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Solid-State Lighting for Offices: Let's Get it Right

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A presentation at the CNC/CIE — IESBC Workshop
"Canadian Research and Development Activities in Light and Lighting",
Vancouver, BC, October 14, 2010.
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Project Motivation

- Focus is human factors
  - It's not about source efficacy
- General office lighting market is huge …
  - … but fluorescent is already efficient and cheap
- Long-term view to explore benefits to occupants of lighting differently
  - It's not about socket-for-socket replacement
  - Form factor
  - Controllable spectrum

Project Structure

- Design workshops, with consortium of interested parties
  - Start with a clean slate
- Fabricate experimental luminous environments
- Conduct human factors studies
  - What works, what doesn't

Project Tasks

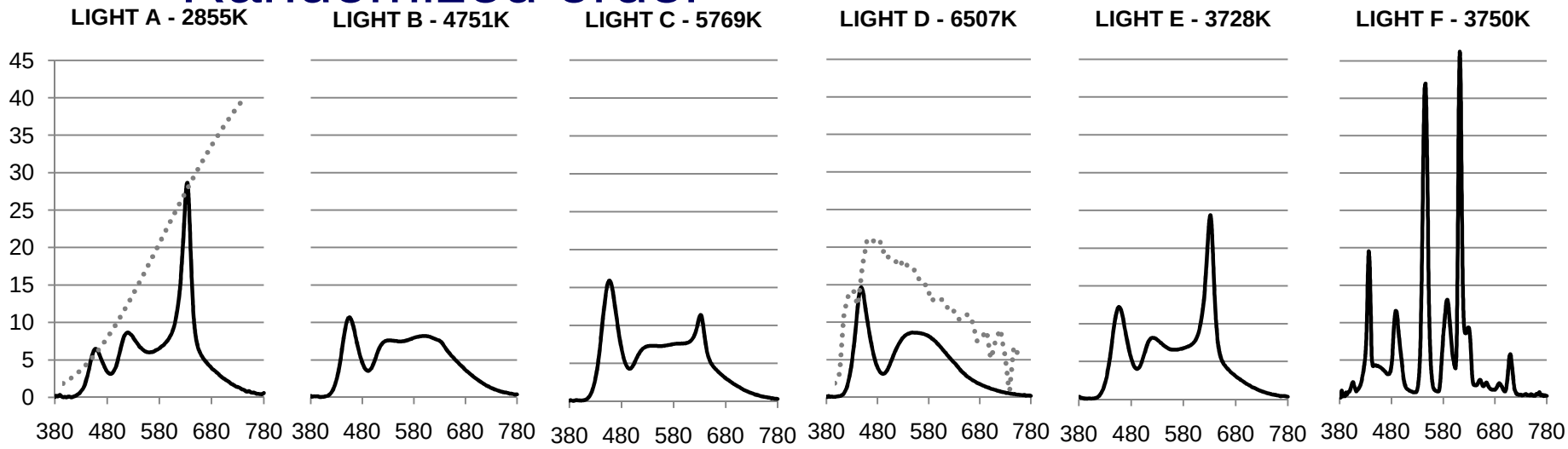
- Experiment 1: scale model
- Experiment 2: full scale
- Experiment X: colour perception
- Demonstrations & prototypes

Experiment 1

- 1/6 scale cubicles

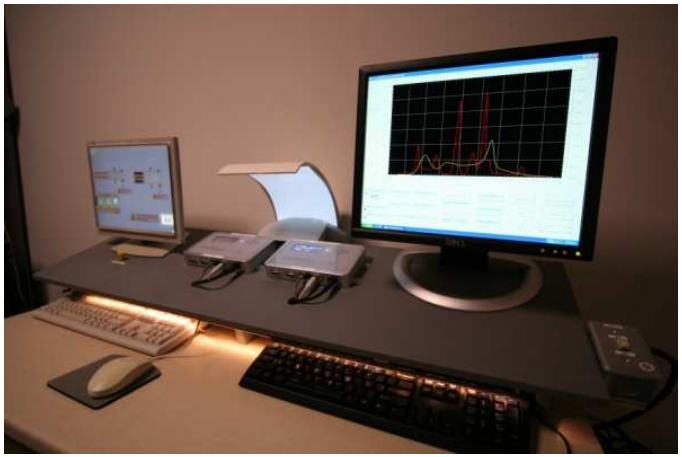
Experiment 1

- Participants viewed five pre-set LED conditions…
- … and one fluorescent condition
- All ~510 lx on desktop
- Randomized order



