




i-ince

Noise – A Stress Factor?


Ergonomic Conditions At Schools

**Gerhart Tiesler
Markus Oberdörster**

Noise at Work, 3-5 July 2007
Lille (France)



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Research Project



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Acoustic Ergonomics of Schools



2001 - 2005




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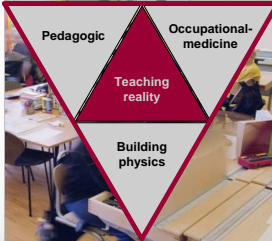

Teaching Reality ?


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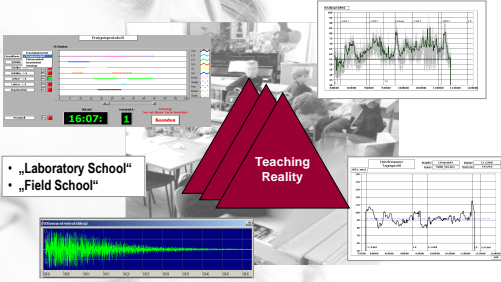
Ergonomics of School


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Field Research



- „Laboratory School“
- „Field School“




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Results

- Room Acoustics
- Room Acoustics & SPL
- Room Acoustics, SPL & Pedagogics
- Room Acoustics, SPL, Pedagogics & Workload

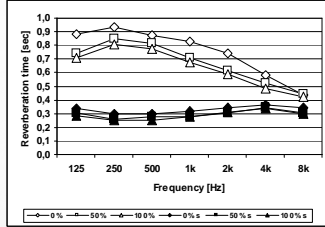


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Room Acoustics

School 1 – Classroom before and after refurbishment



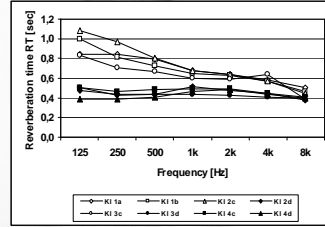
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Room Acoustics

School 2 – 8 classrooms 1st and 2nd floor



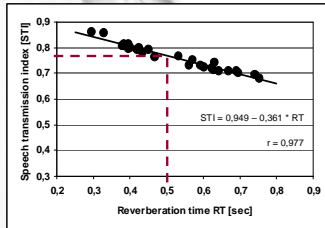
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Room Acoustics

STI as function of RT



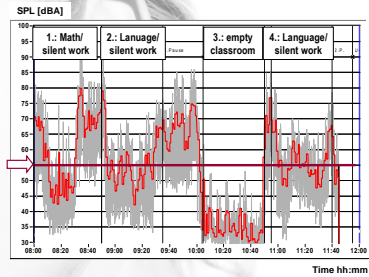
Data: all classrooms with all kinds of occupations

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SPL of one School day



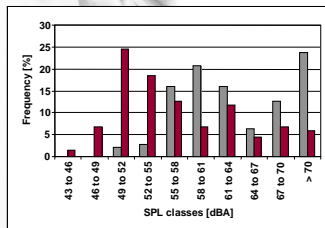
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Room Acoustics & SPL

Frequency distribution of $L_{Aeq,5min}$ before (□) and after (■) refurbishment



Data: School 1, all lessons

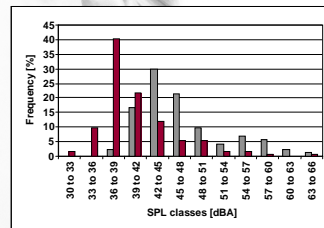
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Room Acoustics & SPL

Frequency distribution of $L_{Aeq,5min}$ before (□) and after (■) refurbishment



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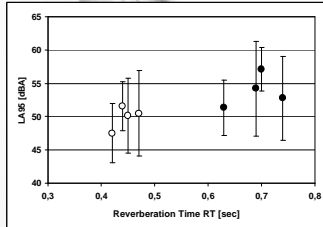
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Basic Noise Level and Room Acoustics

