



estimation of numbers of people affected by traffic noise at home and in parks

Stockholm, Dec 11, 2012

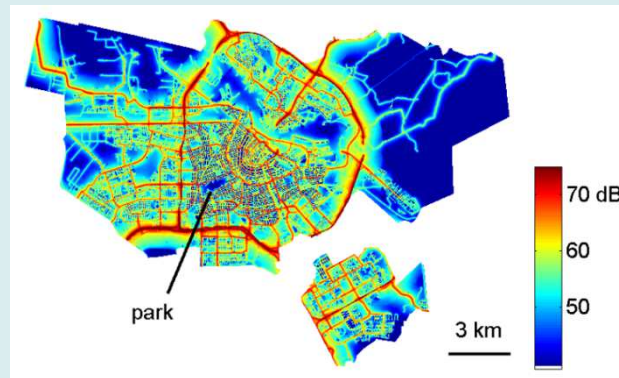
**Erik Salomons
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CityHush



noise maps

traffic data → traffic noise levels → annoyance



how many people are annoyed at home?

how many people are annoyed in parks?

decibels in Amsterdam





decibels in New York

CityHush project – TNO contribution

two methods - effects of traffic noise

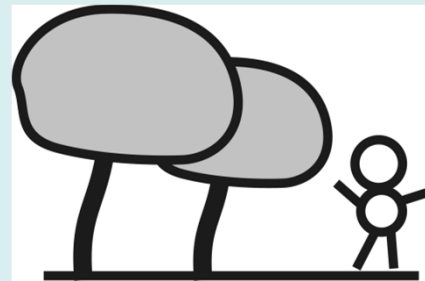
annoyance at home



refined method

based on literature

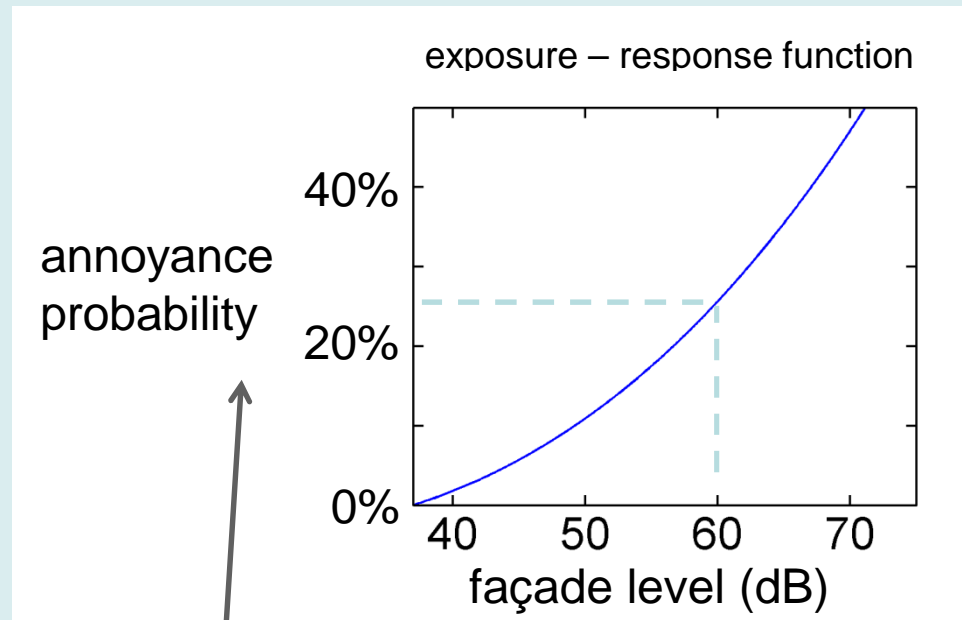
effects in parks



new method

based on
experiment in park in Delft

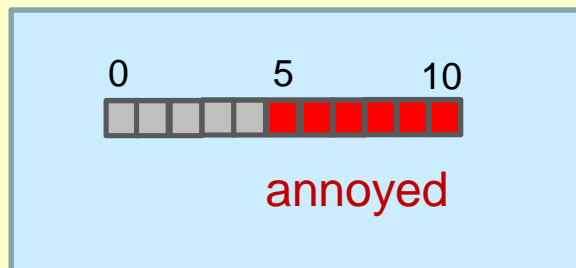
annoyance at home



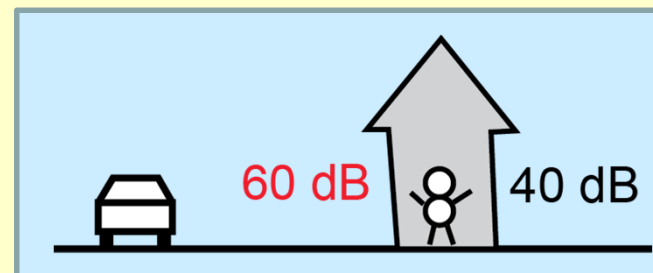
application
Amsterdam population
10% is annoyed

