Energy efficient lighting control systems: consequences for lighting, quality, environment, health and human factors

- Knut Inge Fostervold, Department of Psychology, University of Oslo
- Pål J. Larsen, NTNU/Norconsult AS
- Erlend Lillelien, Lyskultur - The Norwegian Lighting Institute
- Tor Mjøs, Norconsult AS
- Morten Olav Berg, Fagerhult AS

Lyskultur the norwegian lighting institute
ULLEVÅL University Hospital
FAGERHULT
enova
City of Oslo Energy Fund

Introduction

- Claims by lighting industry:
  - Over 80% energy saving potential compared with installations of 20-30 yrs. ago
- Some studies to support industry claims
- However, few studies address at the same time consequences for:
  - human performance
  - health
  - well-being

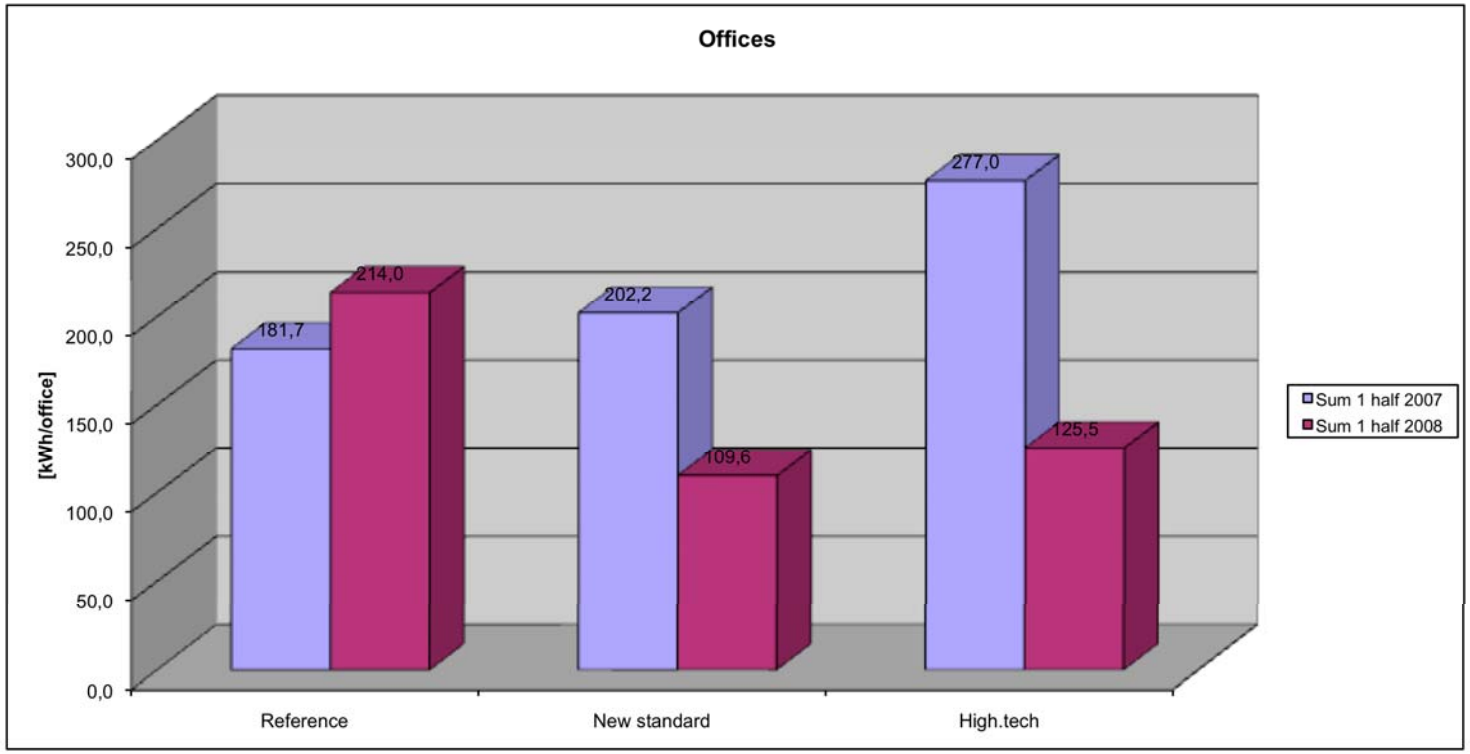
Field Study

- Laboratory building at large hospital in Oslo
  - Around 30 year old structure
  - Unique construction:
    6 main floors each with separate technical floor
  - Open lab spaces and single/double offices mainly
  - Some areas operate 24-7
- Luminaires need replacing due to pcb in capacitors
  - 1 to 1 replacement mainly, due to ceiling- and economic restrictions
  - Maintain lighting level and quality

