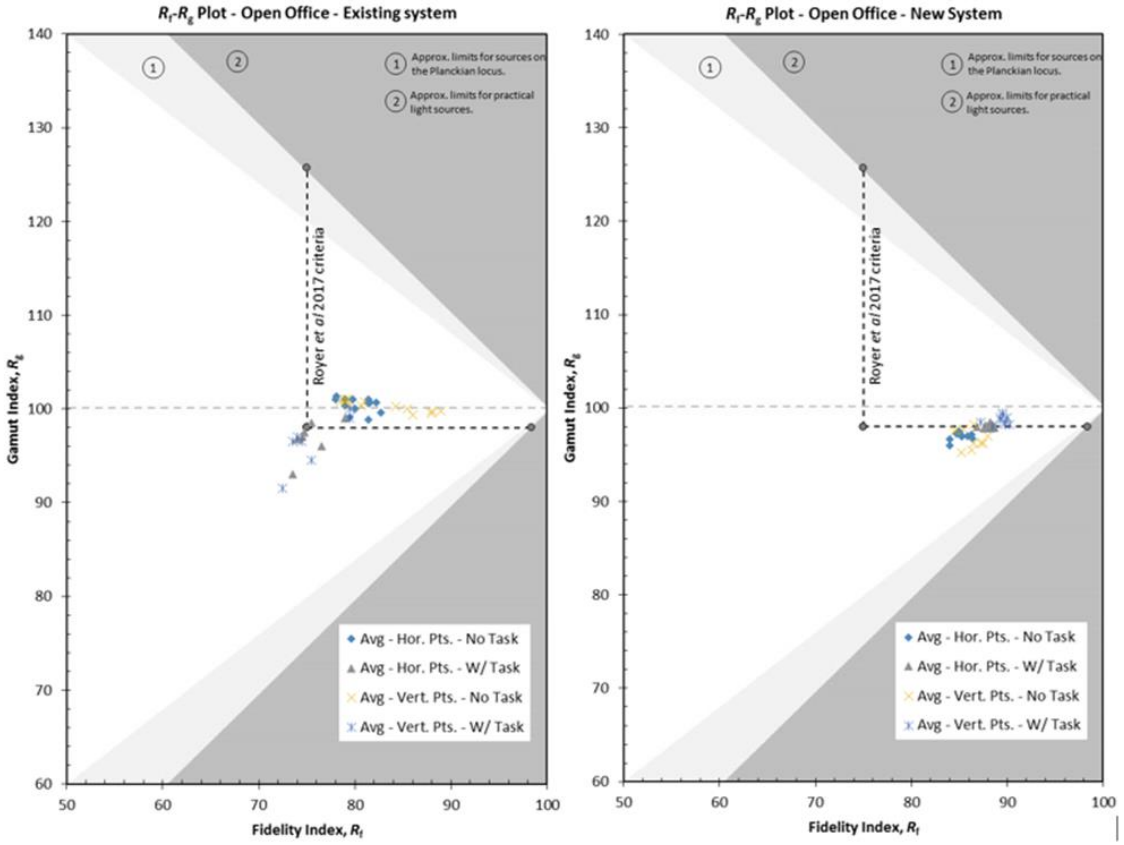
Red Rendering Criteria

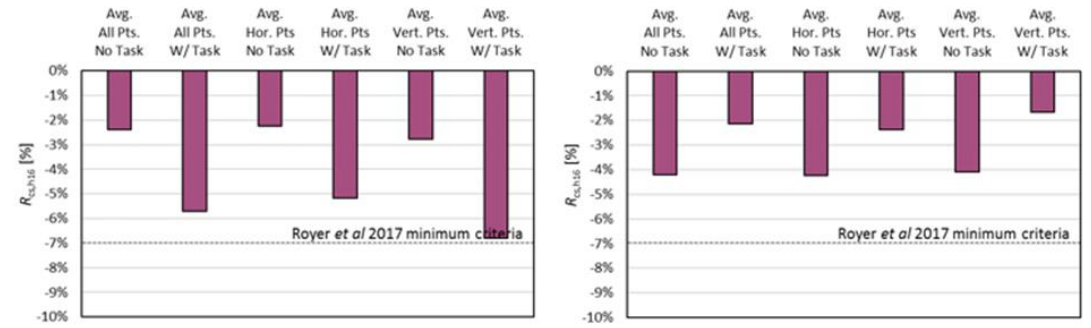
The existing fluorescent lighting system generally has an average gamut area greater than 98 ($R_g > 98$), and where it does not is due to the poor performance of the fluorescent task light.

