

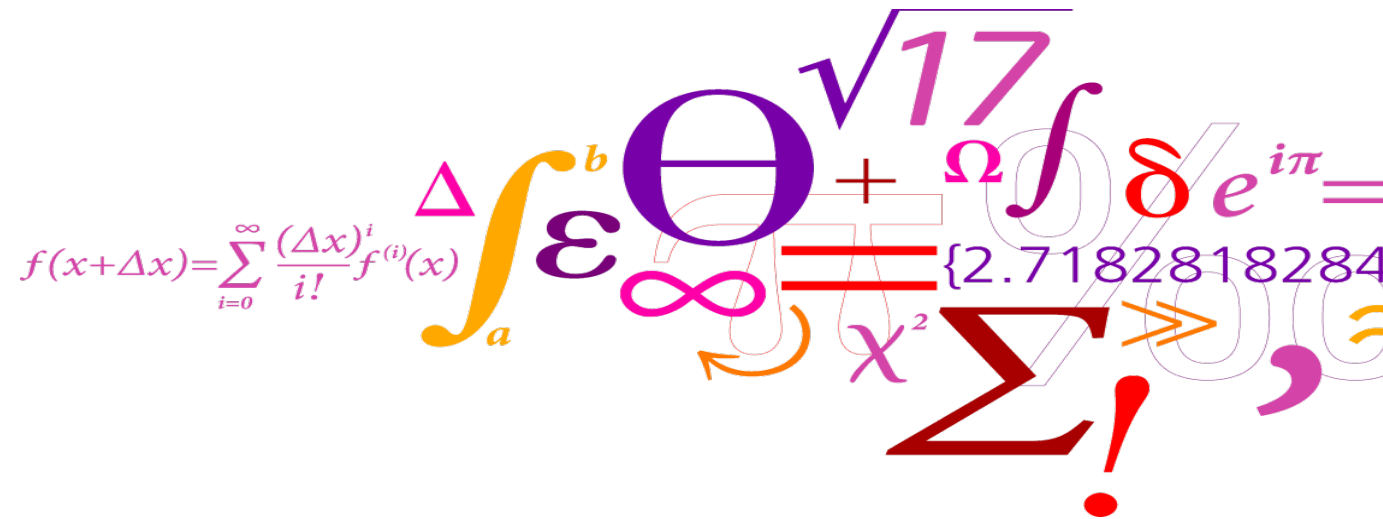
# How can we include occupant behaviour in building design?

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## IEA Annex 66 - Main objective

- How can we develop and apply a robust and standardized quantitative description and computational models of energy-related occupant behavior in buildings to analyze and evaluate the impact of occupant behavior on building energy use and occupant comfort via building performance simulation?
- Four key components
  1. Quantitative descriptions and classifications of occupant behavior;
  2. Methodologies for occupant behavior measurement, modeling, evaluation, and applications;
  3. Implement occupant behavior models in building performance simulation tools
  4. Demonstrate applications of occupant behavior models in design, evaluation, and operational optimization using case studies.



International 4 year cooperation between more than 100 researchers from 20 countries.

It is not possible to cover it all in this presentation

# The adaptive principle

**If a change occurs such as to produce discomfort, people react in ways which tend to restore their comfort**

To restore comfort occupants can

## Adjust to the environment

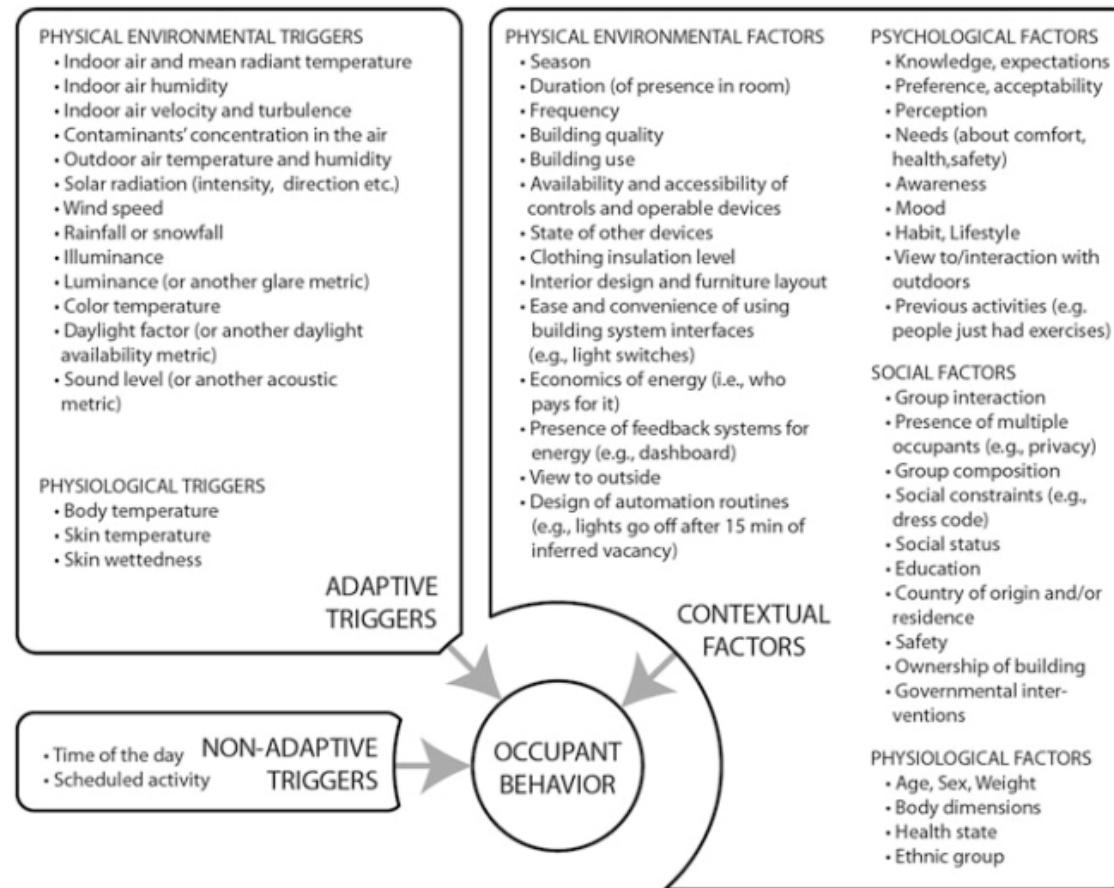
- clothing
- activity level
- posture
- hot/cold drinks
- etc.

