

A unique field experiment to assess the noise annoyance caused by maglev trains



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1. Introduction

2. Experiment

3. Results

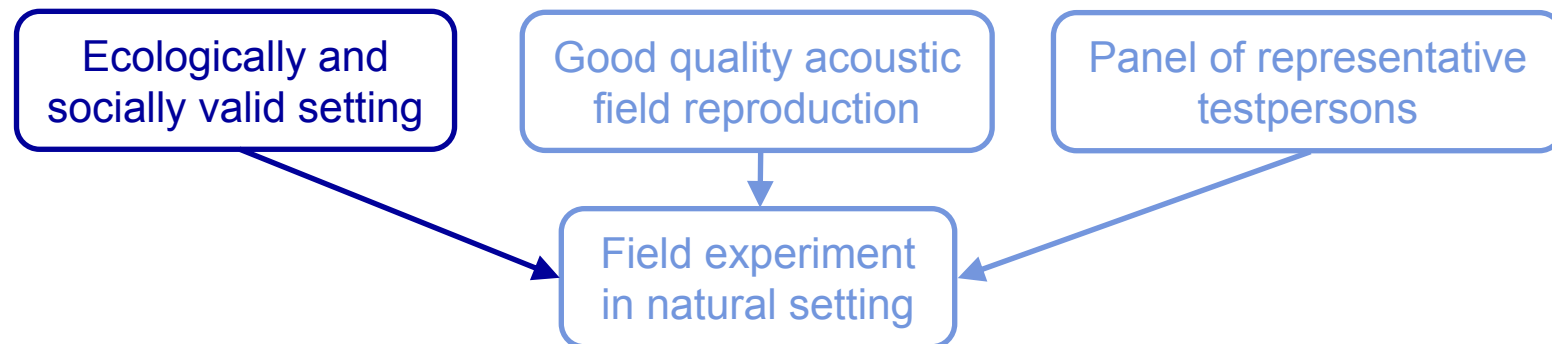
4. Conclusion



- Transportation noise annoyance
 - Trains \neq highway traffic
 - Railway bonus for L_{Aeq}
- Valid for high-speed trains & maglev trains?
 - Vos (2004), Neugebauer et al. (1997), Fastl et al. (1996)
- Questions raised
 - Short samples used (45s) \rightarrow temporal effect obscured
 - Small testperson panel \rightarrow representativity
 - Nonacoustical factors (e.g. noise sensitivity) not taken into account
- The experiment presented
 - Conducted in a realistic setting (holiday cottage)
 - Exposure to longer fragments of sound + quiet periods
 - Traffic noise reproduced in ecologically valid way
 - Representative panellists selected using questionnaire



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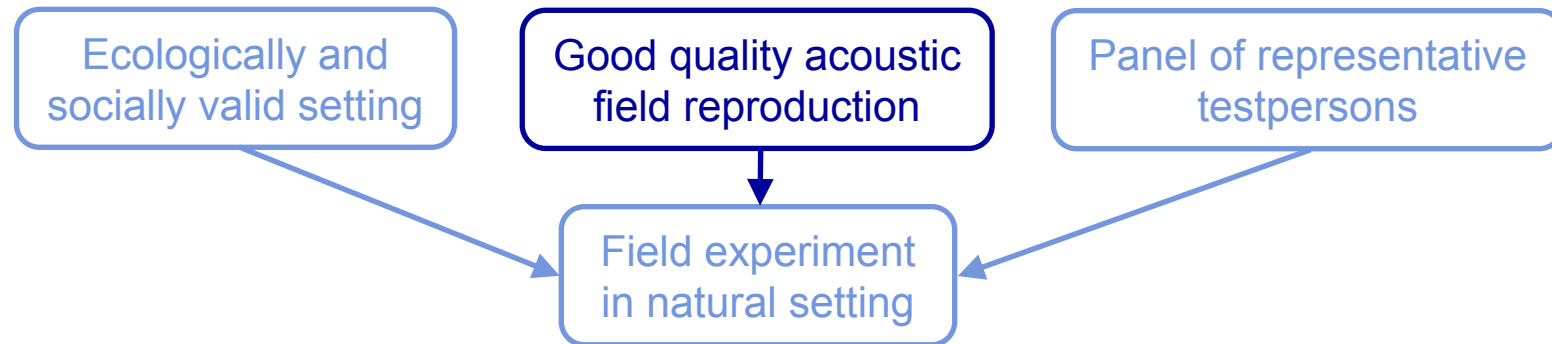
- Natural setting

- Holiday cottage in Westkapelle (Zeeland, The Netherlands)
- Quiet environment
- Subgroups of panellists seated in living room
- Reading magazine, light conversation, something to drink





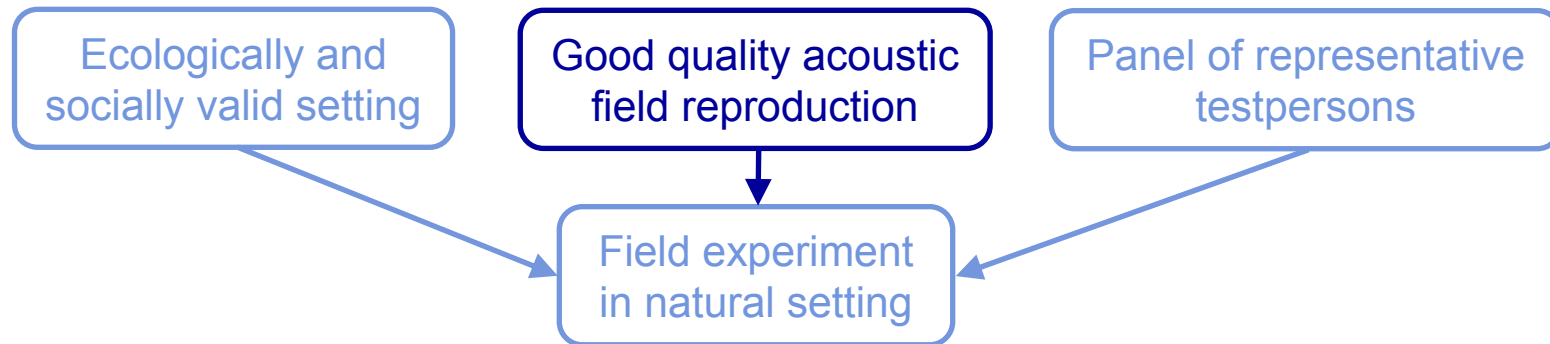
Experiment



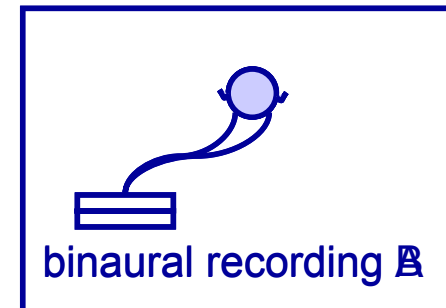
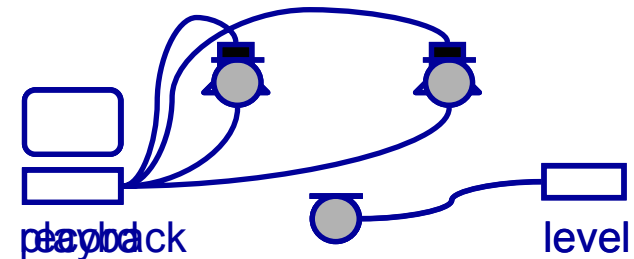
- Sound reproduction objectives
 - Realistic indoor 3D sound of outdoor pass-by sources
 - Preserve natural feeling inside experiment room