Design

- 3x3 mixed, non-equivalent control group design.
  - Between-subjects factor - lighting system.
  - Within-subjects factor - time.
  - One control group - two intervention groups.
- New luminaires and control system:
  - Max energy saving through less installed power and lower cooling load.
  - Advanced controls but simple to use:
    - Presence detection and daylight dimming
- Energy and environmental logging:
  - Energy logging in several office and lab areas, as well as building total
- Health and psychological measurements:
  - Subjective assessment.
  - Performance measurement.

Energy reduction - offices



Energy results

- Rehabilitation overall:
  55% energy reduction, maintaining the same lighting quality

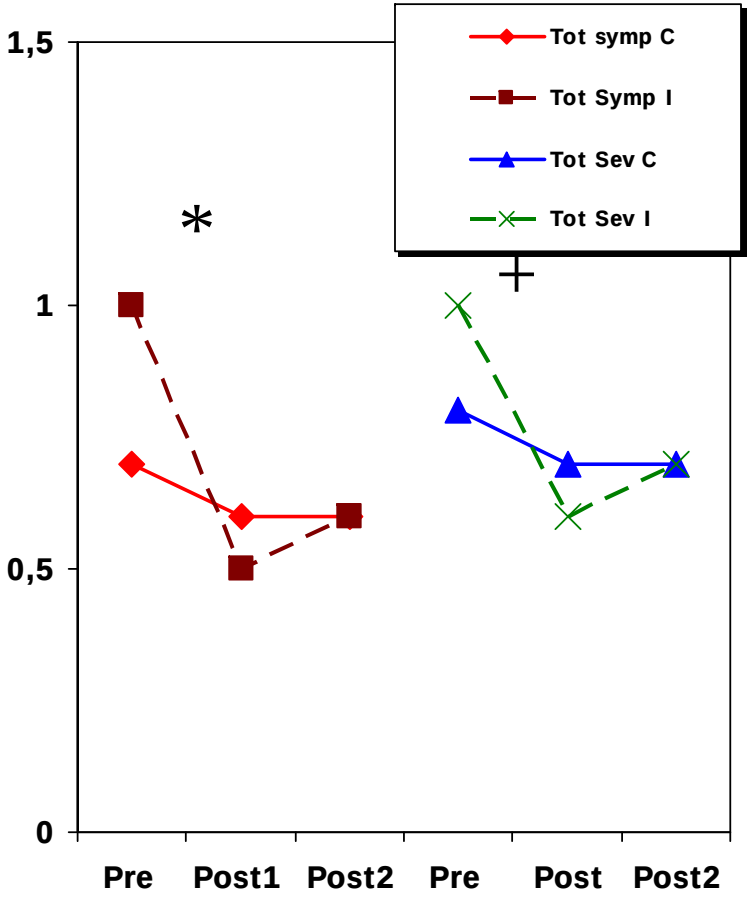
- Offices with a high-tech control system:
  65% energy reduction