many noise surveys

annoyance scores

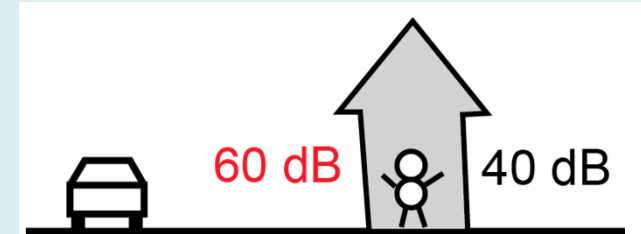


highest façade noise levels



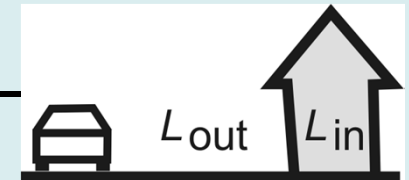
annoyance at home

basic estimate **highest** façade noise level



refinement

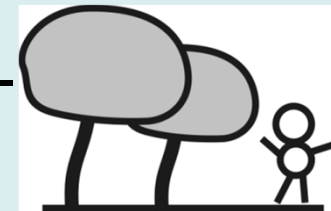
- façade insulation



- quiet façade



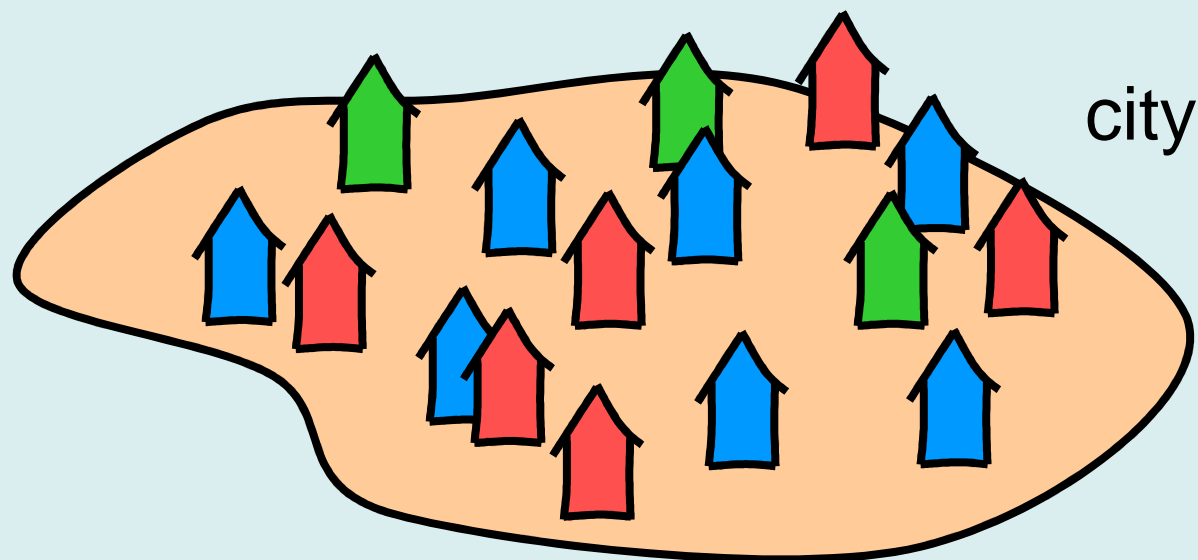
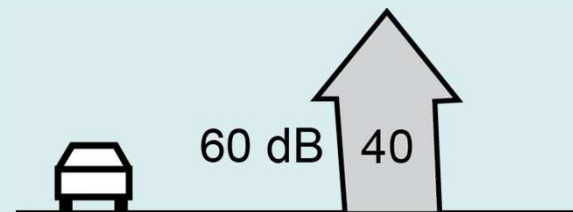
- quiet areas in neighborhood