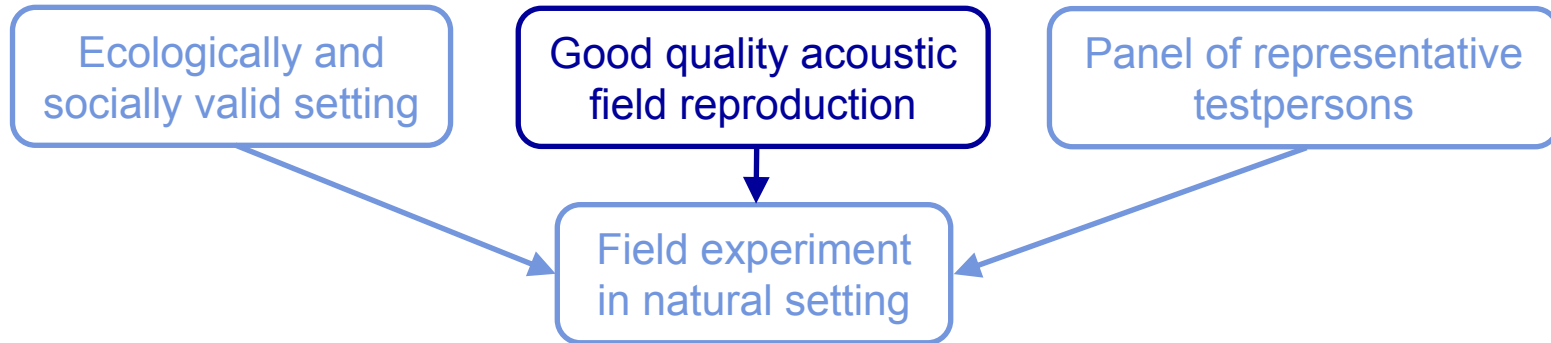


Experiment

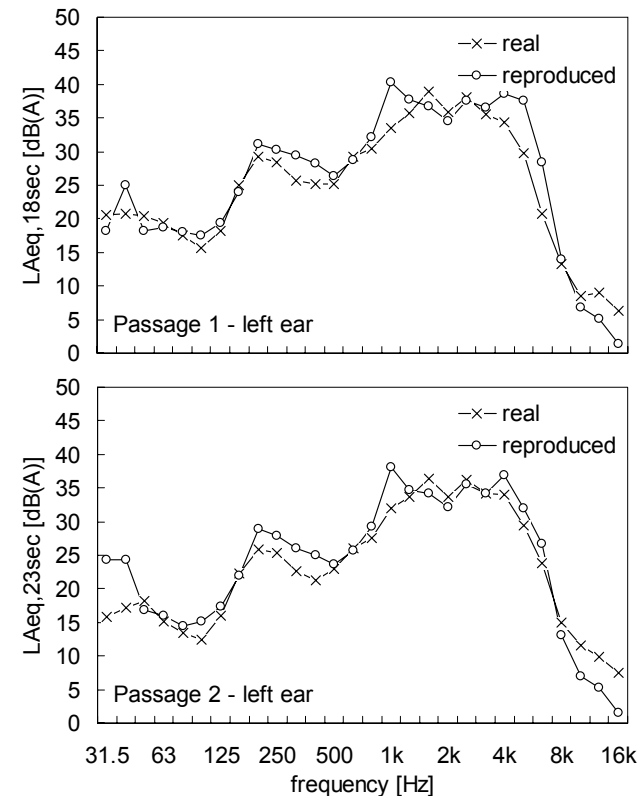


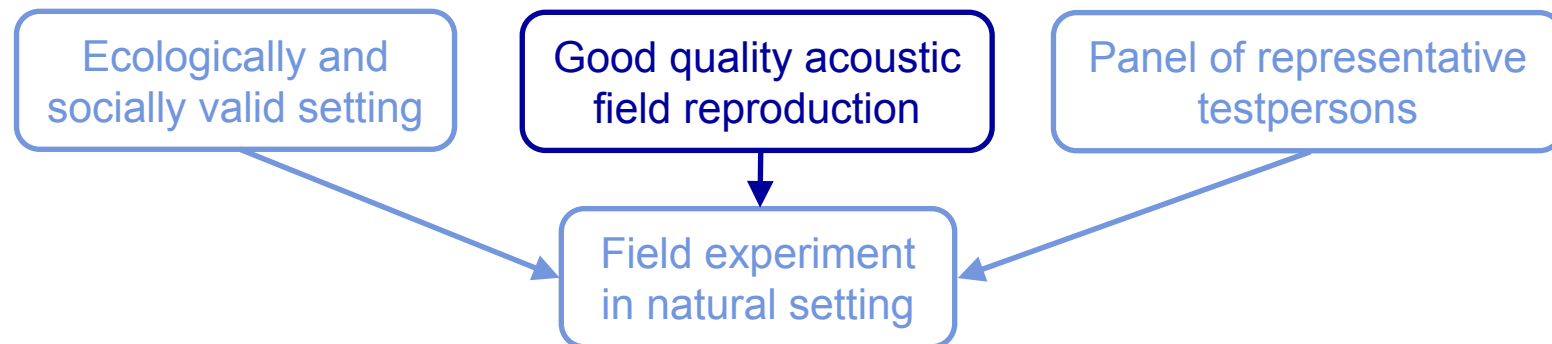
- Sound reproduction objectives
- Methodology and validation
 - Assumption: 2-channel recording
 - Checked for low speed trains at short distance: 2 phases
 - Ideally: $A = B$