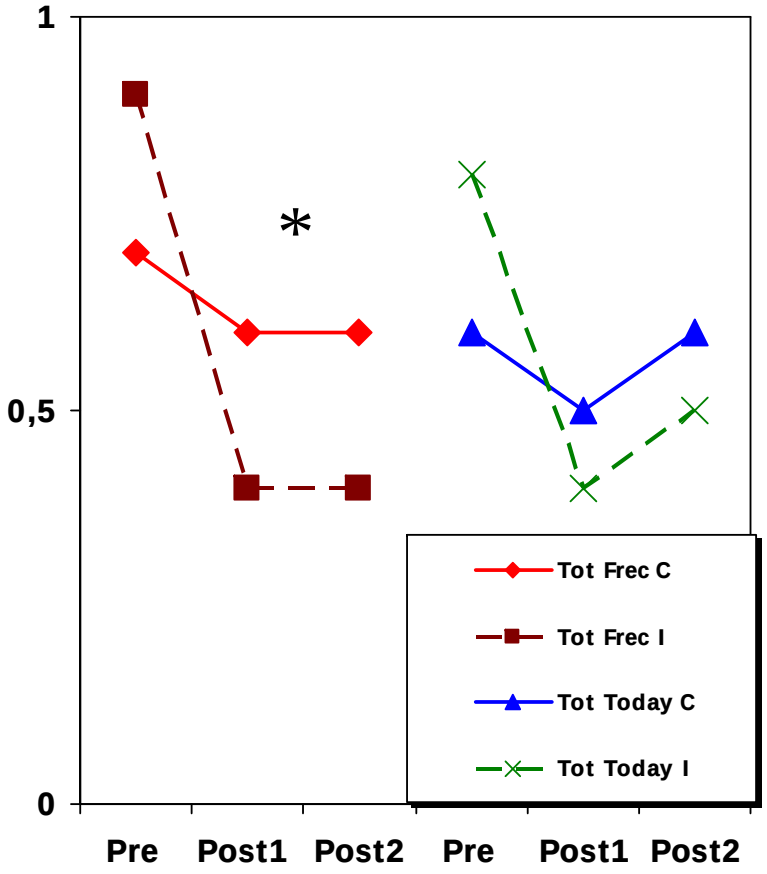
- Parasitic energy 1 year: 7.900 kWh

Dependent variables

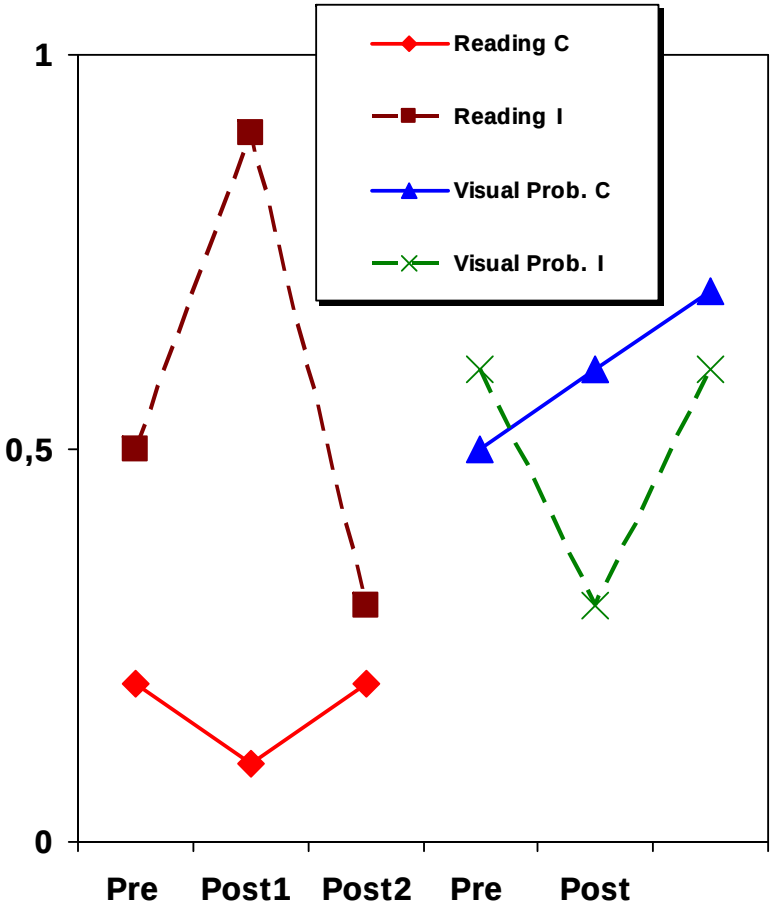
- Anxiety and anger expression.
- Subjective experience of bodily symptoms.
- Subjective experience of quality of the work environment and well-being at work.
- Sleepiness.
- Subjective experience of job stress.
- Cognitive performance.

