# A case study on workstation-dependent acoustic characterization of open plan offices

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## 1.a. Problem description

- Environment: Open plan office
- Typical noise sources: speech, walking sound, environmental noise, working sounds (keyboard, phone)
- Approaches for the design of acoustic treatment usually don't take subjective evaluations of employees perception in to account

## 1.b. Objectives

- Assessment of acoustic environment based on room acoustic measurements and listening tests
- Implementation and validation of numerically simulated acoustic treatment based on objective parameters and perceptual tests

## 1.c. Test case office

- 150 m$^2$
- 24 workstations
- Limited acoustic treatment (panels, ceiling)

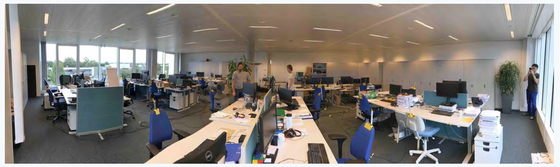
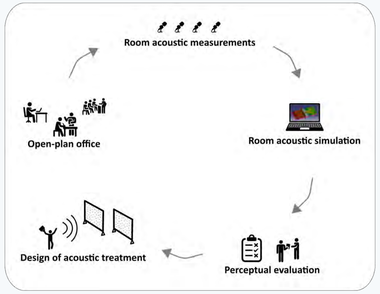


*Figure 1.1: Office overview*

## 1.d. Approach




## 2. Characterization and modelling of the office

- Measurements
  - Receiver microphone at every workstation
  - Source at each workstation sequentially
  - Measurements of all source-receiver transfer function combinations
  - Measurement of reverberation time
  - Binaural recordings on 6 workstations
- Simulations
  - Odeon room acoustic modelling of the office
  - Reverberation time tuned to measurement by adjusting surface absorption
  - Simulation of acoustical treatments using various screen heights **H**: 110 cm, 140 cm, 170 cm
  - Screens are separating every workstation within a desk island
  - Impulse responses within the 'treated' offices are calculated to implement listening test

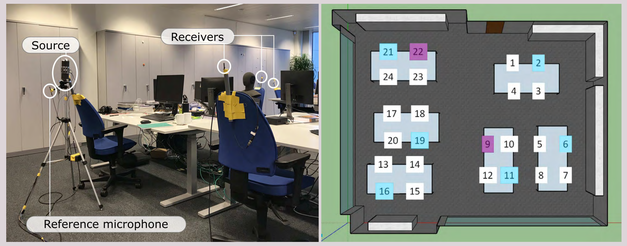



*Figure 2.1: Photo of the measurement campaign (left) and office's floor plan (right)*

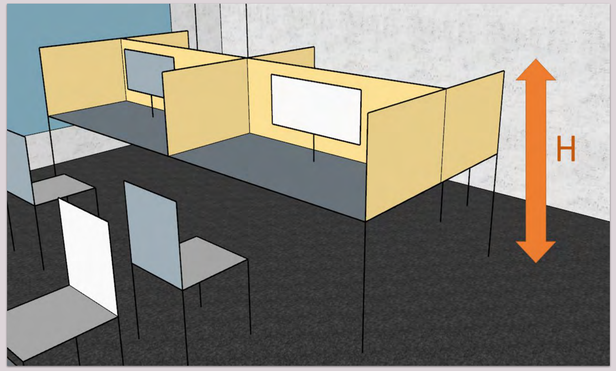



*Figure 2.2: View of simulated separating screens of height H = 140 cm*

## 3. Listening test

- Test layout
  - AB testing of acoustic annoyance (no reference)
  - 72 stimuli (2 receiver positions, 6 sources, 4 screen scenarios)
    - All unordered pairs without repetition
    - Binaural auralization of Harvard speech corpus (single speaker, gender balanced)
  - Comparison between screen heights
    - 6 pairs of screens (eg.110-140cm, 110-170cm)
- Participants and procedure
  - 29 participants in the analysis (5 female, 24 male, age = 34.6+/-9.5 years)
  - Web-based listening test (BeaqleJS, http://lab2.ta.chalmers.se:9035/)
- Hypothesis
  - "The responses of the listening test will vary with respect to stimuli based on different screen heights"
- Results
  - For receiver position R22 the participants were more undecidable in comparison to R09
    - Particularly for screen heights 110-140cm
  - Specific source-receiver combinations show more annoyance is perceived for larger screens
    - These are combinations that have diagonal angle of incidence (45 degrees) with the screens or reflections for the wall (eg. R22-S06, R22-S02)

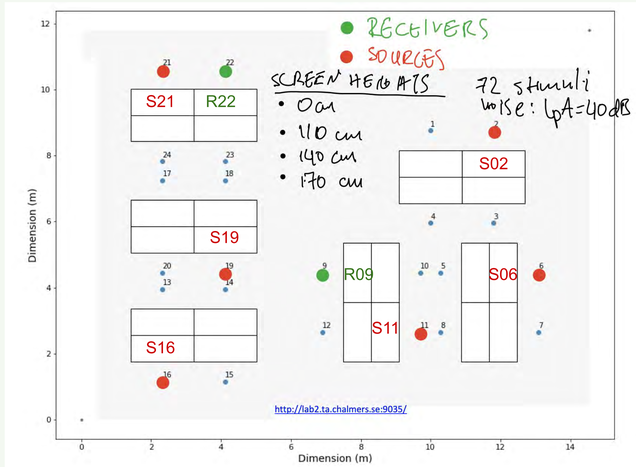
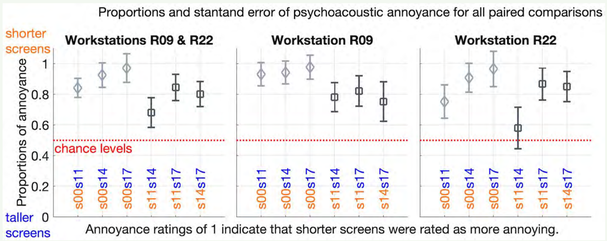



*Figure 3.1: Master plan of workstations & source-receiver positions*

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