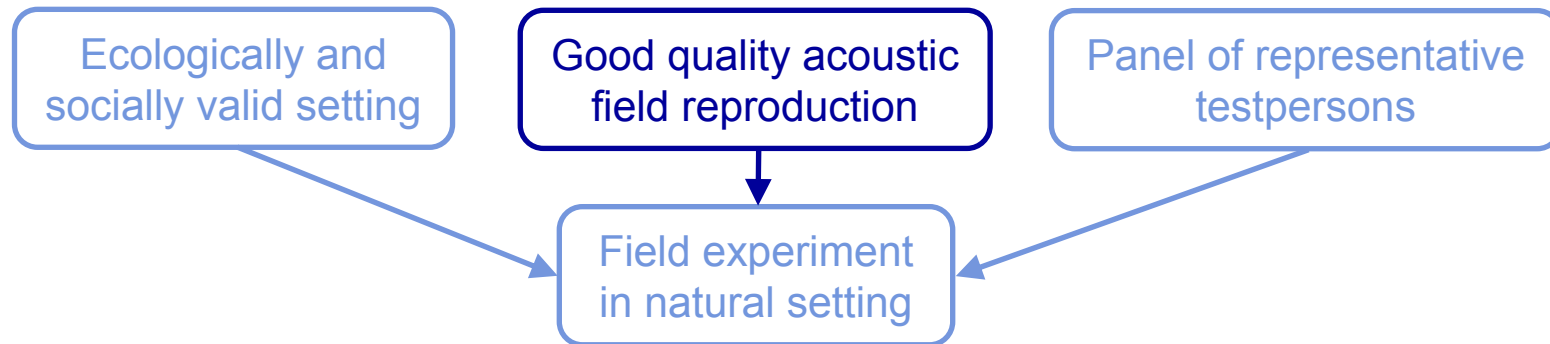
- Sound reproduction objectives
- Methodology and validation
 - Assumption: 2-channel recording
 - Checked for low speed trains at short distance: 2 phases
 - Ideally: $A = B$
 - Error within 5 dB in each tertsband
 - Low frequency



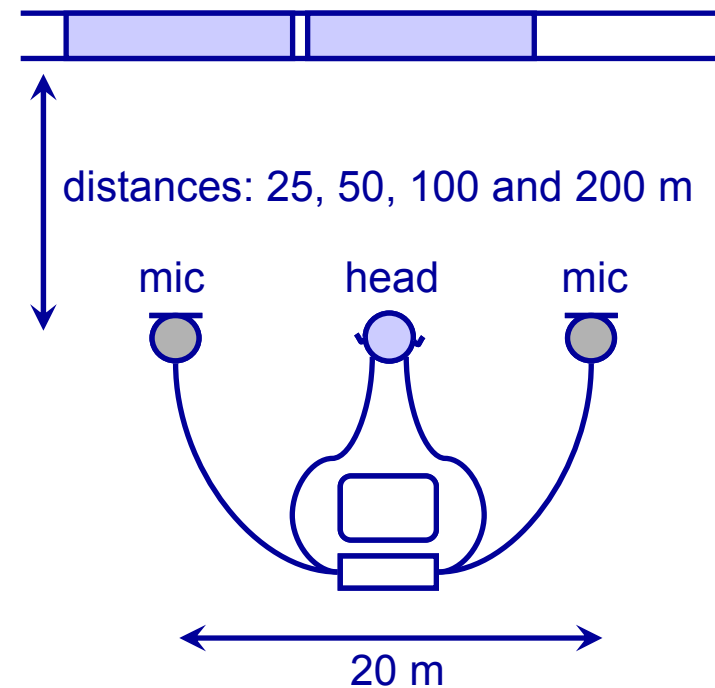


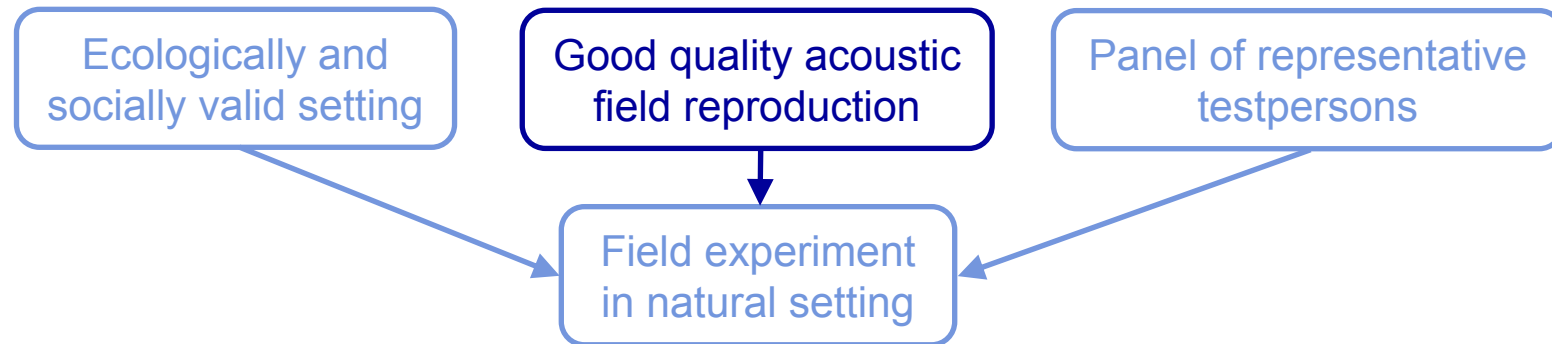
- Sound reproduction objectives
- Methodology and validation
- Reproduction setup
 - 2 loudspeakers + subwoofer in front of slightly opened window
 - Played on PC, equalized (31 bands) and amplified
 - Façade level + indoor soundfield
 - No visual presentation





- Sound reproduction objectives
- Methodology and validation
- Reproduction setup
- Sample collection