Without the task light, the existing system meets minimum R_f-R_g criteria recently published by Royer and others. (Bottom left)

The existing fluorescent system also meets recently published criteria for red rendering, though the task light barely complies in some instances. (Top right)

The color rendering ability of the new low ambient/task system is much more consistent than the existing system and on average, has a higher average fidelity. (Bottom right) The new system meets red rendering criteria recently published by Royer and others [2017].





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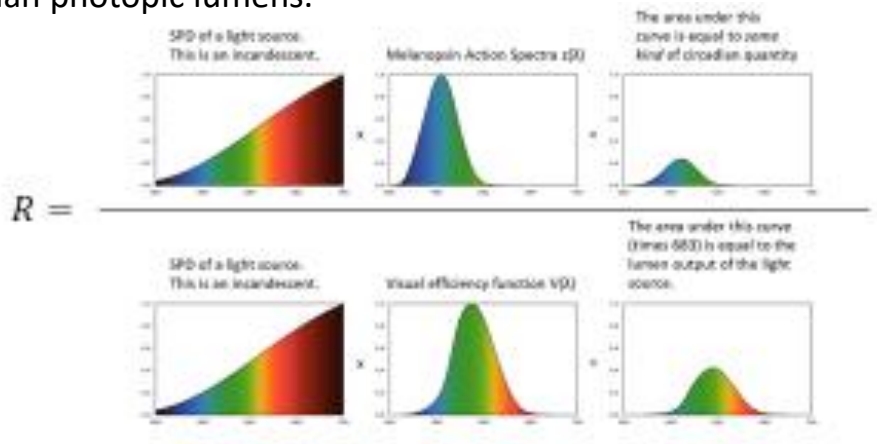
Predicting Circadian Impact

MELANOPIC RATIO [R]

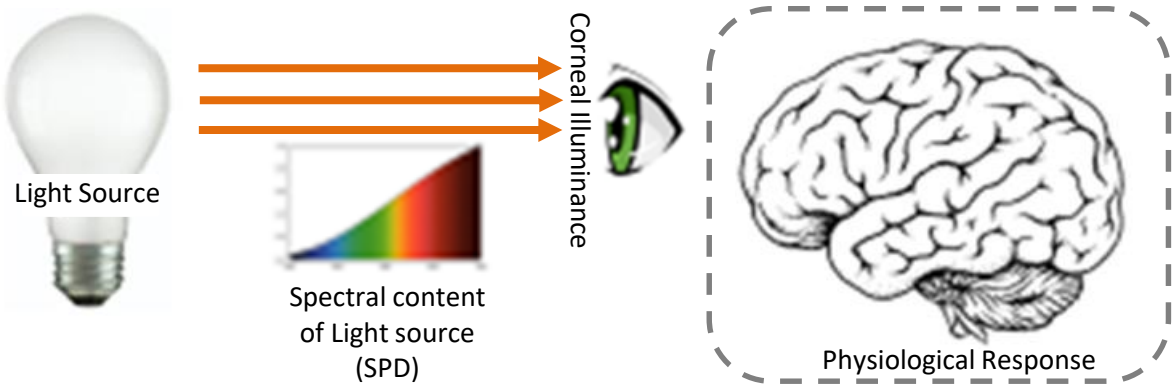
The melanopic ratio was described in the *Well Building Standard* and is cad as the ratio of melanopic *'lux'* (i.e., melanopic weighted radiant power) to the luminous flux. A ratio less than 1.0 (R<1.0) implies that a source contains less *melanopic weighted radiant power* than photopic lumens.