$L_{A95,5min}$ in 1st (●) and 2nd floor (○) vs. RT



Data: School 2, all lessons

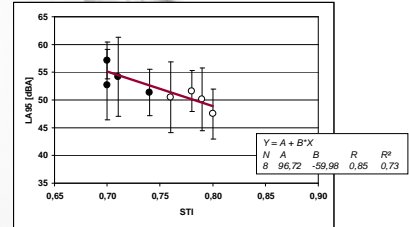
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Basic Noise Level and STI

$L_{A95,5min}$ in 1st (●) and 2nd floor (○) vs. STI



Data: School 2, all lessons

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„Modern“ Teaching?!



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„Modern“ Teaching?!

- Openness
- Independence
- Individualisation

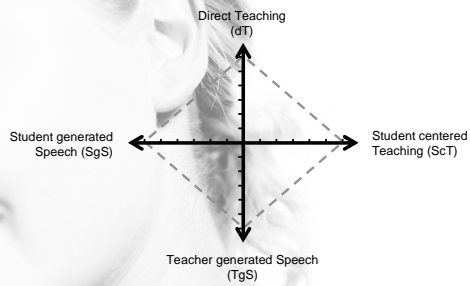


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How to Measure Teaching?!

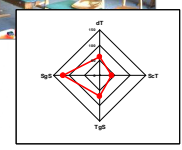
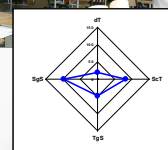
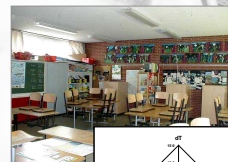


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„Modern“ Teaching?!



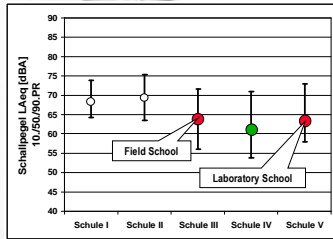
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SPL and Pedagogics

Sortiert nach Schulen



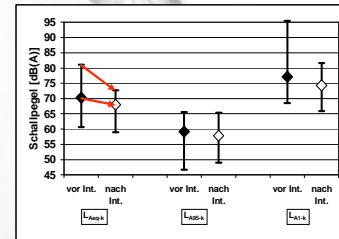
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Pedagogical Intervention

L_{Aeq} , L_{A95} , L_{A1} School III/Class E



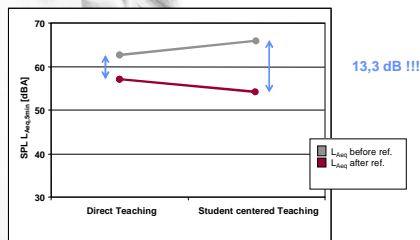
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SPL, RT and Pedagogics

L_{Aeq} before and after refurbishment



Data: School 1, all lessons

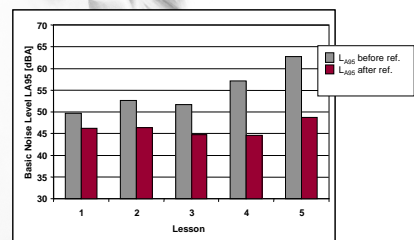
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Prospect: Fatigue Phenomenon?

Increase of L_{A95} before and after refurbishment



Data: School 1, all lessons

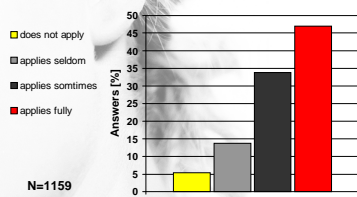
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"Noise" – A Stress Factor?