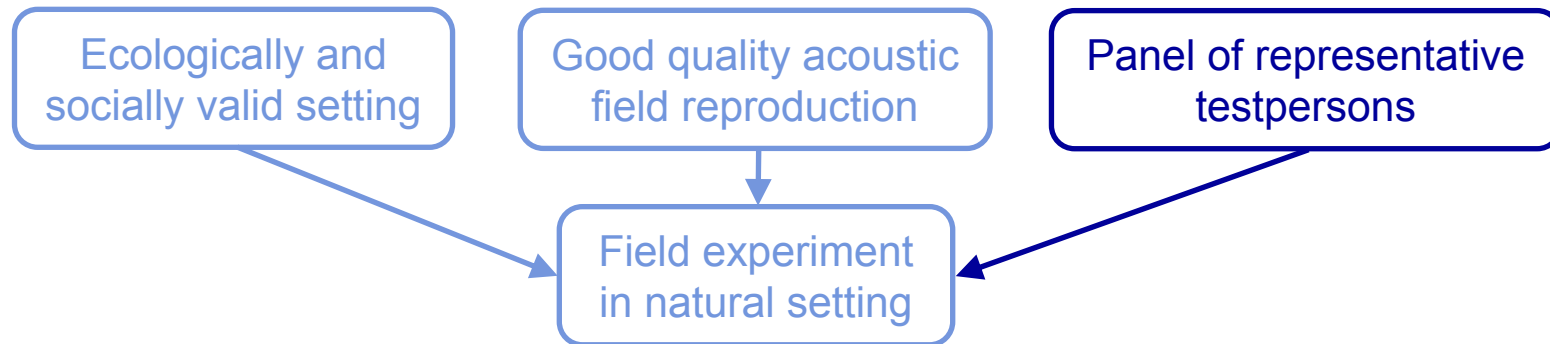


- Sound reproduction objectives
- Methodology and validation
- Reproduction setup
- Sample collection
 - IC: 140 km/h
 - TGV: 140 & 300 km/h
 - Maglev: 200, 300 & 400 km/h
 - Highway: free flow
- 45-sec passage fragments cut



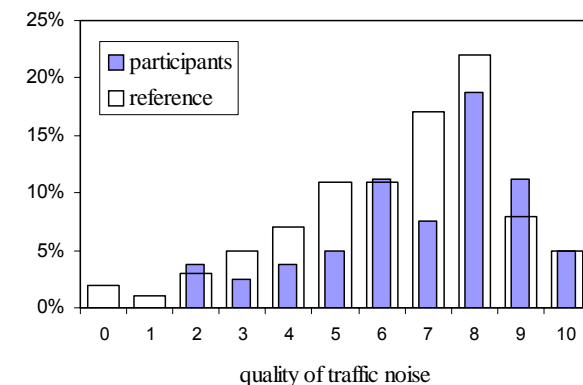
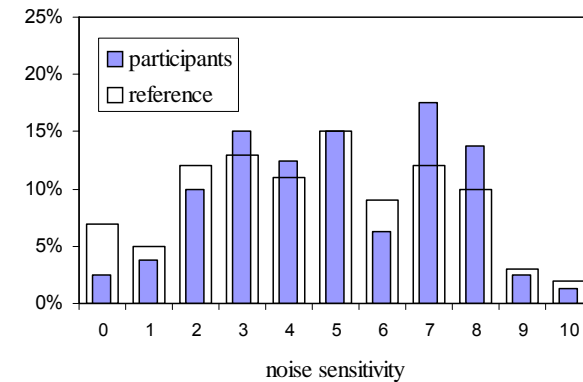


Experiment



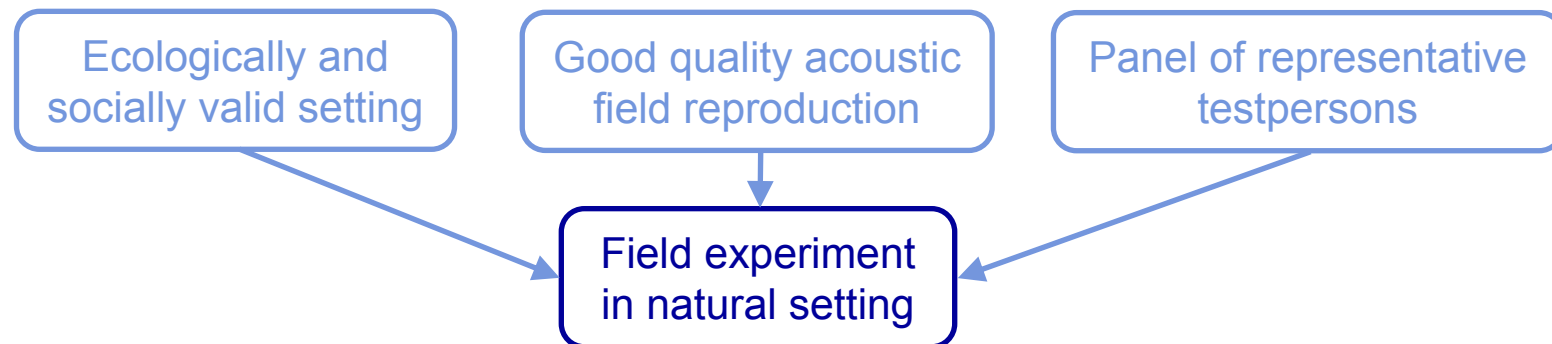
• Selection of panellists

- Questionnaire to 1500 people in neighbourhood of testhouse
- Representative structure Dutch population
 - RIVM environmental noise survey
 - Eurobarometer questionnaire
- Drawing 100 out of 255 replies
 - Age & hearing ability
 - Disimilarity using binary coding
 - Fuzzy resemblance Dutch person





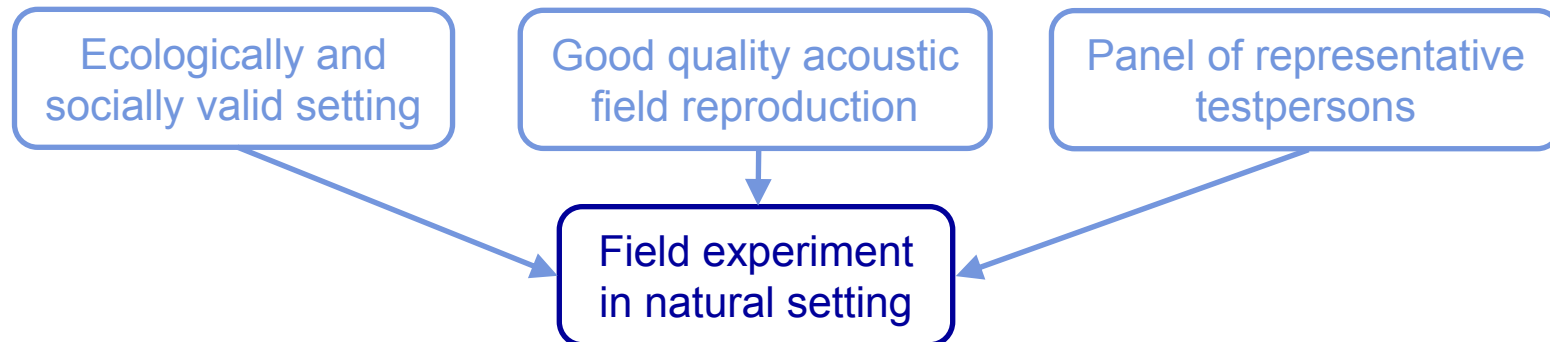
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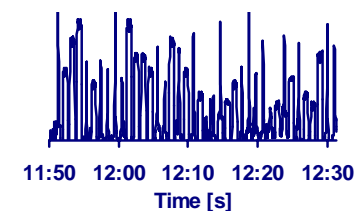
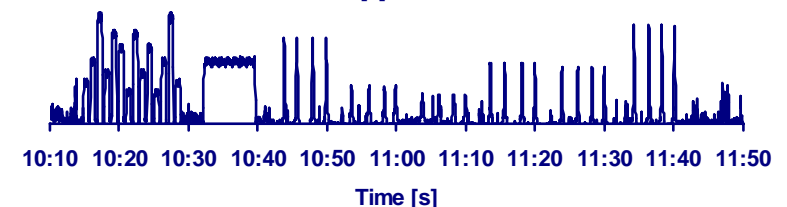
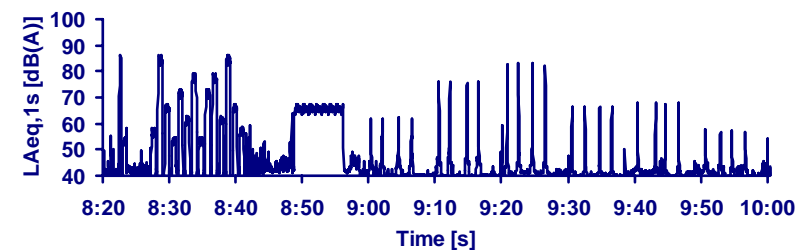
- Listening test menus
 - Longer exposure → 10 minutes
 - Called “menu”
 - Consists of
 - 2 passages of same train
 - 4 passages of same train
 - 8 minutes continuous highway noise
 - Scaling context for panellists:
 - 7 reference 45-sec fragments
 - Produced of highway noise at 50 m
 - Scaled up and down + spectral