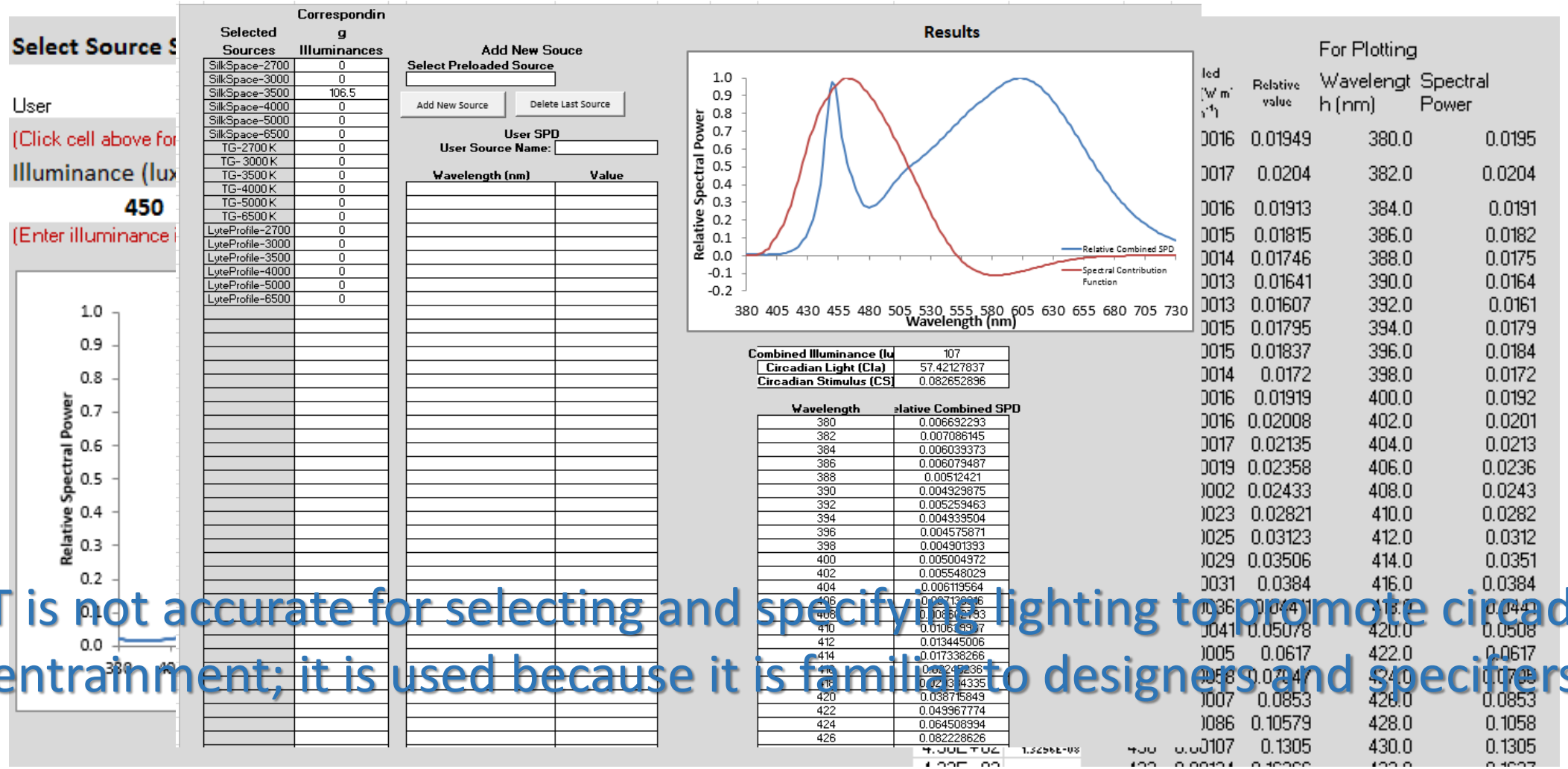
Reference:
Well Building Standard
V1 with May 2015 addenda

