The background of the slide is a light blue gradient. On the left side, there is a large, stylized image of a human head in profile, composed of various mechanical gears and parts. In the top left corner, there is a photograph of a modern, curved glass building. In the bottom left corner, there is a small icon of a gear with a wrench and a screwdriver.

Hearing Aid Fitting – Key issues and own studies

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Hearing aid fitting – overview

1. Assessment of user profile (needs & demands)
Ultimate goal: “Measure an entire profile to be completely compensated by hearing aid”
→ *difficult/impossible???*
2. Basic fitting
 - Generic fitting formula (threshold-based)
 - NaI-NL2 } *additional variables*
 - DSL v5 } *included in new versions*
 - Product-specific fitting formula (threshold-based)
 - Loudness-based procedures
3. Fine-tuning
 - By intuition
 - By fitting assistant
 - Based on data-logging
 - By self-learning systems
 - In virtual environments
4. Gliding fitting (up to 6–12 months) to allow for acclimatization

Evaluation
↑
Assessment of user benefit
↓

Key issues in hearing aid fitting

Key issues

- Validity of targets
- Fitting/amplification strategies
- Changing requirements over time (acclimatization)
- Changing requirements for different environments
- Personal preferences
- Unknown other factors
- Assessment of user benefit is difficult

3 own studies
being
reported now

being touched
in my later
presentation


Key statements

Hearing aid fitting is

- ... not a “single shot”
- ... never finished
- ...strongly affected by “soft factors”, such as personality and psychology, at least as much as by auditory factors

Comparison of fitting strategies

Own studies



Study 1:
“Compressive” vs. “Partly linear” gain

Comparison of fitting strategies

The Oldenburg Master Hearing Aid

Pros

- Notebook-based solution
- Versatile
- Parameters that are not in focus can be kept constant
- Open for new solutions
- Semi-portable in backpack or shoulder bag (lab & campus)

➔ Excellent research platform

Cons

- Bulky
- Not fully portable
- Not a real hearing aid

➔ Cannot be used in real life



Comparison of fitting strategies

Study 1: “Compressive” vs. “Partly linear”

Test persons

- 10 experienced hearing aid users with moderate symmetrical sensorineural hearing loss

Loudness-based fitting strategies

- GiFit 101: *compressive gain* in the entire dynamic range (WDRC: Wide Dynamic Range Control)
- GiFit 201: *partly linear gain* in the speech dynamic range below 65 dB

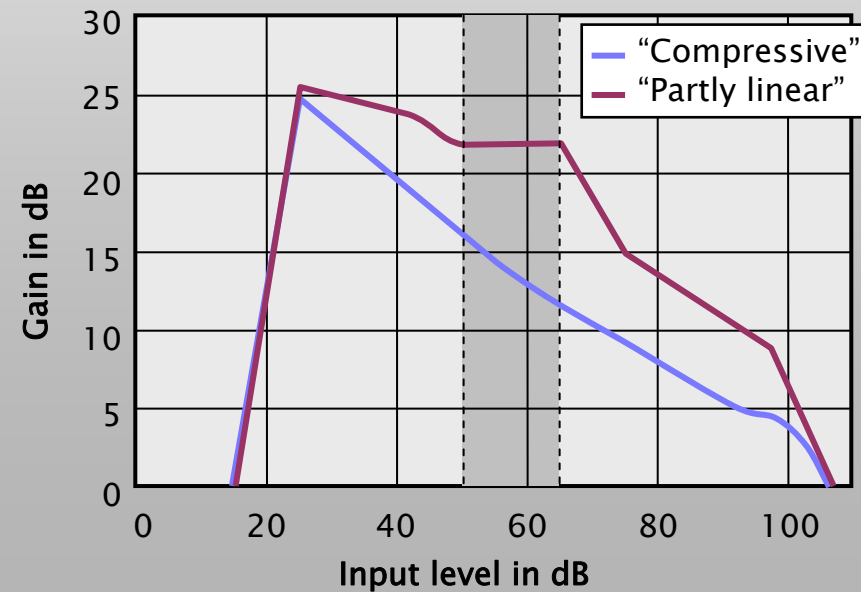
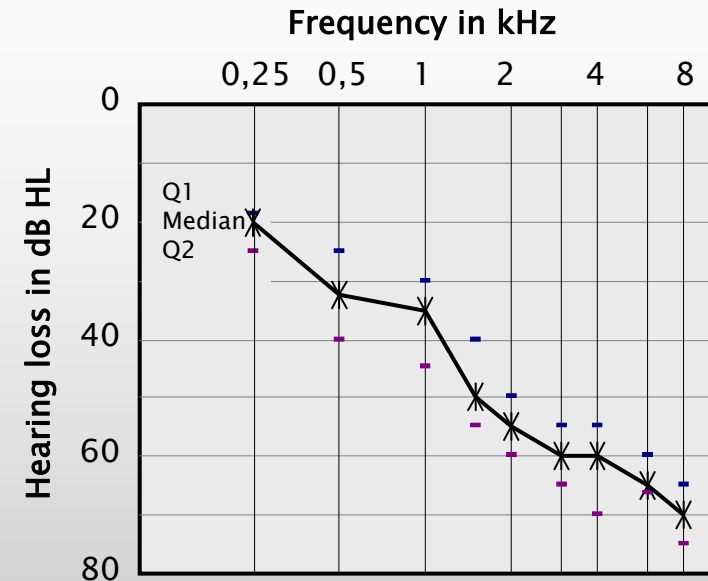
Evaluation methods