Experiment

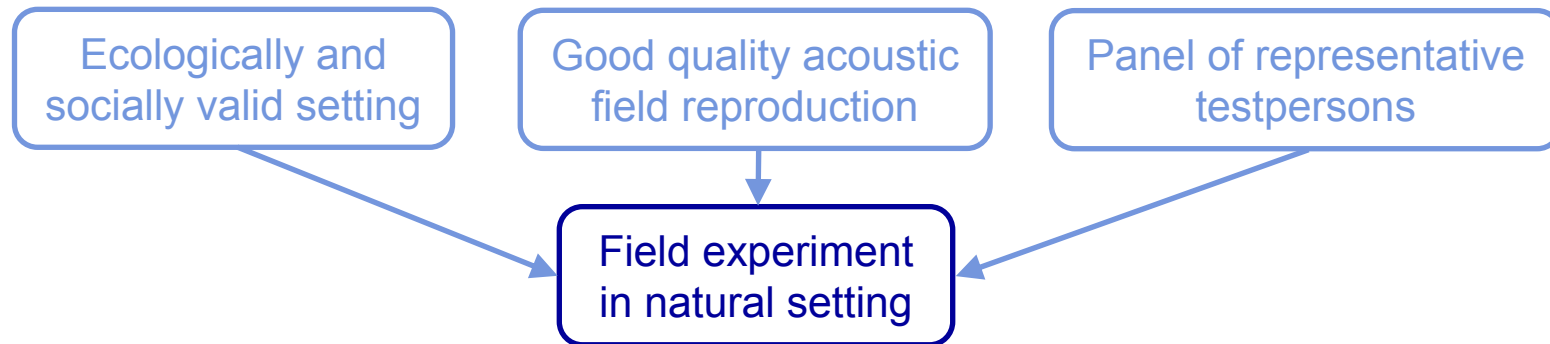


- Listening test menus
- Outline test
 - ± 5 panellists / session
 - Session façade level
 - 14 minute training session
 - 7 menus of 10 minutes IC/TGV or Maglev
 - 14 minute training session
 - 7 menus of 10 minutes Maglev or IC/TGV
 - Conventional listening test

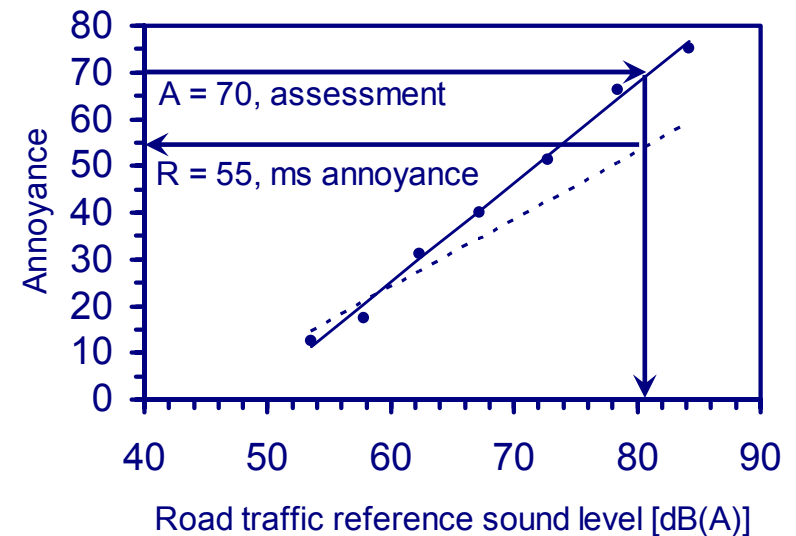




Experiment



- Listening test menus
- Outline test
- Perceived noise annoyance
 - Free number estimation
 - Master scaling