- low frequency noise (trucks)
- noise fluctuations

annoyance at home

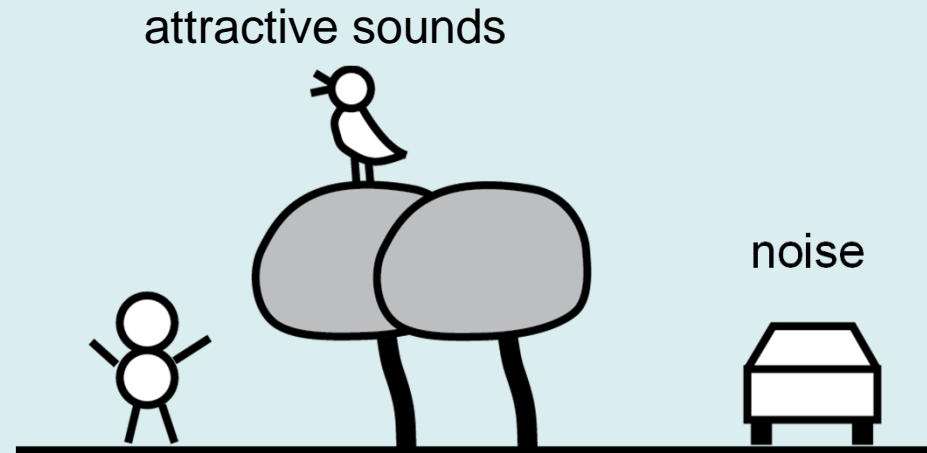
average insulation 20 dB



insulation	30 dB	20 dB	10 dB
annoyance	less	average	more
	15%	25%	40%

effects in parks

traffic noise annoyance
overall sound environment



Swedish study 2006



city parks, 55 dB