Quality rating by paired comparisons in terms of:

- General Preference
- Naturalness
- Loudness

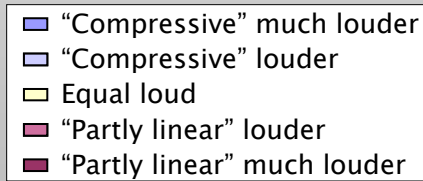
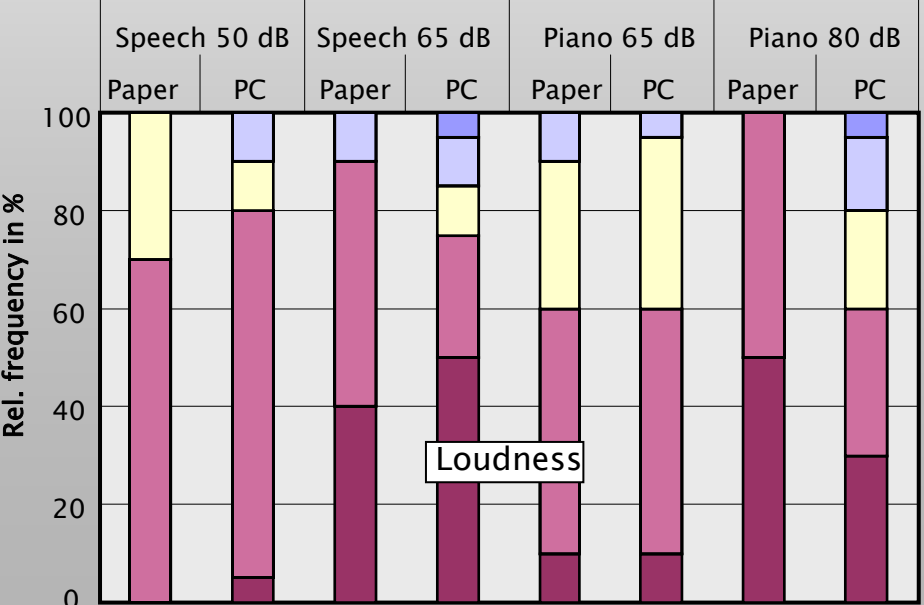
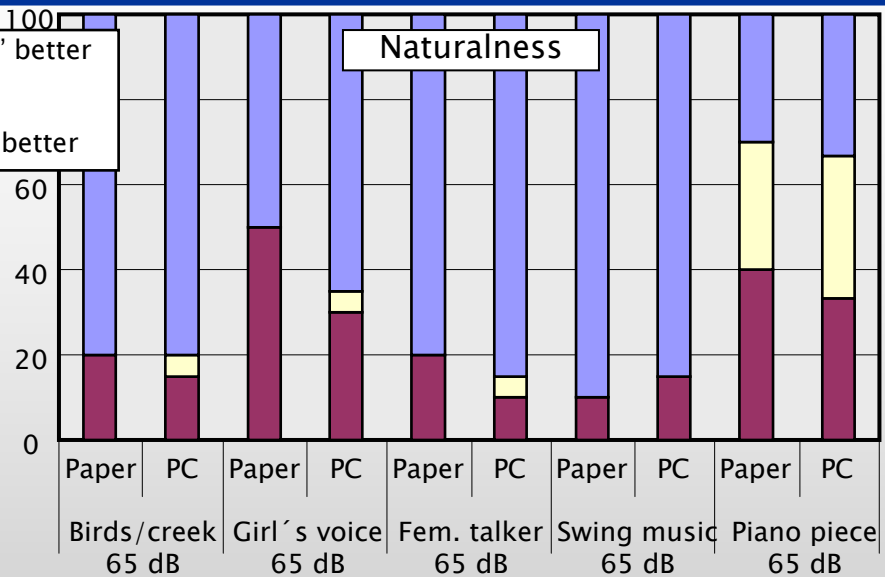
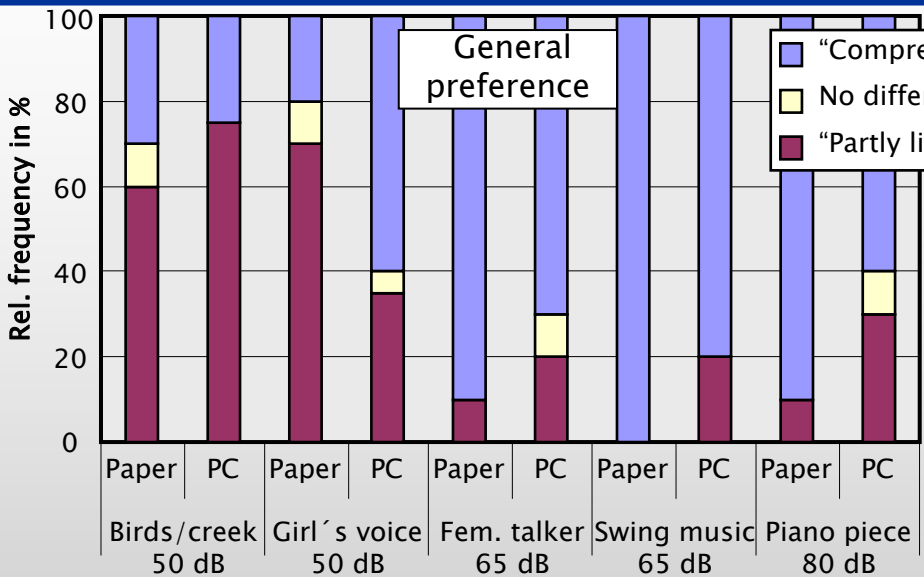
Two procedures (counterbalanced sequence):