## Adjust the environment

- thermostat adjustments
- window openings
- electrical lights
- solar shading
- etc.

The choice can affect energy use by up to 300% in an average Danish dwelling

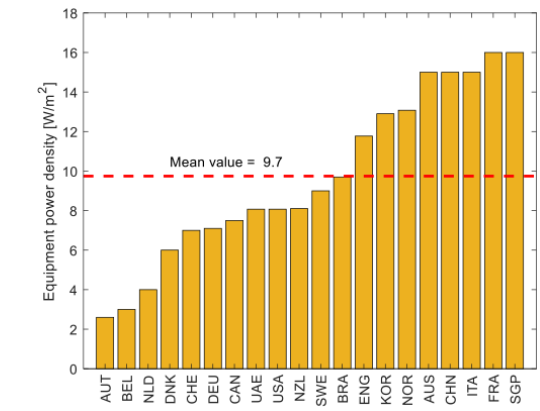
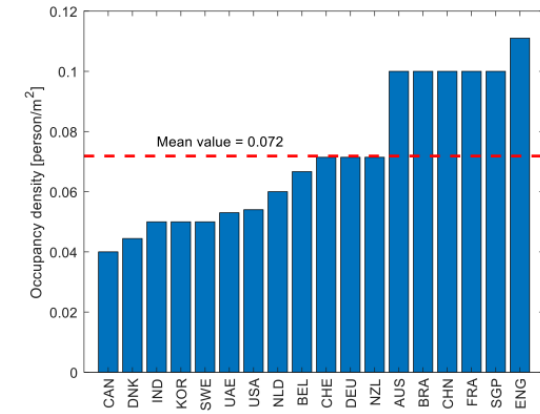
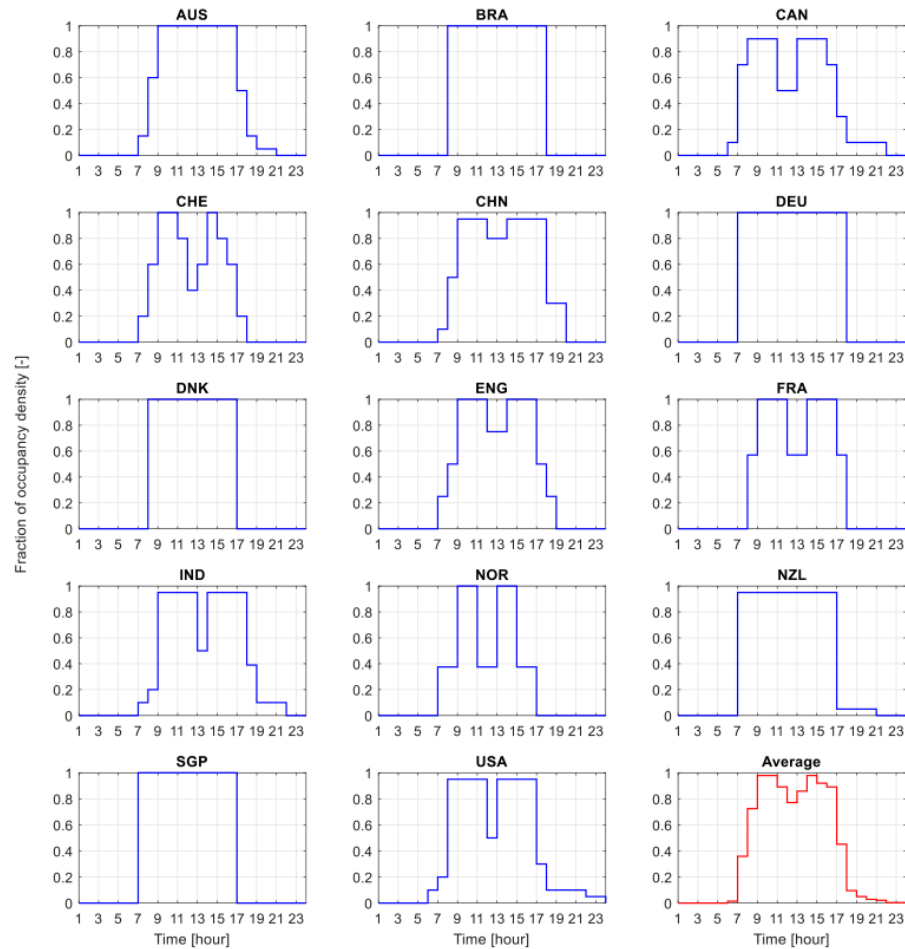
# Potential triggers of occupants' actions