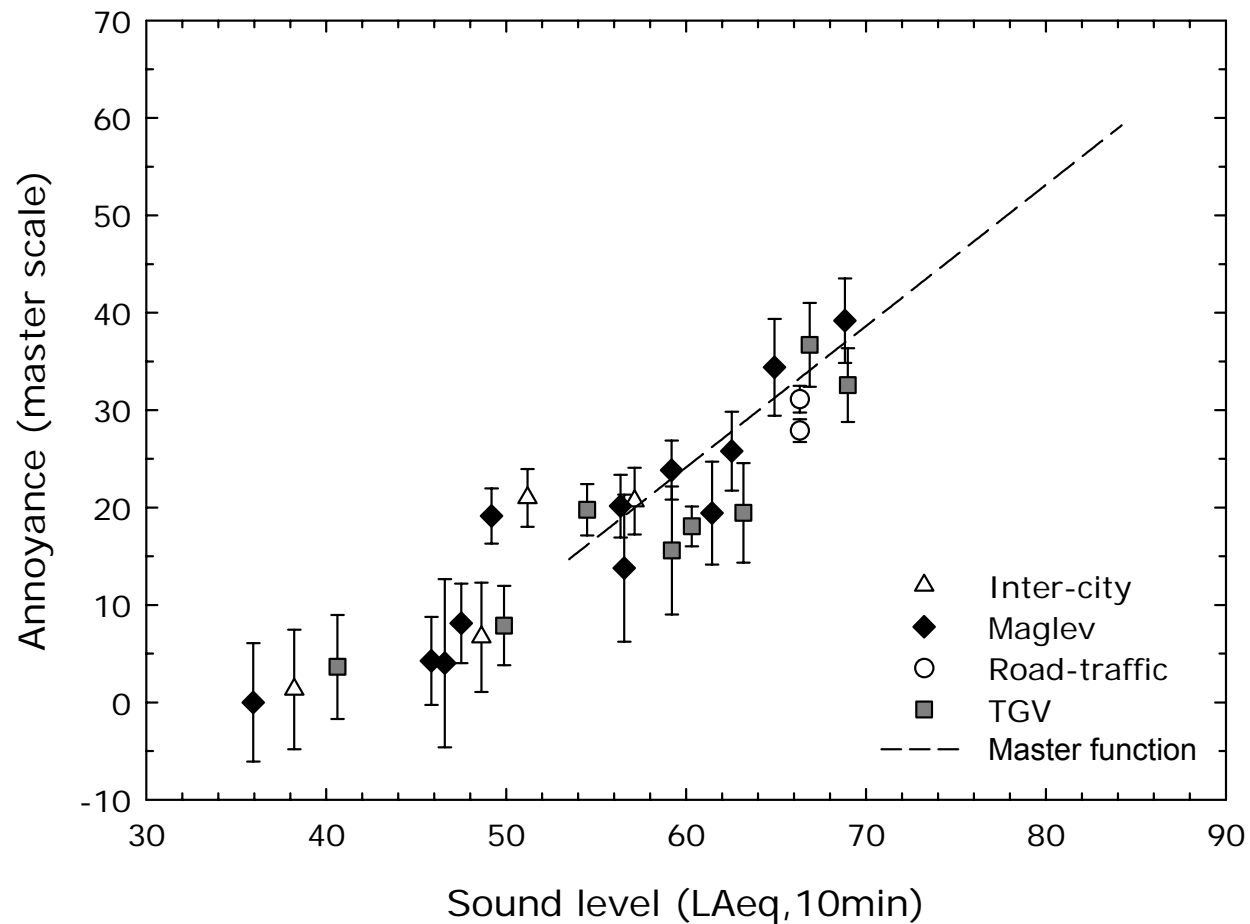




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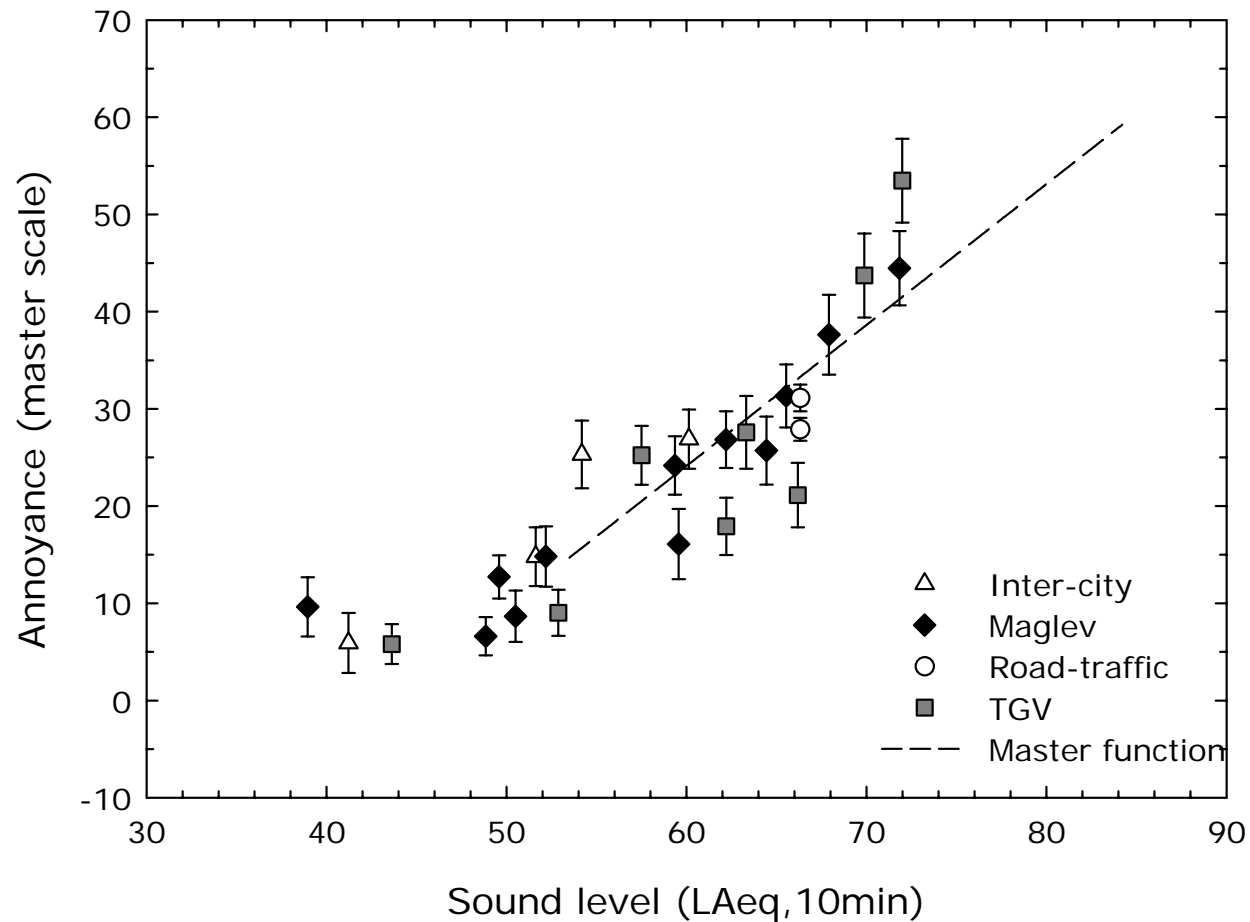
- Average master scaled annoyance vs $L_{Aeq,10min}$