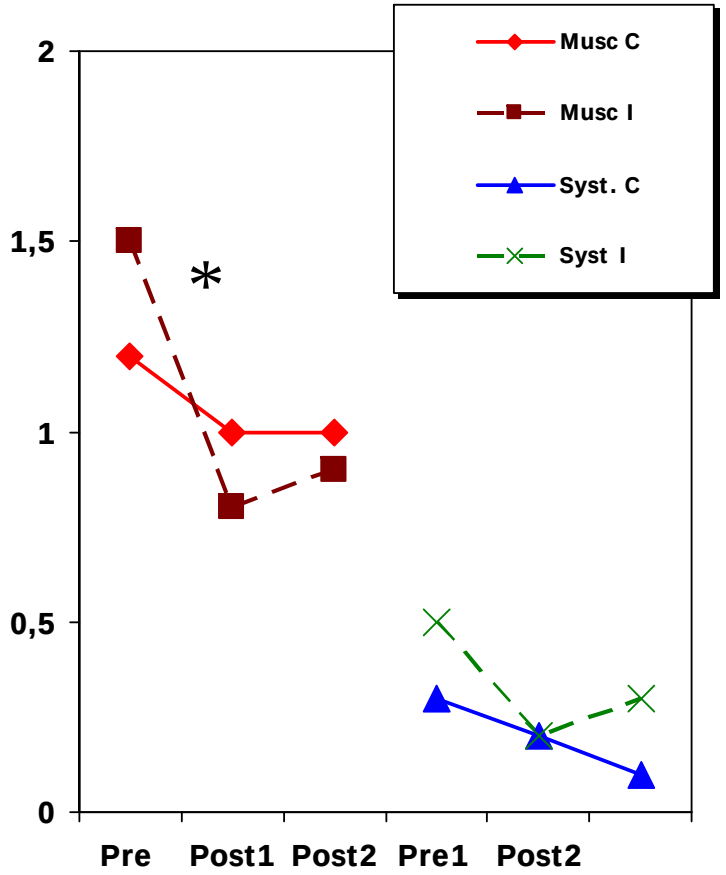
Subjective experience of bodily symptoms.