„...concerning the students, I am primarily stressed by...
[105] ... noise, made by the students“



N=1159

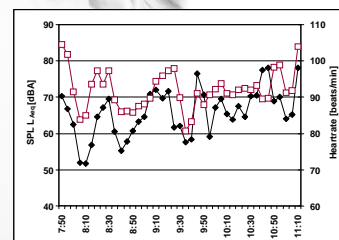
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Work Load Reaction

SPL and average HR_{smin} of the teacher



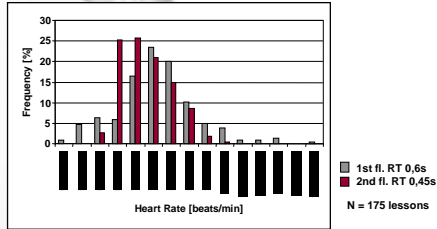
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4) RT and Workload

Classrooms in 1st (=) and 2nd (#) floor



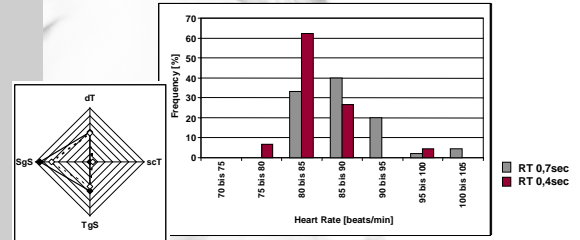
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4) RT and Workload

Single Case Example: Tuesday 2nd Lesson (School 1)



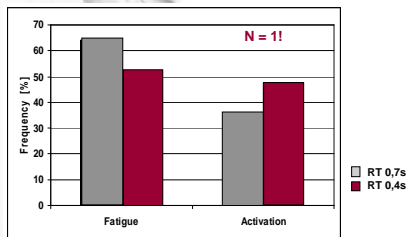
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Fatigue and Type of Working

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



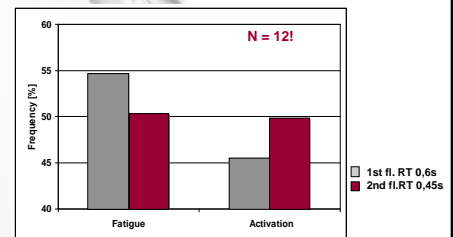
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Fatigue and Activation

