


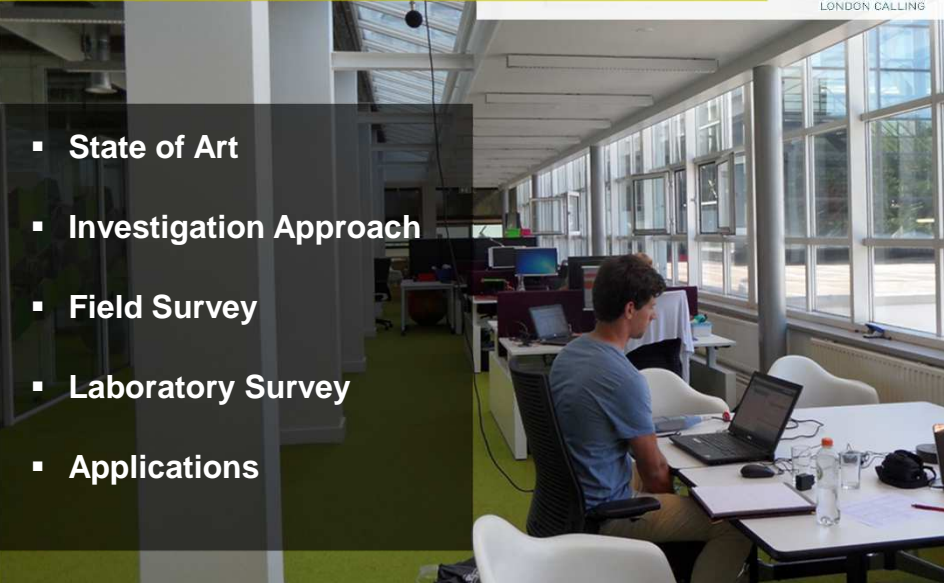


Proposed method for measuring 'LIVELINESS' in open plan offices

Designing an acoustic communication tool

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Content

- State of Art
- Investigation Approach
- Field Survey
- Laboratory Survey
- Applications

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State of Art

Psychological Factors

- state of mind
Oseland and Hodsman 2015
- sound sensitivity
Ellermeier and Zimmer 1997, Venetjoki, Kaarlela-Tuomaala, Keskinen and Hongisto 2006




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State of Art

Sound Levels

- high increase of **dissatisfaction** with higher sound levels (4 – 68%)
Witterseh, Wyon and Clausen 2004
- only little loss of **productivity** (2-3%),
Haaka, Haakpakangas, Keranen, Hakala, Keskinen and Hongisto 2009
Oseland and Hodsman 2015

The effect of **habituation** and **soundmasking**

Dutch writer Simon Vestdijk is known to work with the sound of his vacuum cleaner (and earplugs to avoid unexpected sounds)



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State of Art

Distraction

- distraction > signal to noise ratio (SNR)
Chanaud 2008
- high distraction > intelligible speech (STI)
Hongisto 2005, Venetjoki, Kaarlela-Tuomaala, Keskinen and Hongisto 2006



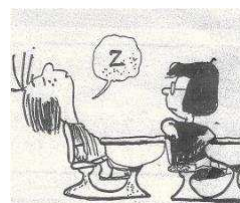
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State of Art

Positive Stimulation

- static noise:
high intelligence > more focus ↔ less intelligent > distraction
Witterseh, Wyon and Clausen 2004
- intelligible speech:
above average intelligence > little effect ↔
below average intelligence > loss of productivity up to 11,5%
Ebissou, Parizet and Chevret 2015

Focus ↔ Distraction



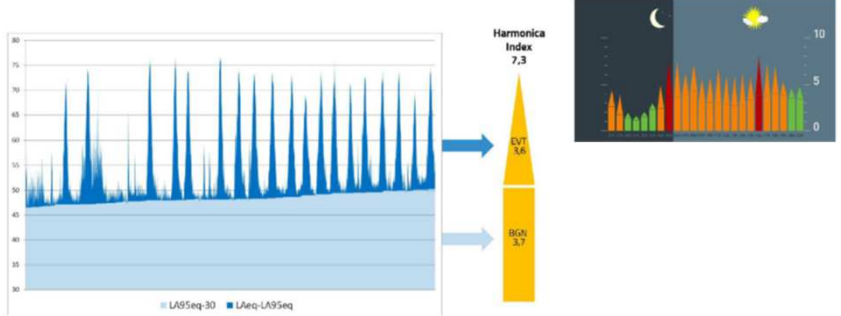
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State of Art

User Feedback

- HARMONICA French/European project > how to communicate acoustics in **understandable language**

Mietlicki, Mietlicki, Ribeiro, Gaudibert and Vincent 2014



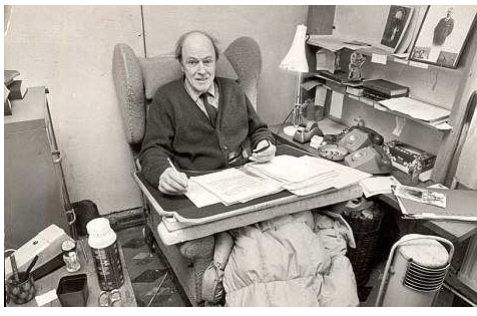
The figure displays acoustic analysis results. On the left, a spectral plot shows LA95eq-30 (light blue) and LAeq-LA95eq (dark blue) levels across a frequency spectrum from 30 to 80 Hz. A yellow bar chart to the right indicates a Harmonica Index of 7.3, with sub-values of 5.6 and 3.7. To the right of the bar chart is a bar graph with a y-axis from 0 to 10, showing frequency components under a night sky with a moon and a sun.