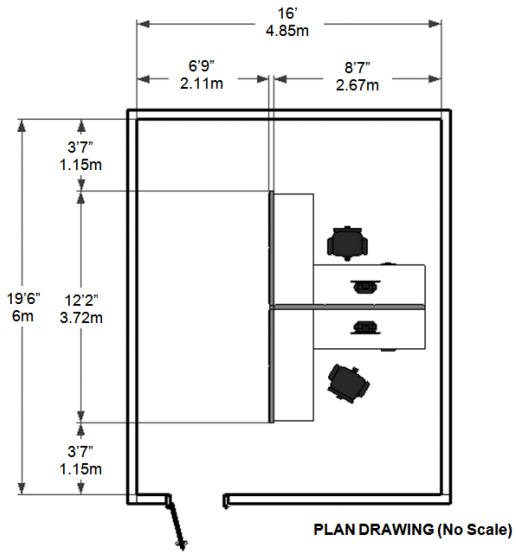
Experiment 1

- Then give participants the sliders:
  - Free and constrained individual control
    - No desktop illuminance limit
    - Desktop illuminance 450-550 lx
  - Record spectrum and level of choices



Experiment 2

- Non-daylit space
- Two cubicles



PLAN DRAWING (No Scale)

Experiment 2

- Replicating work on individual control over illuminance
- Full day exposure
- Half of participants get choice in afternoon

	No Change		Choice	
Lighting for Periods 1-2	3000 K	6500 K	3000 K	6500 K
Lighting @ Period 3-4:	Unchanged		Self-Chosen	

- Tests for cognitive performance, vigilance, mood, colour discrimination, room appearance, personal appearance, environmental satisfaction

Experiment 2

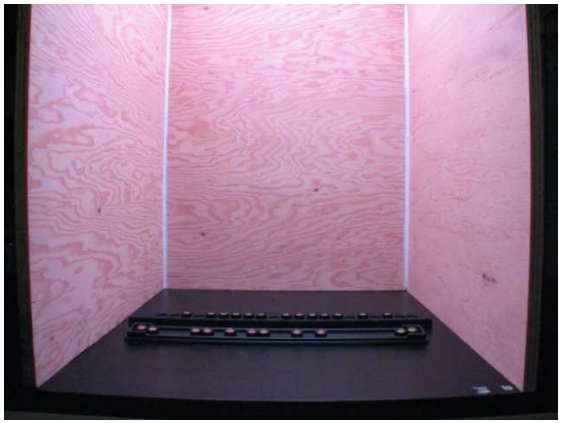
- H1: Colour discrimination performance will be better for conditions with higher colour quality.
- H2: Performance and alertness in Period 3 (post-prandial dip) will be higher for the 6500 K group than the 3000 K group.
- H3: People will self-select a variety of SPDs as their preferred lighting.
- H4: Being given control will stop or reverse the daily trend in reduced performance and mood.
- H5: Those whose preference at Period 4 is most different from what they previously experienced will show the largest (favourable) changes in mood, satisfaction, and performance.

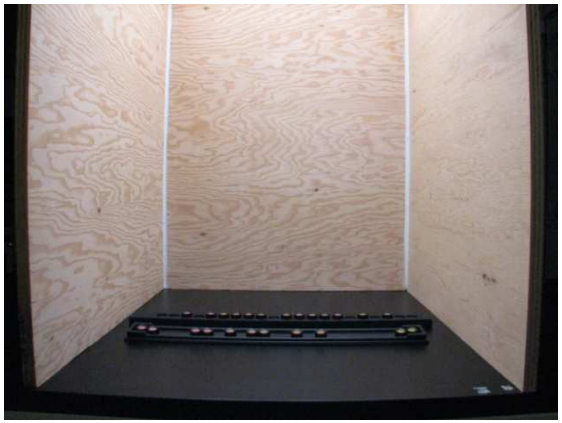
Experiment X

- UBC/NRC collaboration, with participation from Cardiff University student
- Question: For a given CCT and chromaticity, how do colour discrimination and colour preference vary?

Experiment X

- A: Filtered quartz halogen to produce “perfect” colour rendering at 3500 K
- B: Extreme RGB LEDs with combined CCT of 3500K and poor colour rendering
- C: A different set of LEDs with combined CCT of 3500K and excellent colour rendering





Next Steps

- Complete existing project (ends March 2011)
- Continuation of design & controls idea demonstrations
- 2011-2012, possible experiment on effects of LED flicker
- Participation in IEEE PAR 1789, "*Recommending practices for modulating current in high brightness LEDs for mitigating health risks to viewers*"

Getting it Right

- Solid-state lighting is exciting and promises to be energy-saving…

but…

- If it's not useful from the start, people won't adopt it.
- Now is the time to attend to usability issues.

Acknowledgements

- This work is supported by: NRCan – Panel on Energy Research & Development; NRCan — Office of Energy Efficiency; BC Hydro; Philips Color Kinetics; Philips CANLYTE; GO Lighting, UBC Structured Surface Physics Laboratory; NRC Institute for Research in Construction; and volunteer advisors from industry and research labs.
- The project team: Erhan Dikel, Greg Burns, Guy Newsham, Sandra Mancini, Chantal Arsenault, Toby Pilditch, Pavel Popov, Chris Hahn