All lessons of School 2



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Cause Effect Chain

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

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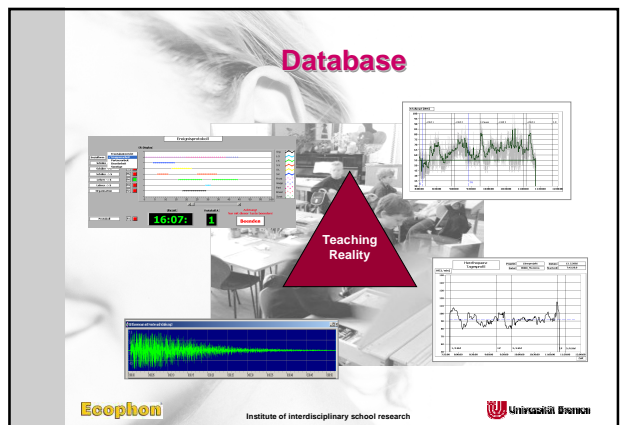
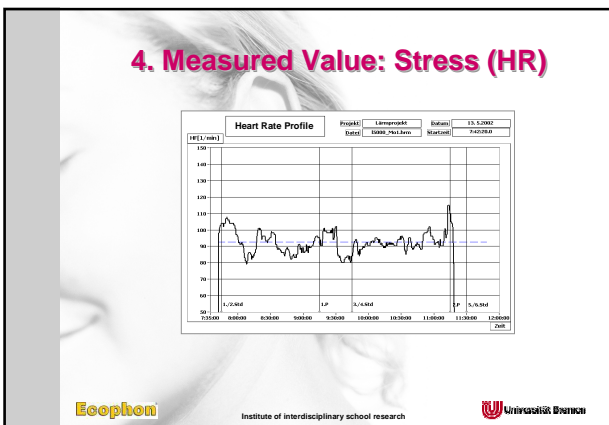
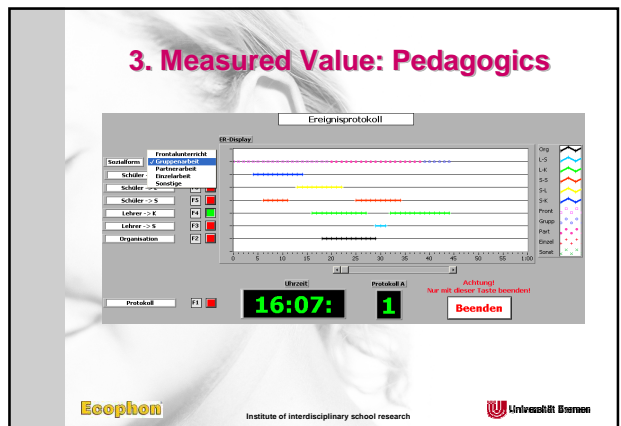
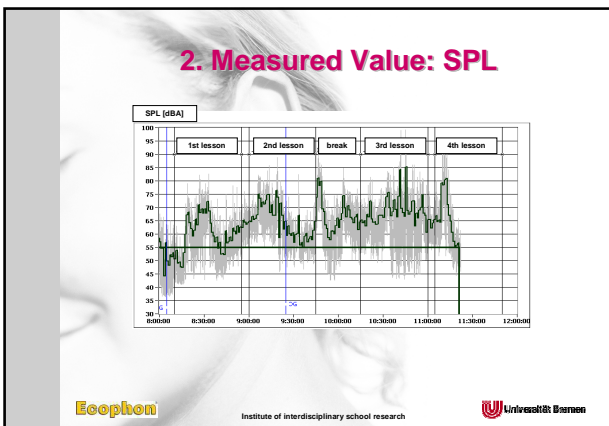
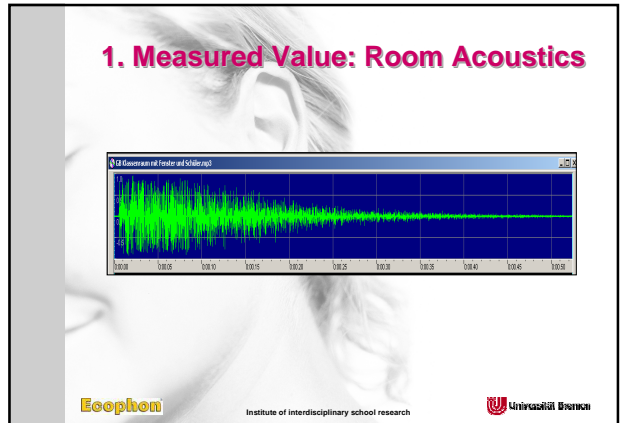
Thanks for Your Attention