# Modelling Occupant Behaviour

- Modelling approaches
  - General linear models
  - Generalized Linear Models
  - Linear mixed effects models
  - Hierarchical generalized linear models
  - Markov chains
  - Hidden Markov chains
  - Bayesian network models
- Models of
  - Occupancy
  - Window operation
  - Thermostat adjustments
  - Appliance use
  - Solar shading
  - Light switching

# Occupancy and equipment power in building codes\*

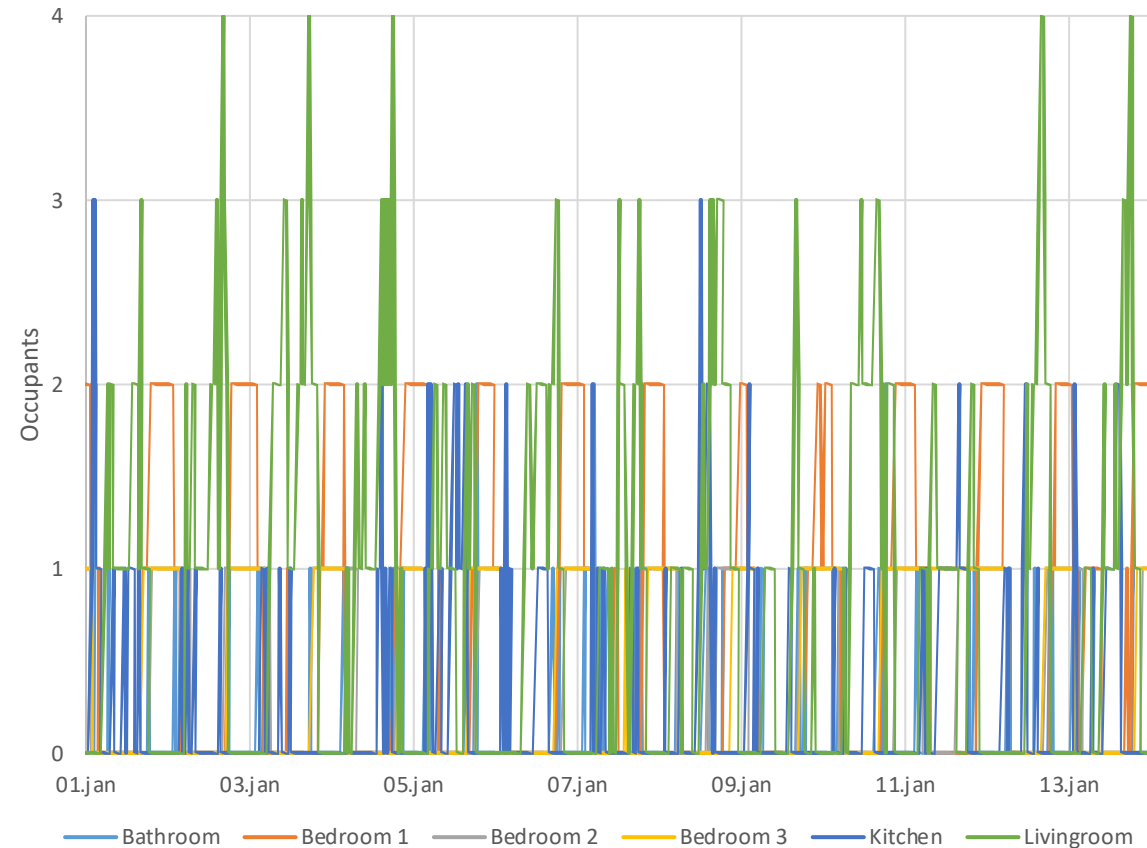


\*Figures from: O'Brien et al. An international review of occupant-related aspects of building energy codes and standards, Building and Environment 179 (2020)

# Occupancy profile generators

- Occupancy profile generators available at
  - Residential: <https://www.proccs.org/>
  - Office: <http://occupancysimulator.lbl.gov/>

Example from proccs.org – 4 persons, 3 bed rooms



# Thank you for your attention!

Questions?