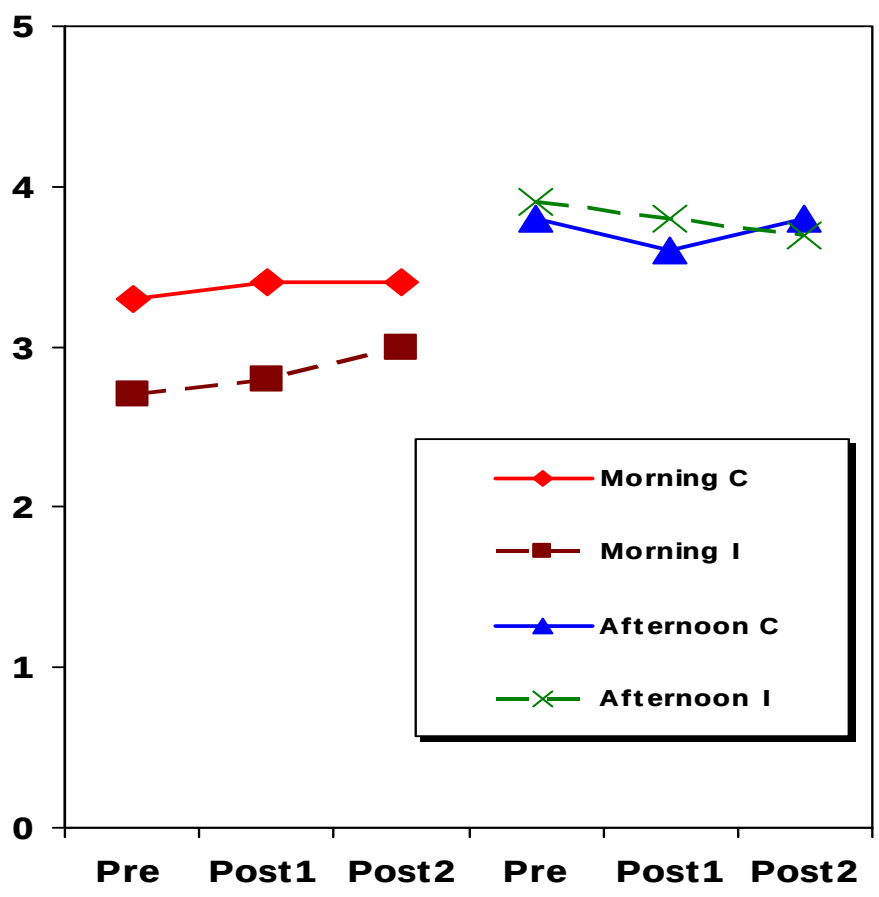


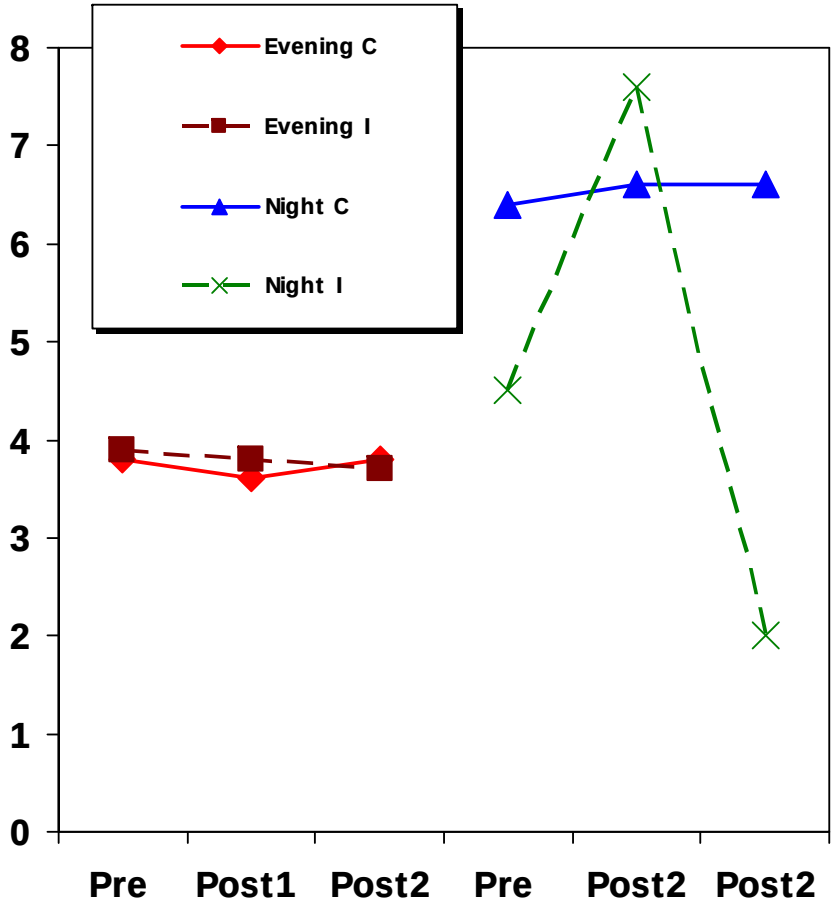
Subjective experience of Symptom clusters