Math: $$R = \frac{72{,}983.25 \int_{380}^{780} P(\lambda) z(\lambda) d\lambda}{683 \int_{380}^{780} P(\lambda) V(\lambda) d\lambda}$$

CIRCADIAN LIGHT [CL] AND CIRCADIAN STIMULUS [CS]

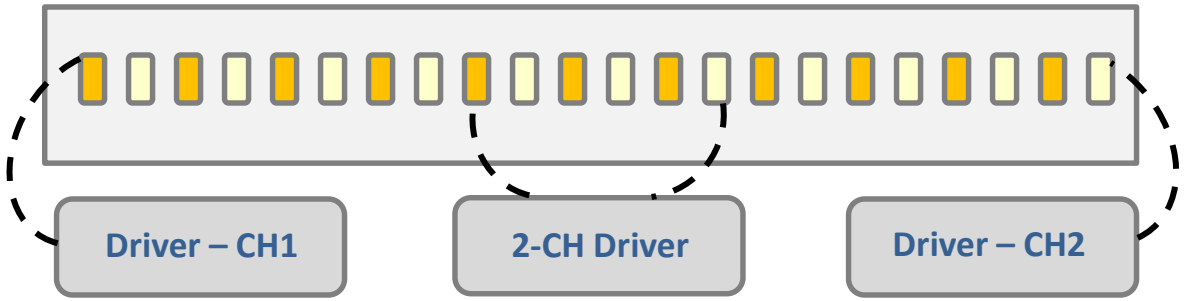


Circadian Stimulus (CS) Calculator



CCT is not accurate for selecting and specifying lighting to promote circadian entrainment; it is used because it is familiar to designers and specifiers

Tunable White – What is it?