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State of Art

Personal Preference

- **subjective** experience ↔ **objective** assessment




Roald Dahl at work in his cluttered shed: Researchers found that cluttered desks actually help people to focus on the task at hand

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Investigation Approach

- Neutral approach to sound 'LIVELINESS':
4 scales: *quiet – tranquil – lively – turbulent*
(with subscales 1 to 10)
- Field survey: 5 days - 2 acousticians - 5 office locations
designing the algorithm
- Laboratory survey: 16 audiofragments – 3 questionnaires
validating the algorithm



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Field Survey

	5	5.5	6	6.5	7	8	9	10	
	3.5	4	4.5	5	5.5	6.5	7.5	8.5	y4 (Ln) e2
	2	2.5	3	3.5	4	5	6	7	y3 (Ln) d2
	1.5	2	2.5	3	3.5	4.5	5.5	6.5	y2 (Ln) c2
	1	1.5	2	2.5	3	4	5	6	y1 (Ln) b2
<x1 (Leq)	x1 (Leq)	x2 (Leq)	x3 (Leq)	x4 (Leq)	x5 (Leq)	x6 (Leq)	x7 (Leq)	<y1 (Ln)	a2
	a1	b1	c1	d1	e1	f1	g1	h1	

Figure 1: Frame for designing the algorithm for *Liveliness*.


Designing the algorithm

- scale 1-10: combination of $L_{eq, 5min}$ and L_n
- scale LIVELINESS: *quiet – tranquil – lively – turbulent*



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Field Survey



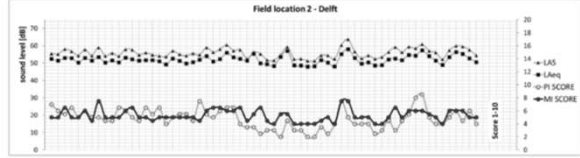


Figure 2A: Field research with 2 acousticians (second location).

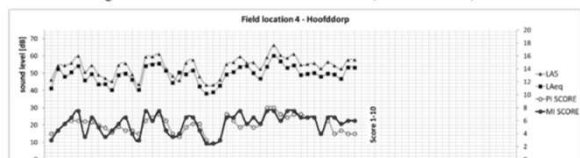


Figure 2B: Field research with 2 acousticians (fourth location).





Figure 2C: Field research with 2 acousticians (fifth location).

Matching PI and MI

- PI: Personal Index
- MI: Mach Index

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Laboratory Survey




Validating the algorithm

- design a questionnaire with preselected audiofragments:

> Welcome to this audio fragment.
I would rate the liveliness of this office environment as

1. QUIET
2. almost quiet
3. more tranquil
4. TRANQUIL
5. almost tranquil
6. almost lively
7. LIVELY
8. more than lively
9. almost turbulent
10. TURBULENT



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Laboratory Survey



Validating the algorithm – part I

- 10 acousticians
- 16 audio fragments

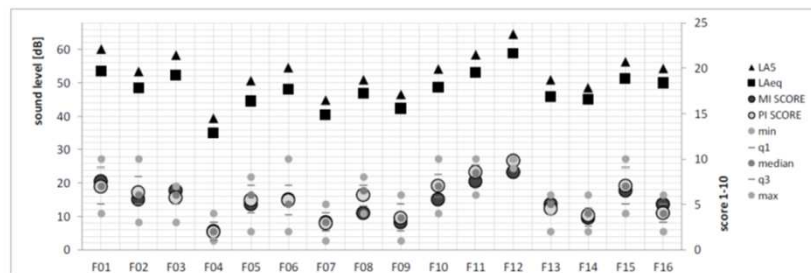


Figure 4A: Results of questionnaires with 10 acoustician respondents and 16 audio fragments.

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Laboratory Survey



Validating the algorithm – part II

- 100 respondents – random professions
- 12 audio fragments (8 fragmenst per set)

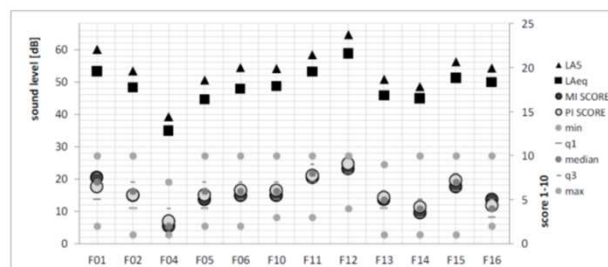


Figure 5A: Results of questionnaires with 100 respondents – random professionals and 12 audio fragments (8 fragments per set).

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Applications

Building a web based application

- MACH Index [MI]
- combination: *microphone – algorithm – online data*

Middenruimte

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Results

- a practical application to start with..