2 events / 10 minutes



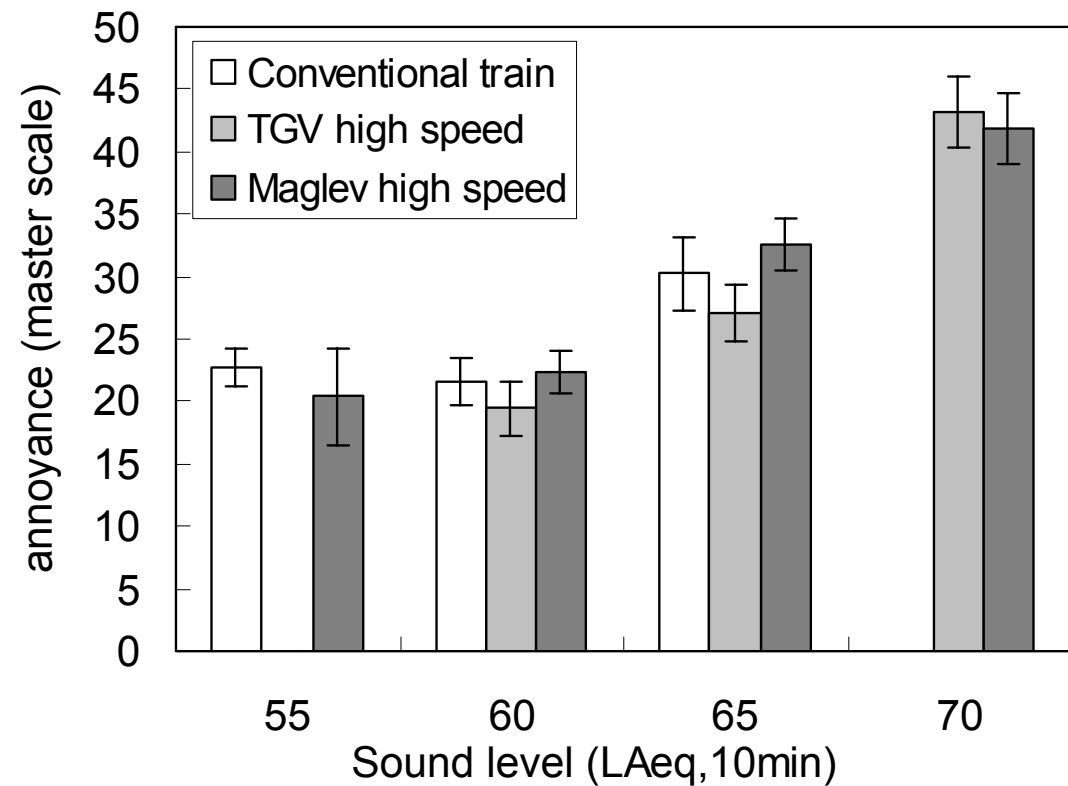
- Average master scaled annoyance vs $L_{Aeq,10min}$

4 events / 10 minutes

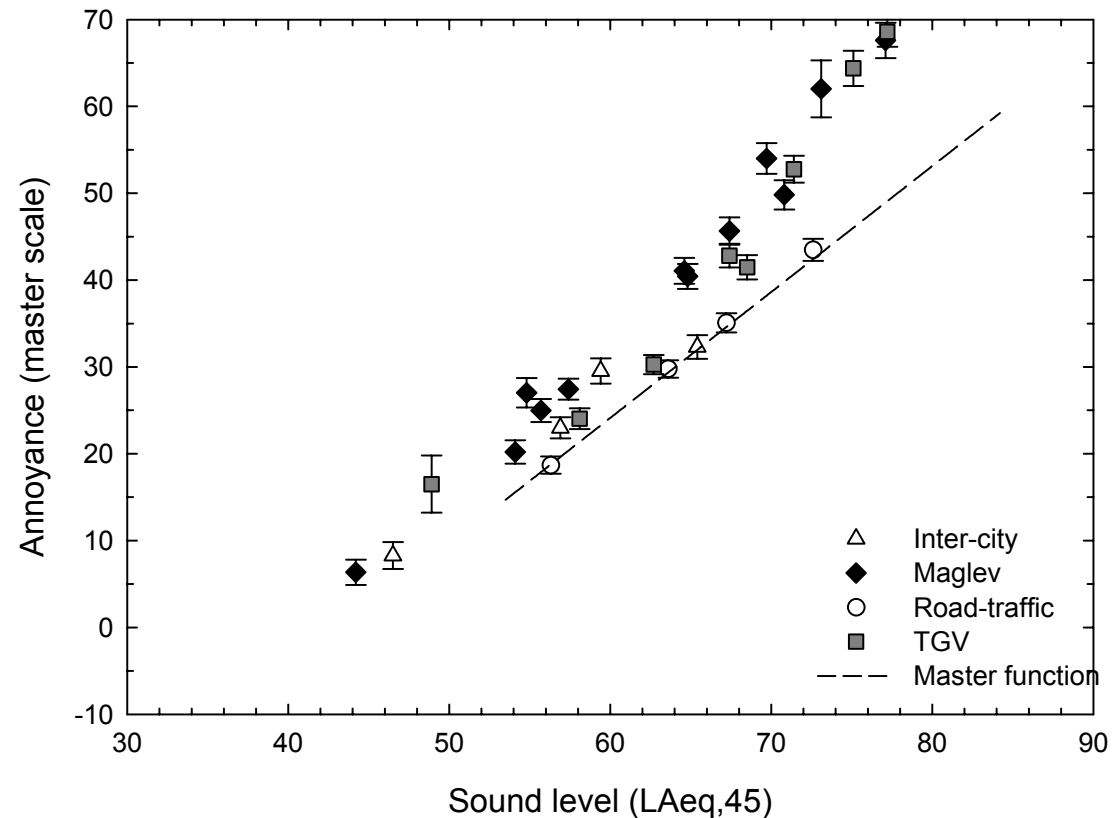


- Average master scaled annoyance vs $L_{Aeq,10min}$

- $L_{Aeq} < 65$ dB(A):
 - Maglev ~ IC
- $L_{Aeq} > 60$ dB(A):
 - Maglev ~ TGV
- 55 dB(A) → 65 dB(A):
 - Annoyance↓ [T,v,d]