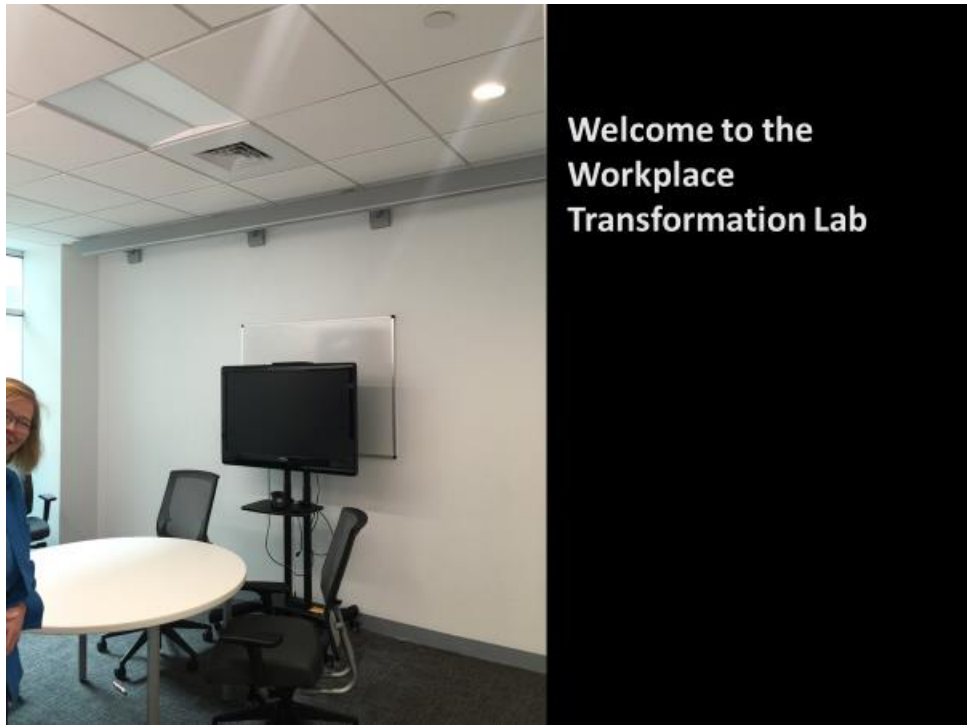


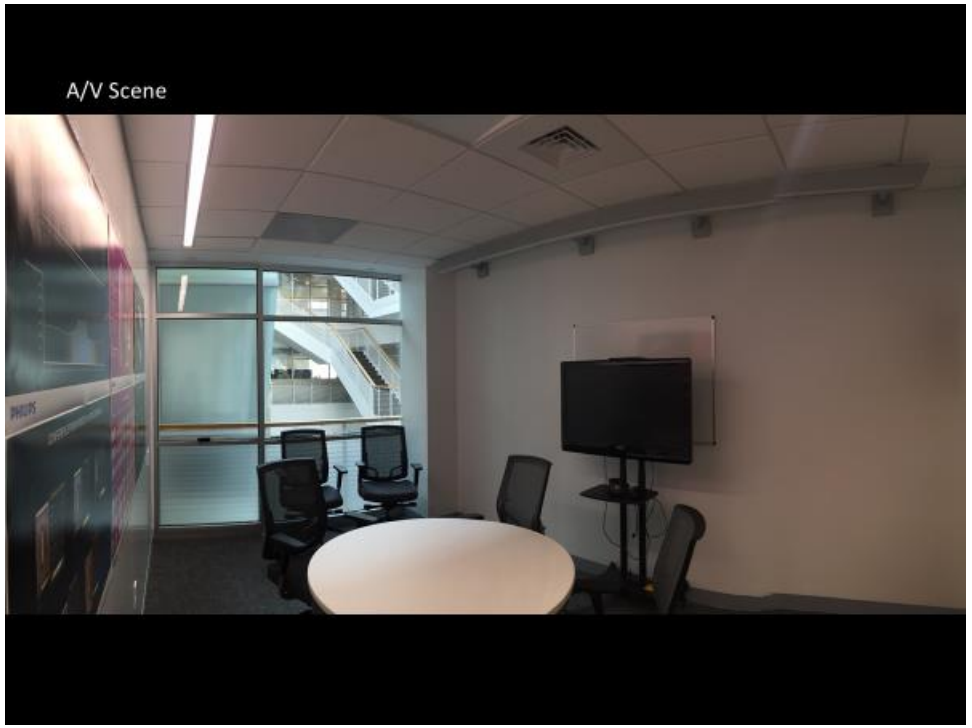
How do you tune a TW luminaire?

Proportions of each channel mix to create desired CCT and light levels

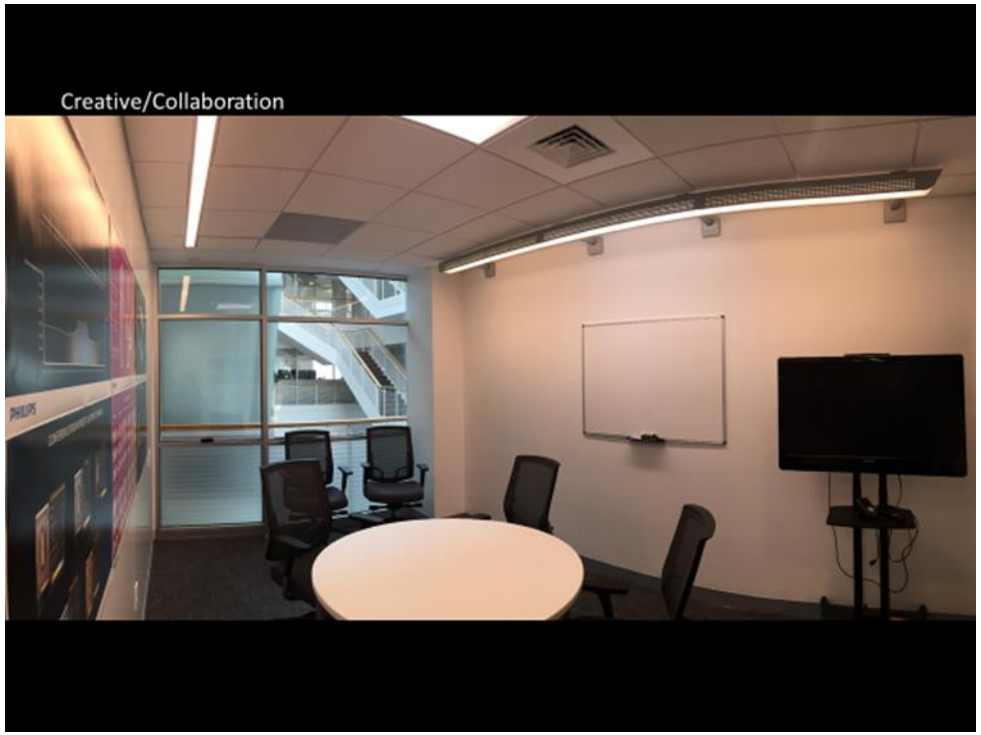
	Preset 1 3000K min	Preset 2 3000K max	Preset 3 5000K min	Preset 4 5000K max	Preset 5 6500K min	Preset 6 6500K max
CW1	1%	15%	13%	100%	1%	100%
WW1	25%	100%	1%	34%	0%	0%
CW2	1%	15%	13%	100%	1%	100%
WW2	25%	100%	1%	34%	0%	0%
					lowest light output for 6500K	highest light output for 6500K