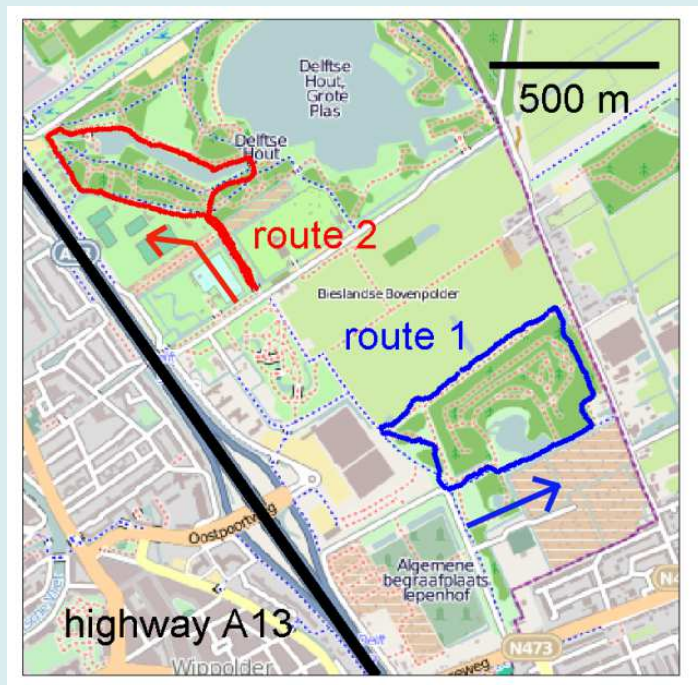
suburban parks, 45 dB

60% rate sound environment as good

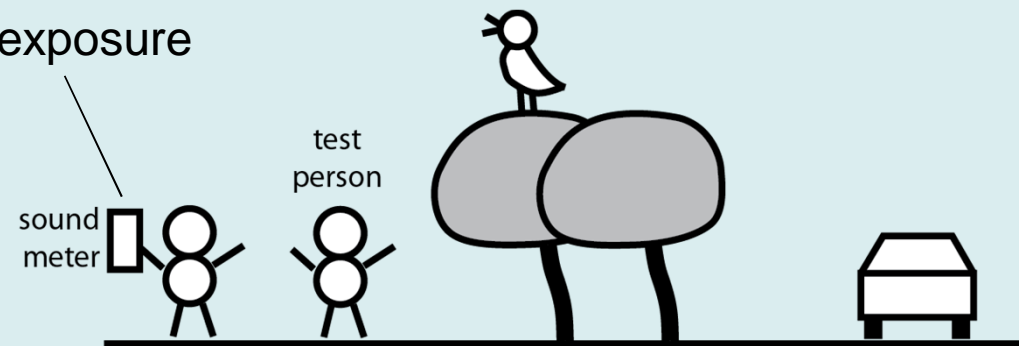
90% rate sound environment as good

effects in parks

park in Delft, 52 test persons



noise exposure

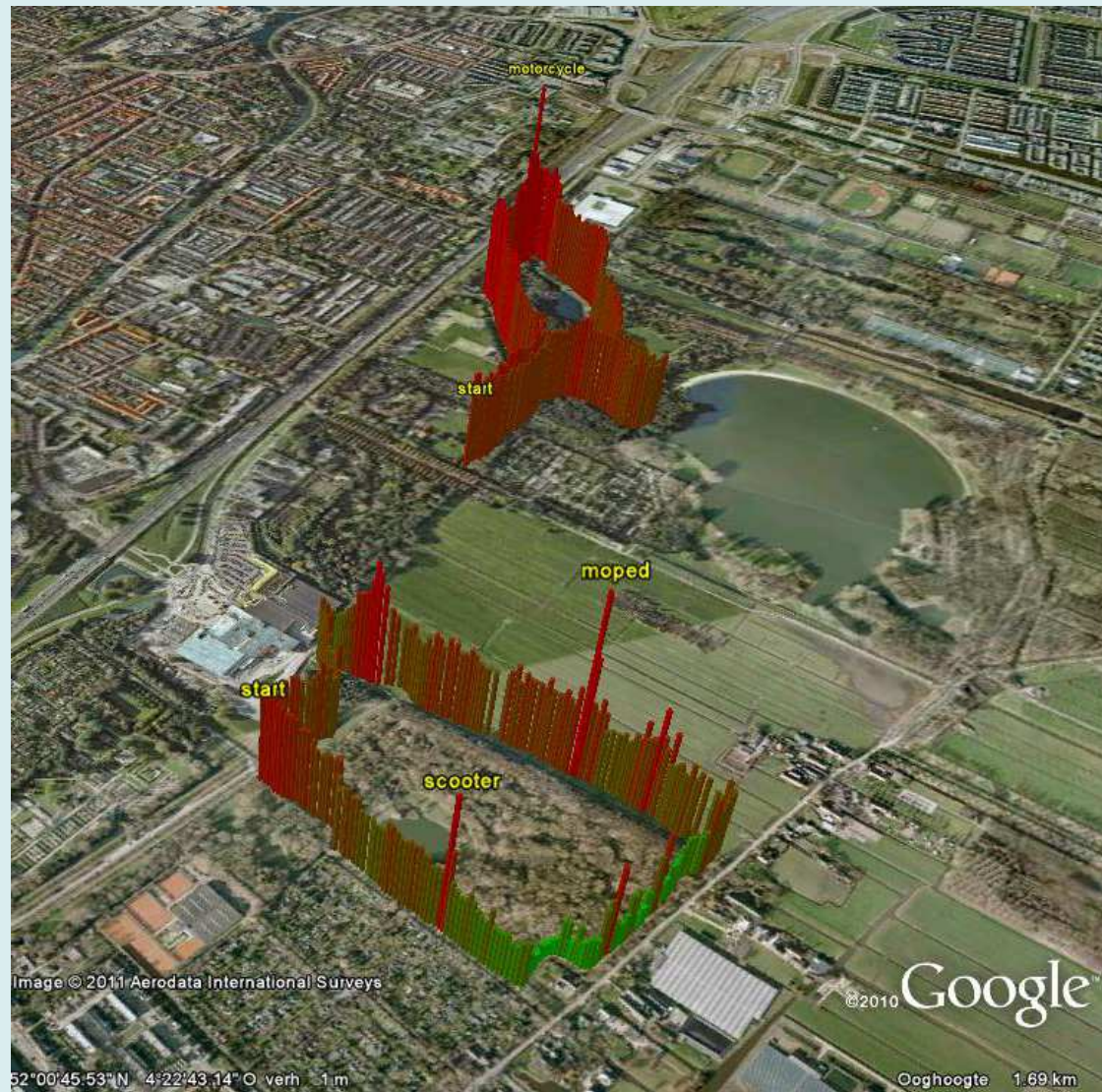


heart rate, blood pressure (no effects)

