Noise – A Stress Factor?

Ergonomic Conditions At Schools

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Research Project

Universität Bremen
Institute of Interdisciplinary School Research

Acoustic Ergonomics of Schools
2001 - 2005

Teaching Reality?

Ergonomics of School

Pedagogic

Occupational-medicine

Teaching reality

Building physics

Field Research

Results

- Room Acoustics
- Room Acoustics & SPL
- Room Acoustics, SPL & Pedagogics
- Room Acoustics, SPL, Pedagogics & Workload
Basic Noise Level and Room Acoustics

Basic Noise Level and STI

„Modern“ Teaching?! • Openness • Independence • Individualisation

How to Measure Teaching?!
SPL and Pedagogics

Sortiert nach Schulen

Pedagogical Intervention

Sortiert nach Schulen

Work Load Reaction

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SPL, RT and Pedagogics

\( L_{\text{Aeq}} \) before and after refurbishment

Prospect: Fatigue Phenomenon?

\( L_{\text{Aeq}} \) before and after refurbishment

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“Noise” – A Stress Factor?

...concerning the students, I am primarily stressed by...

[100] ...noise, made by the students”

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Work Load Reaction

SPL and average HR_{a} of the teacher
Fatigue and Type of Working

Time slices with quota of dT > 50% (School 1)

Fatigue and Activation

All lessons of School 2

Cause Effect Chain

- better room acoustic
- better communication
- reduced working SPL
- lower speech effort
- Lower stress
- better human working conditions

Thanks for Your Attention
1. Measured Value: Room Acoustics

2. Measured Value: SPL

3. Measured Value: Pedagogics

4. Measured Value: Stress (HR)

Database
**Recorded Data**
- Reverberation time RT
- Speech transmission index STI
- Room description
- Pedagogical protocol
- Type of work
- Quota of speech 1 sec
- Event protocol
- Disturbances, noises, etc. 1 sec
- Sound pressure SPL L
- LAeq 1 sec; LAF LA1
- Stress
- Heart Rate HR 15 sec

**Room Acoustics**

**SPL\_RT and Pedagogics**

**SPL\_RT and Pedagogics**

**Working SPL L\_Aeq,5min**

1st class Monday 1st + 2nd lesson (90 min)

+ 11 dB !!!

**1st Conclusion:**

As expected we find reduced stress at the persons working in this environment by reducing the physical stress "noise". This effect can be intensed by one teacher (school 1) doing an experiment:

Consequence: Lowering of the stress, measured by heart rate, up to 10 beats/min. The reason that for is variance in the room acoustics (RT from 0,7 down to 0,4 s).
**Work Load Reaction**

*As a result of „noise“*

![Graph showing work load reaction](image)

$r = 0.55$

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**Basic Activation**

- Heart rate at waking up
- Heart rate at rest

Basic activation is very individually, depending on physical fitness, time of day, current situation, emotionally arousal and ...

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**4) RT and Workload**

**Stress model**

*by Sust & Lazarus 1997*

![Stress model diagram](image)

**SPL, Type of Working and Stress**

Connection between type of working and basic- or working SPL was shown before

How much stress is the consequence?

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**Stress in Direct Teaching**

Time slices with quota of $dT > 50\%$ (School 1)

![Stress in direct teaching graph](image)
**Stress in Student Centred Teaching**

Time slices with quota of scT > 50% (School 1)

- 1st fl. RT 0,6s
- 2nd fl. RT 0,45s

**Fatigue and Type of Working**

Time slices with quota of dT > 50% (School 1)

**Fatigue and Type of Working**

Time slices with quota of dT > 50% (School 2)

**Stress model**

by Suls & Lazarus 1997

- Influence of environmental factors on emotional and physical reactions
- Result: reduced stress level

**Conclusion:**

As expected, we find reduced stress at the persons working in this environment by reducing the physical stress "noise". This effect can be tested by one teacher (school 1) using an experimental setting.

Consequence: Lowering of the noise stress, measured by heart rate, up to 10 beats/minute. The reason for this variance is the noise acoustic (dT from 0.5 down to 0.36 s).

The effect of room acoustics on stress reactions by lowering the basic And working noise level will be found also in school 2 at all teachers working there. This implies reduced stress under better ergonomic conditions, that means working more relaxed.