Enhancing functionality:
Task support for visual acuity





New recipes combining image forming and non image forming requirements



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Lighting is Personal

5|20

Diversity is not simply a matter of age, there will be **five generations** in the workplace by 2020.

Diversity includes over **twenty differences** including gender, ethnicity, cultural, life style, Chrono-type, personality type, and thinking styles.

It is essential that we appreciate that human beings have an individual and systemic response to light.

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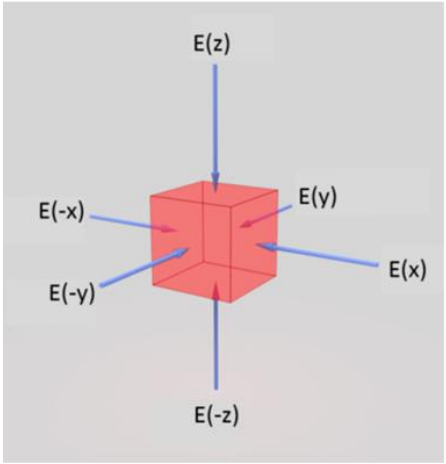
Task Light

Vector/Scalar ratio

We are inspired by Kit Cuttle's prescient words written in 1973 "An office worker's appreciation of his desk or his telephone is unlikely to be influenced to any extent by the value of the vector/scalar ratio, but his interactions with other people certainly are susceptible to this influence. From the "soft lights" of the intimate night club to the harsh glare of the interrogation situation, *there is a rich variety of ways of manipulating the flow of light to influence inter—personal communication. Perhaps this is a step towards illuminating engineering becoming recognized as an aspect of social psychology."*

	Location			
Direction	14	15	16	Note
1	220	275	304	Up (facing ceiling)
2	45	30	42	Down (facing floor)
3	99	83	91	Left
4	110	121	51	Right
5	107	67	122	Front (facing work station)
6	136	97	69	Back (facing away from work station)
VS	1.50	2.2	2.4	



New CIE update of UGR

"Responsive Lighting Solutions," prepared for the General Services Administration Lawrence Berkeley Laboratory, September 2012. 40% of respondents (approximately 200) reported experiencing glare.
The 2015 Office Project 80% of respondents in a small pilot reported glare reduction.

Type of Glare	State of Art: % saying they experience it sometimes, often, or always	DOE Office 2015 Validation: % saying they experience it sometimes, often, or always
Reflected on work surface	43.4	0%
Reflected on computer screen from the light fixtures	38.2	0%
Discomfort glare from nearby overhead light fixtures	32.5	25%
Discomfort glare from distant overhead lighting	23.1	12%

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DATA + AI=?

+ Machine Learning =

4.