questions

- traffic noise annoyance
- overall sound environment

effects in parks

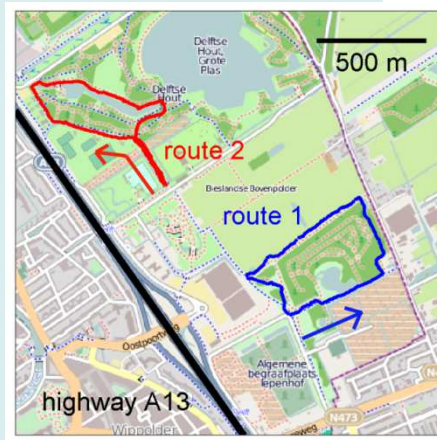


50

60

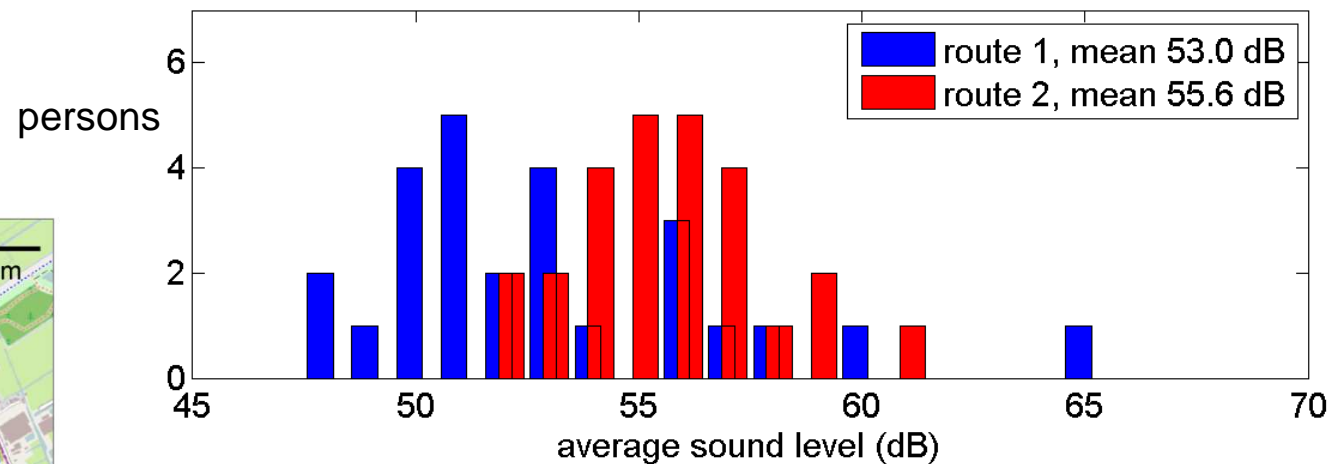
70 decibel

effects in parks



10 000 cars per hour → 50 dB

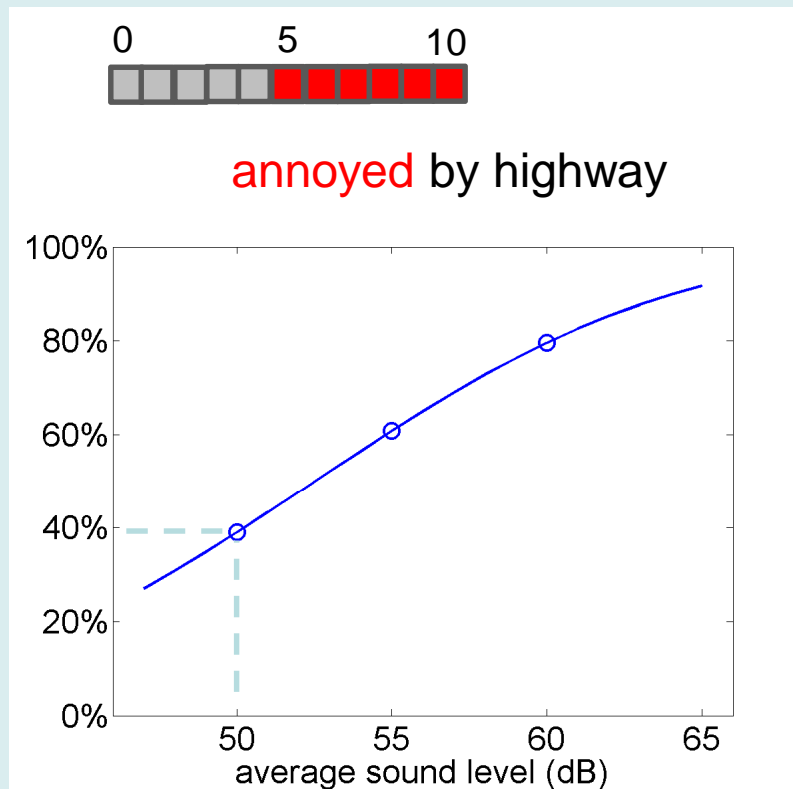
individual noise levels



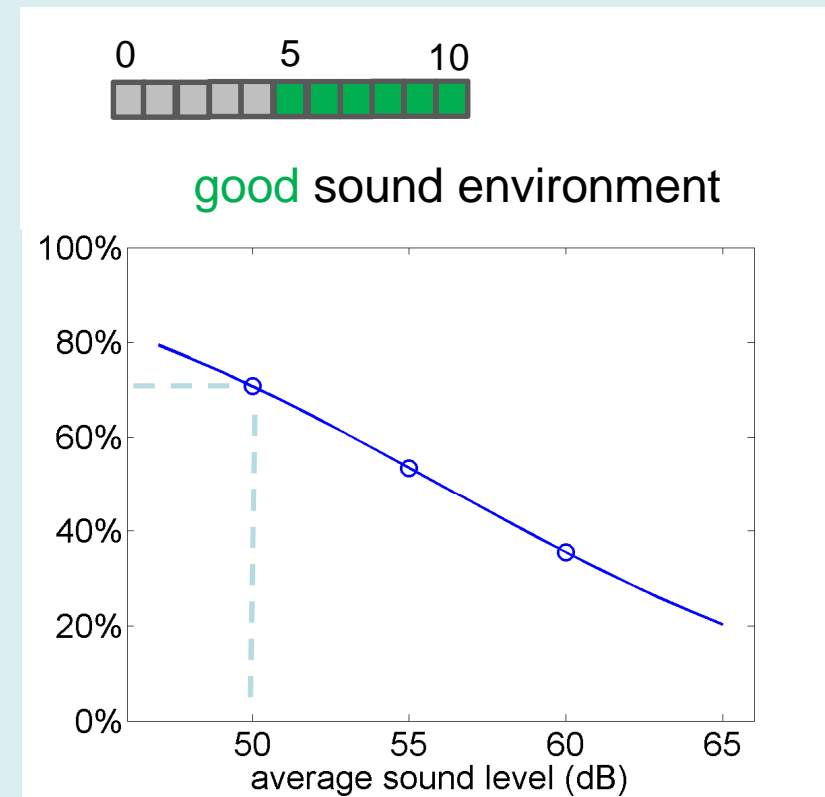
sound level variations

- traffic variations
- wind direction
- local sources (people, mopeds, birds)

effects in parks



at 50 dB: 40% is **annoyed** by highway



70% says sound environment is **good**

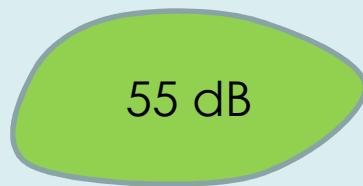
effects in parks

1. acceptable in city park

50 dB +++

55 dB +

2. annoyed park visitors



1000 visitors per day → 600 annoyed

conclusions

two methods - effects of traffic noise

annoyance at home

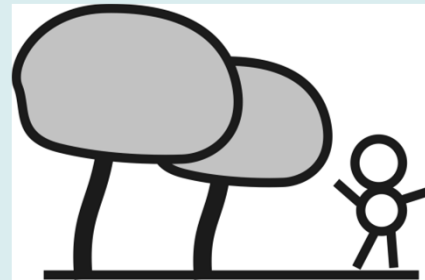


refined method

façade insulation
quiet façade

...