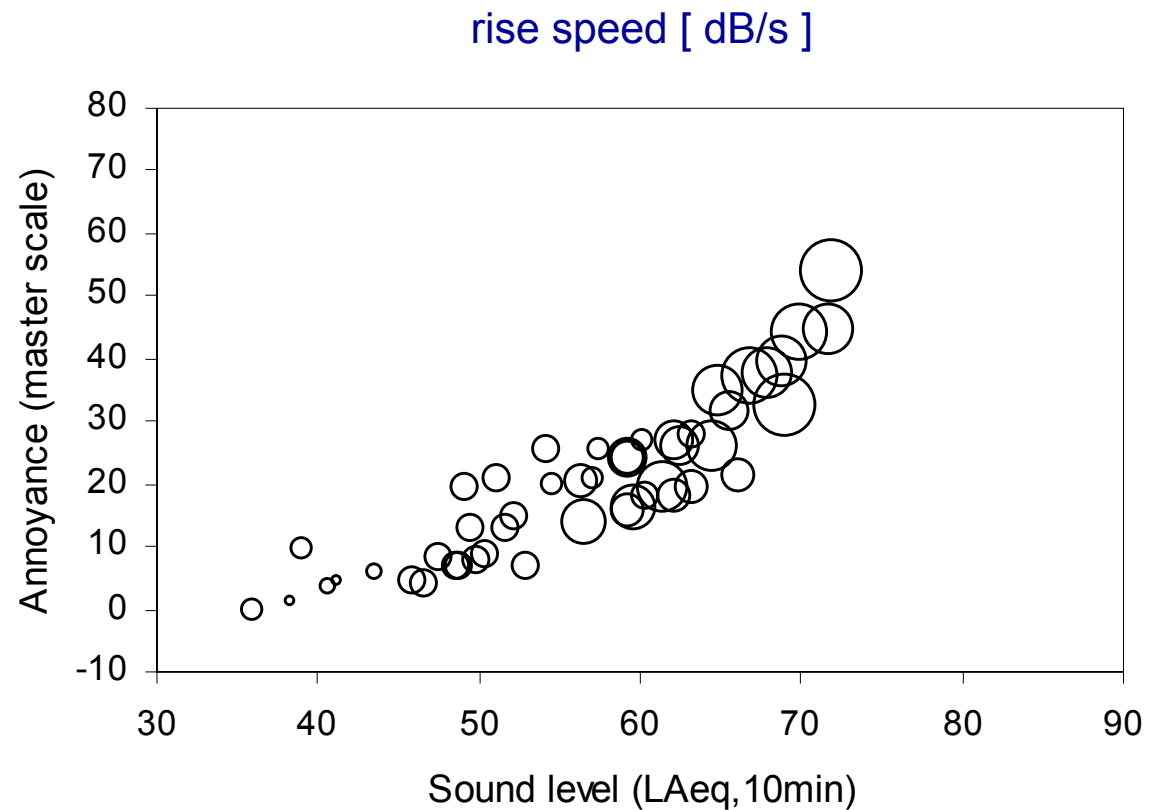


- Average master scaled annoyance vs $L_{Aeq,45sec}$
- Assess loudness rather than annoyance
- Train passage at least as annoying as 45-sec highway
- $L_{Aeq} > 60$ dB(A):
 - Maglev + TGV hs > TGV ls + IC
- $L_{Aeq} > 65$ dB(A):
 - Maglev ~ TGV



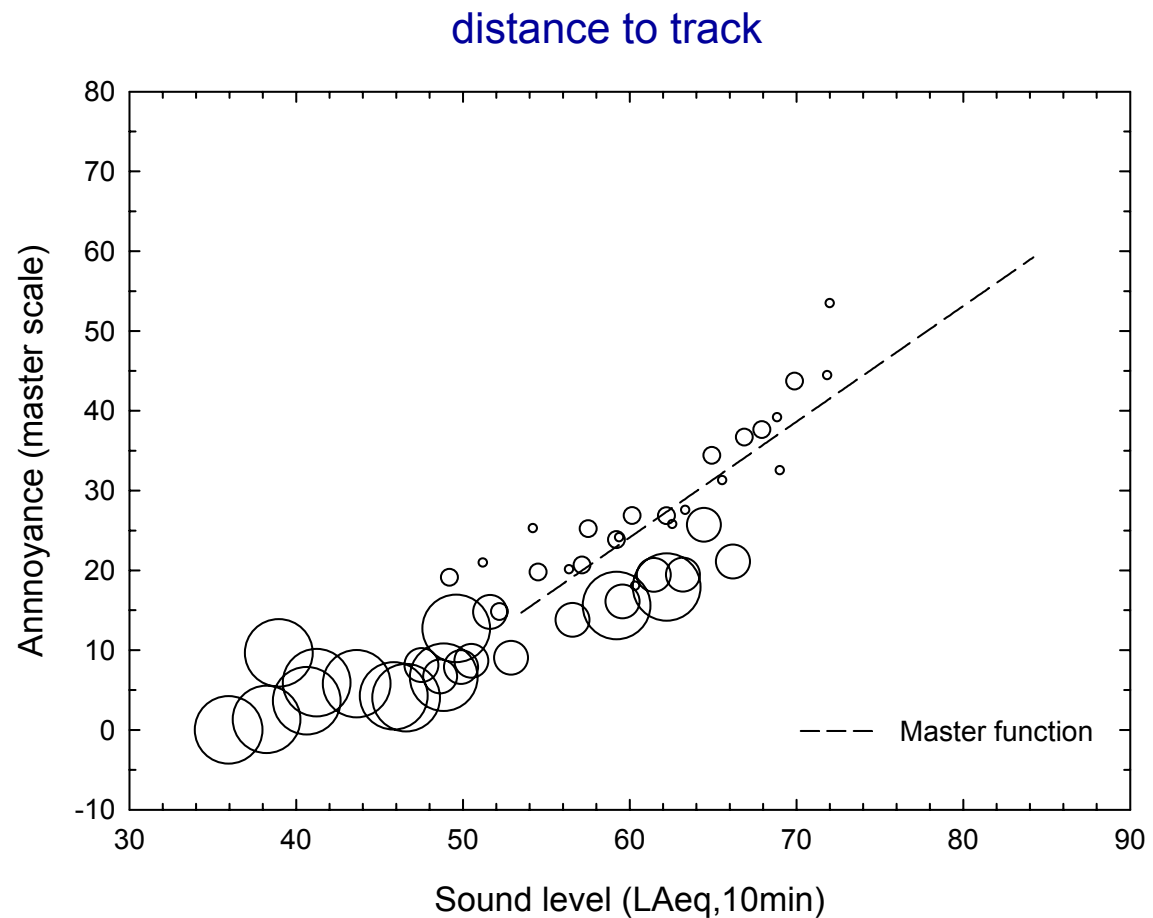
- Average master scaled annoyance vs $L_{Aeq,10min}$

- Upward bending may be explained by rise time



- Average master scaled annoyance vs $L_{Aeq,10min}$

- Annoyance less for trains passing at large distance





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Conclusion

- In “at home like” context, noise annoyance of \neq types of trains at the same façade level is not significantly different
 - LAeq < 65 dB(A): Maglev ~ IC
 - LAeq > 60 dB(A): Maglev ~ high speed TGV
- Railway bonus not observed for distances < 100 m