- Comparison by computer program (“PC”)
- Comparison by paper & pencil (“paper”)



Comparison of fitting strategies

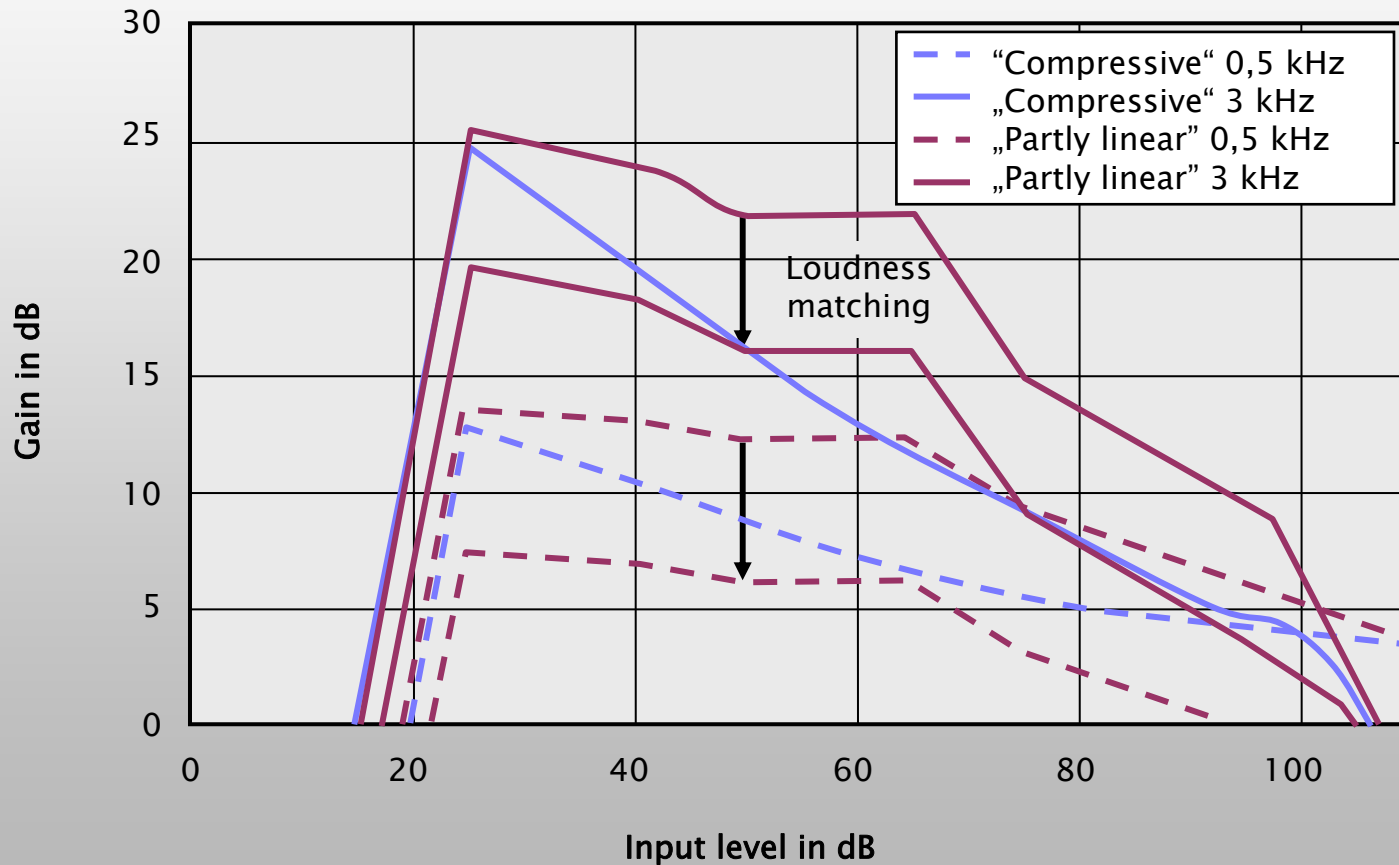