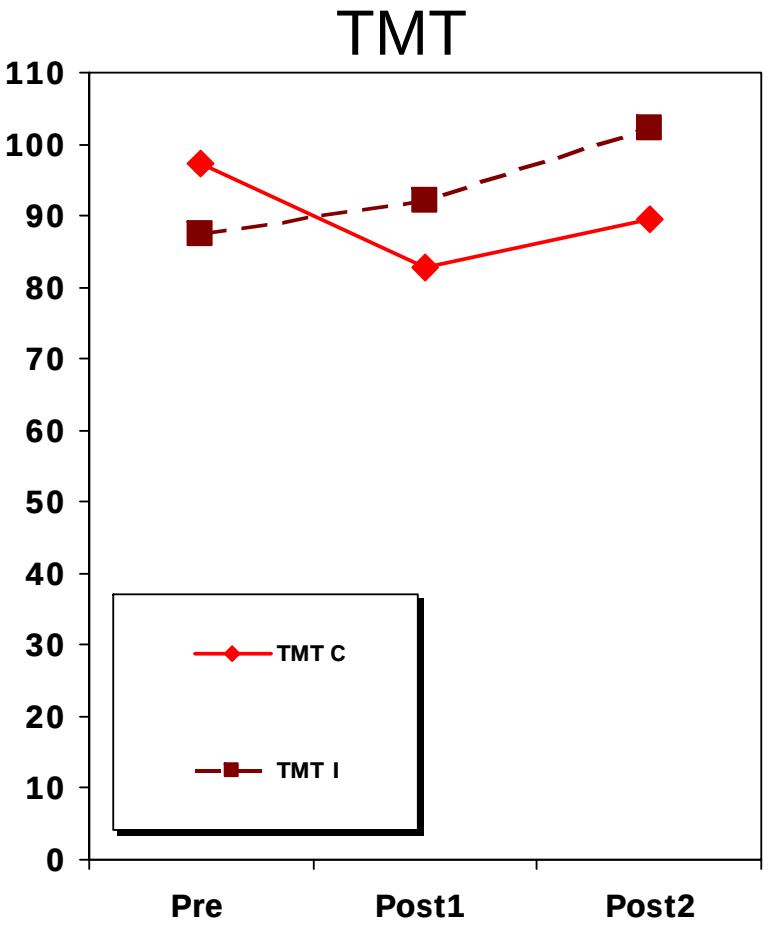


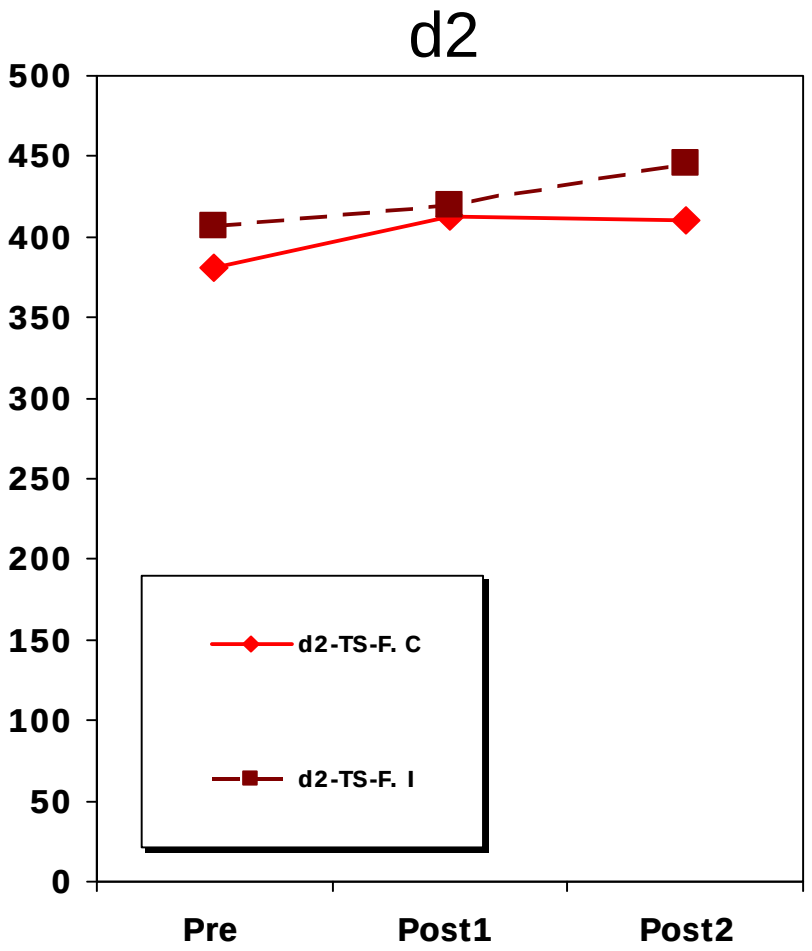
Subjective experience of tiredness and sleepiness (KSS)





The Trail Making Test and d2.





Conclusion

- Significant reductions in perceived symptoms as a consequence of new lighting.
  - The most prominent reductions were found for musculoskeletal symptoms.
- No negative findings related to the intervention.

Possible explanations

- Reduction in musculoskeletal symptoms.
  - Change in posture due to improved lighting.
  - Functional dynamic interplay between the oculomotor system and the musculoskeletal system.

Thank you for your attention!

Questions?

Final project report will be presented in Oslo March 25th at a seminar at Ullevål University Hospital.

For more info see: www.lyskultur.no or e-mail: nlk@lyskultur.no