effects in parks



new method

acceptable traffic noise levels in park

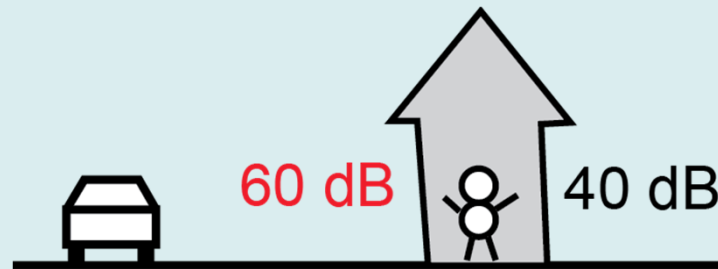
backup sheets

traffic noise at home – façade noise level

annoyance predictor

highest façade noise level

$$L_{\max} = 60 \text{ dB}$$



averaging over time

day-evening-night façade level

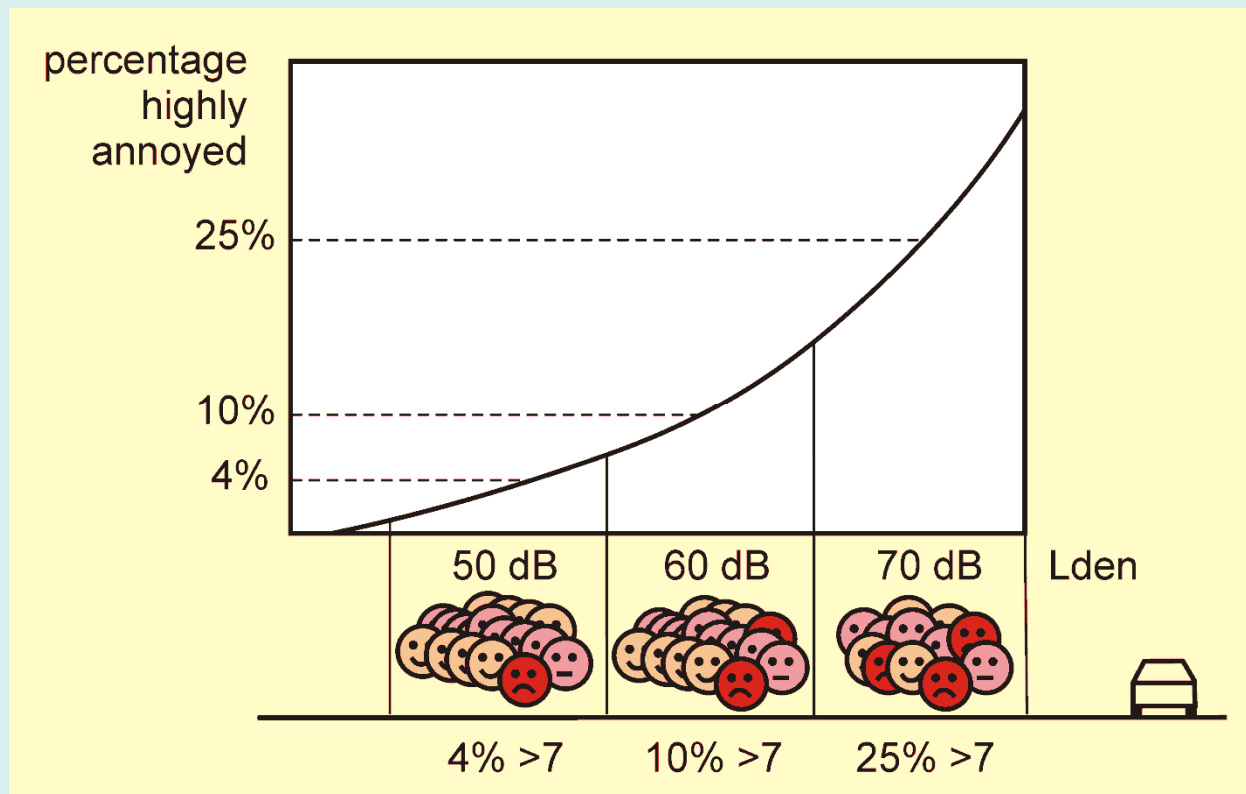
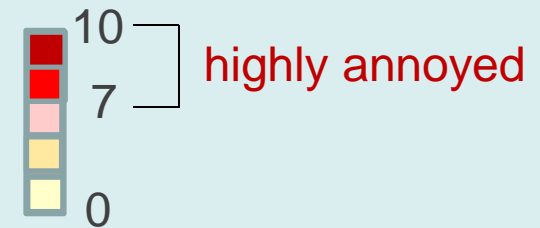
L_{den}

day (7-19h)	0 dB penalty
evening (19-23h)	5 dB penalty
night (23-7h)	10 dB penalty