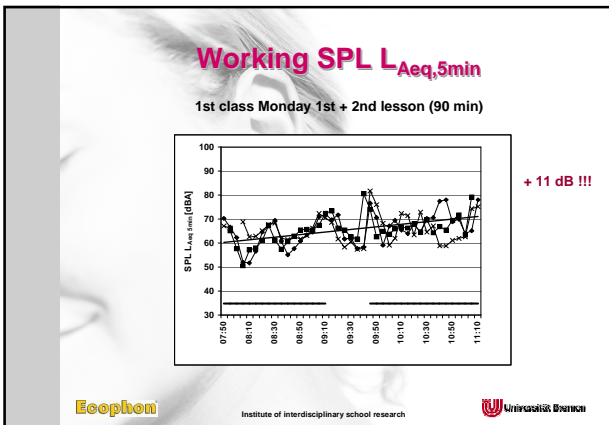
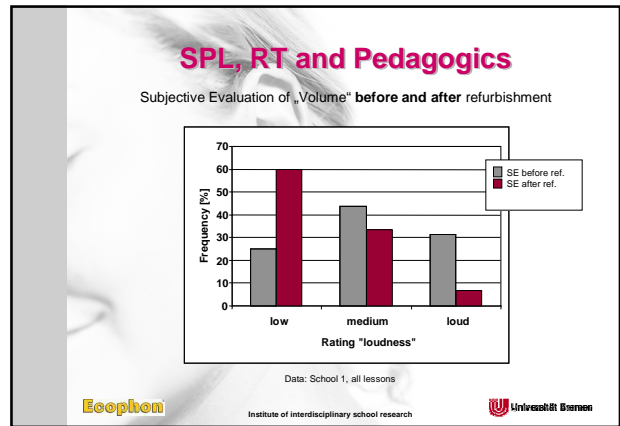
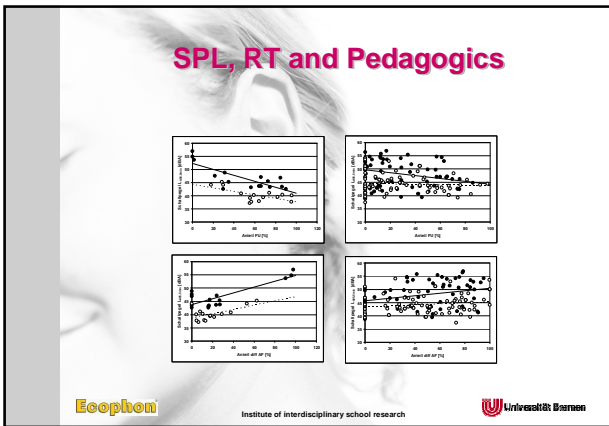
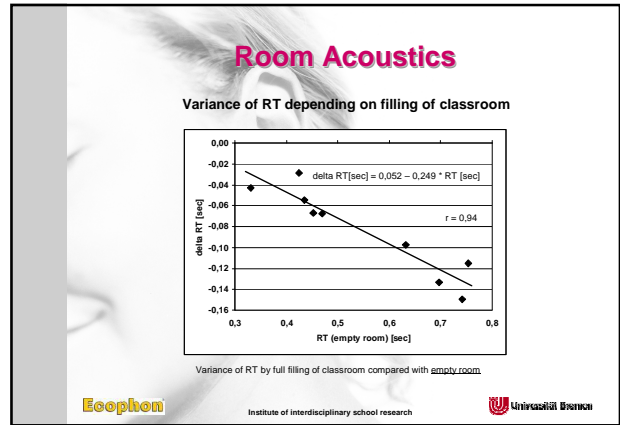
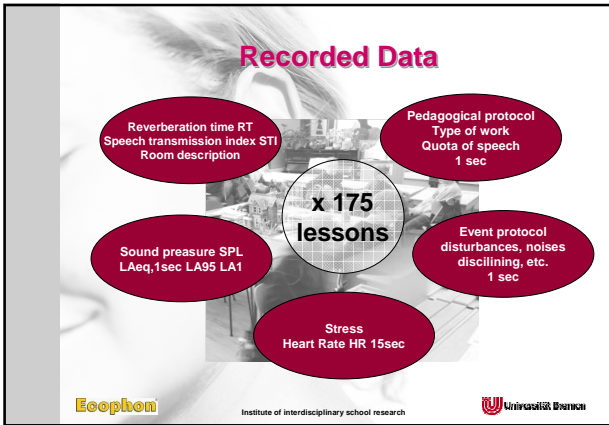


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1st Conclusion:

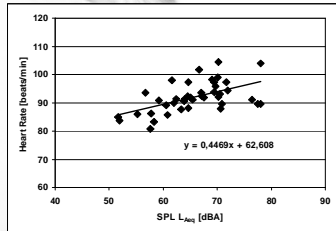
As expected we'll find reduced stress at the persons working in this environment by **reducing the physical strain "noise"**. This effect can be instanced by one teacher (school 1) quasi as an laboratory experiment. Consequence: **Lowering of the mean stress, measured by heart rate, up to 10 beats/min.** The reason that for is variance the room acoustic (RT from 0.7 down to 0.4 s).