Apply evidence-based design guidelines for commercial (office) spaces ranging from 1970 to 2020

The struggle to establish global standards: Comparing results and the elusive n=>20

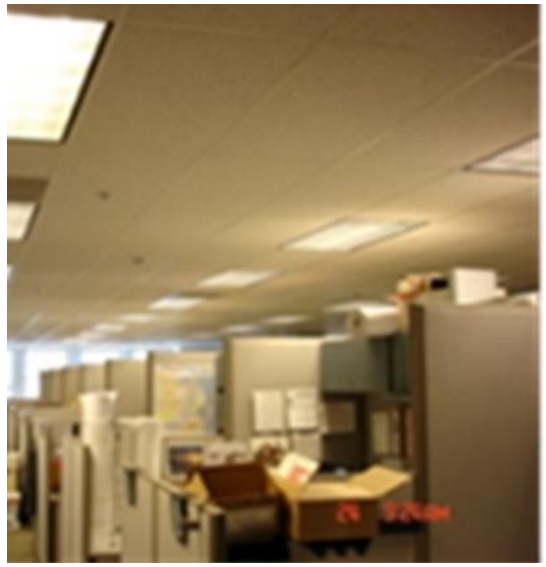
Problems of limited sample size	Advantages of large sample size
• Limited statistical power	• Accuracy
• High false discovery rate	• Subgroup analysis
• Limited reproducibility	• Diversity and outliers
LIMITED GENERALIZABILITY	GOOD GENERALIZABILITY

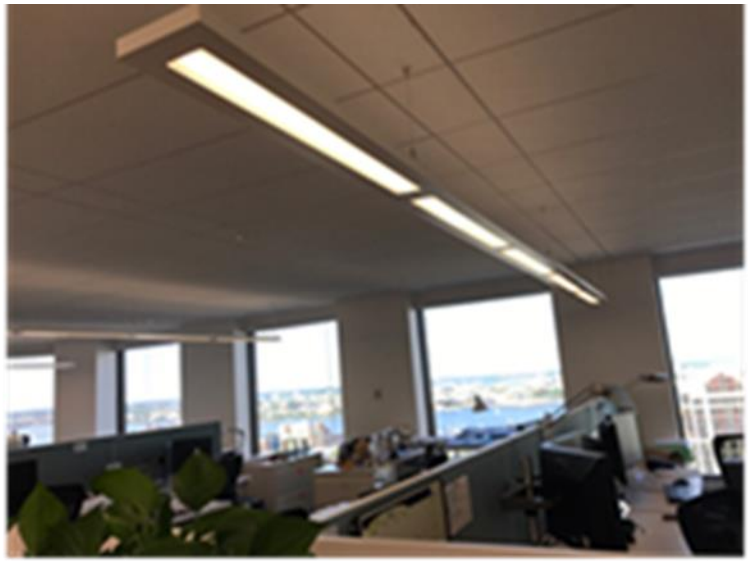
Most of our existing office space is not optimized for daylighting

88% of Building Stock pre 2003, (50% pre 1980) and 50% under 50,000ft^2

2012Commerical Building energy Consumption Survey
Layouts: http://aceee.org/files/proceedings/2012/data/papers/0193-000077.pdf

These space types can be defined as:





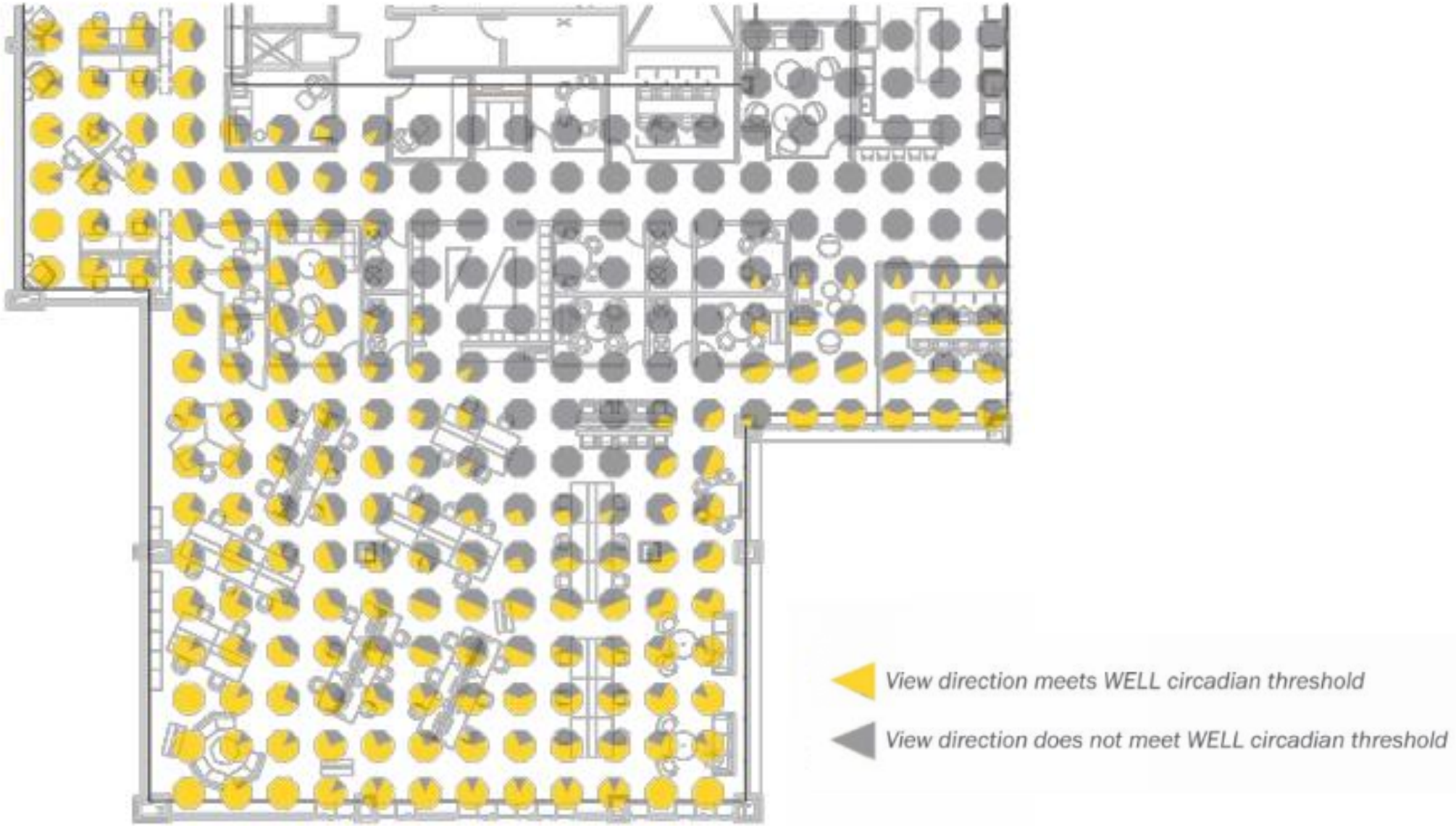
- Existing building pre 1986 (lighting circa 1992
  - represents nearly 50% of the commercial office spaces, nearly half of those < 50,000ft^2
- Offices built or refurbished 2003-2015 characterized by office densification = approx. 38% of commercial office.
  - “typical office” provided to us belongs in this category
- Recently built or refurbished to be an “activity based workplace”. New construction 12% of commercial office space.
  - floor footprints of these tend to be larger than older construction.

Circadian Lighting Design

Feature 54

DAYLIGHTING

Precondition



Circadian Lighting Design

Feature 54

Electric Light

Scale: 1/16" = 1'-0"

- Calculation point,
  units in equivalent melanopic lux.

WELL/Delos Headquarters

New York, NY

LEED V4 Platinum & WELL Platinum

A working demonstration of WELL strategies & features for an interior fit-out project

Lighting system is completely RGB and tunable white within one MacAdam ellipse at any wavelength.

WELL/Delos Headquarters

New York, NY

LEED V4 Platinum &
WELL Platinum

Daylighting feature dependent on interior shading strategies, nothing exterior

This concludes The American Institute of Architects Continuing Education Systems Course