traffic noise at home – annoyance prediction

many noise surveys

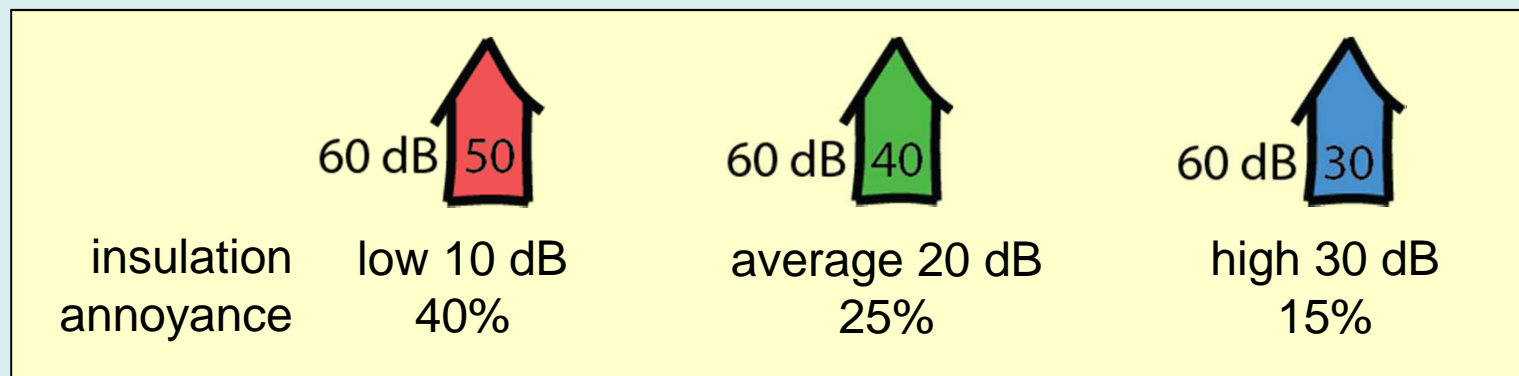
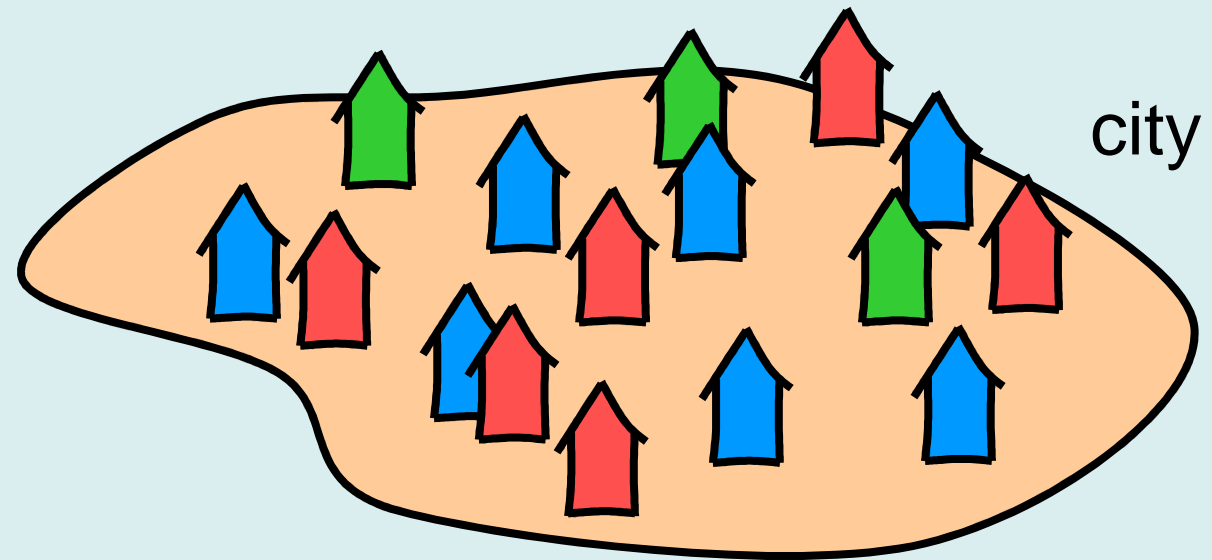
how annoyed are you on a 0 – 10 scale?



application

6% of Amsterdam population is highly annoyed

annoyance at home



agrees with study Norway