The effect of room acoustics on stress reactions by lowering the basic and working noise level we'll find also in school 2 at all teachers working there. This implies reduced stress under better ergonomic conditions, that means **working more relaxed.**

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Work Load Reaction

As a result of „noise“



r = 0,55

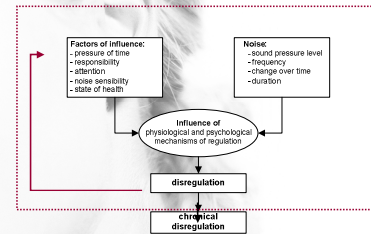
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Stress model

by Susta & Lazarus 1997



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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 ...

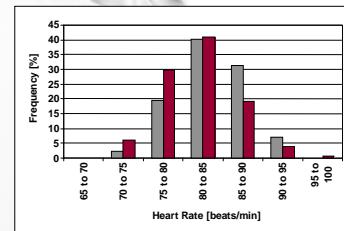
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4) RT and Workload

before (□) and after (■) refurbishment (School 1)



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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?

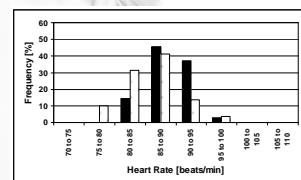
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Stress in Direct Teaching

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



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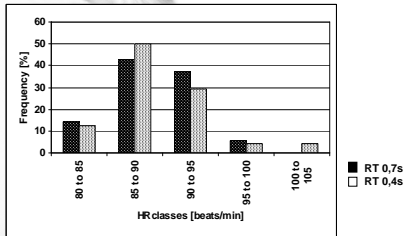
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■ 60% under 90 beats/min
□ 83% under 90 beats/min

Stress in Student Centred Teaching

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



■ 57,1% under 90 beats/min
□ 62,5% under 90 beats/min

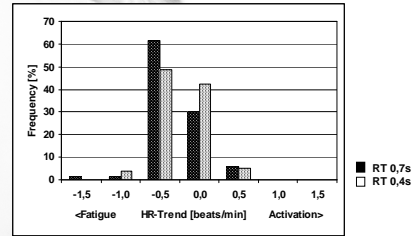
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Fatigue and Type of Working

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



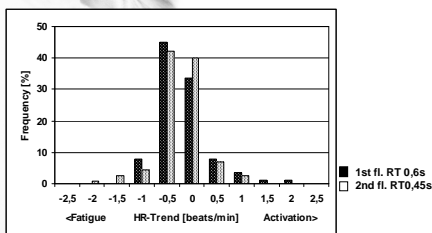
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Fatigue and Type of Working

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



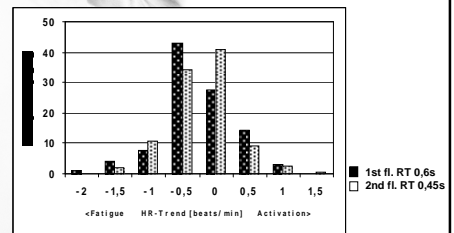
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Fatigue and Type of Working

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



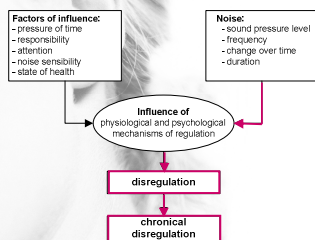
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Conclusion:

As expected we'll find reduced stress at the persons working in this environment by **reducing the physical strain "noise"**. This effect can be instanced by one teacher (school 1) quasi as an laboratory experiment. Consequence: **Lowering of the mean stress, measured by heart rate, up to 10 beats/min.** The reason that for is variance the room acoustic (RT from 0,7 down to 0,35 s).

The effect of room acoustics on stress reactions by lowering the basic And working noise level we'll find also in school 2 at all teachers working There. This implies reduced stress under better ergonomic conditions, that means **working more relaxed.**

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