Study 1: "Compressive" vs. "Partly linear"



Result:
 => "Partly linear" louder

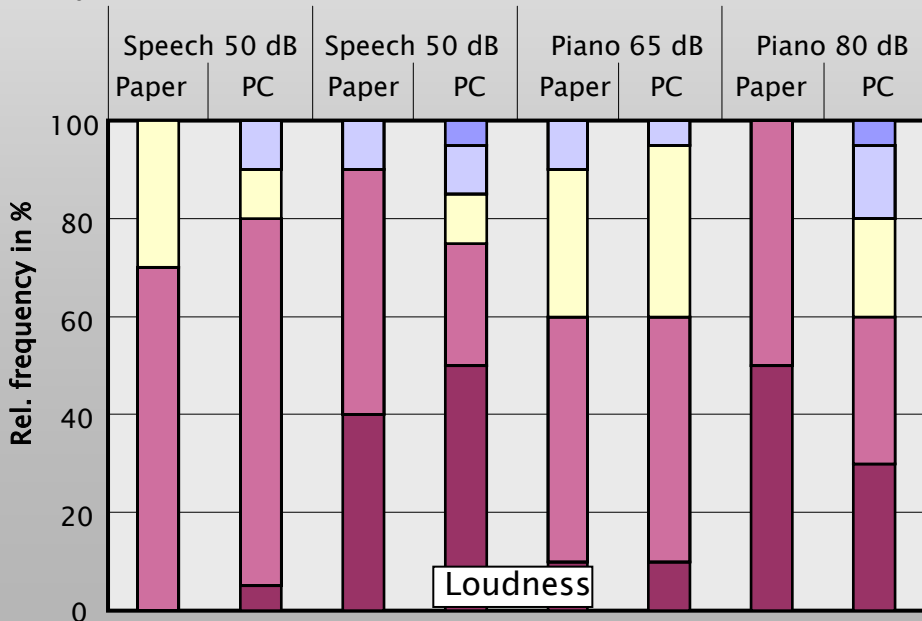
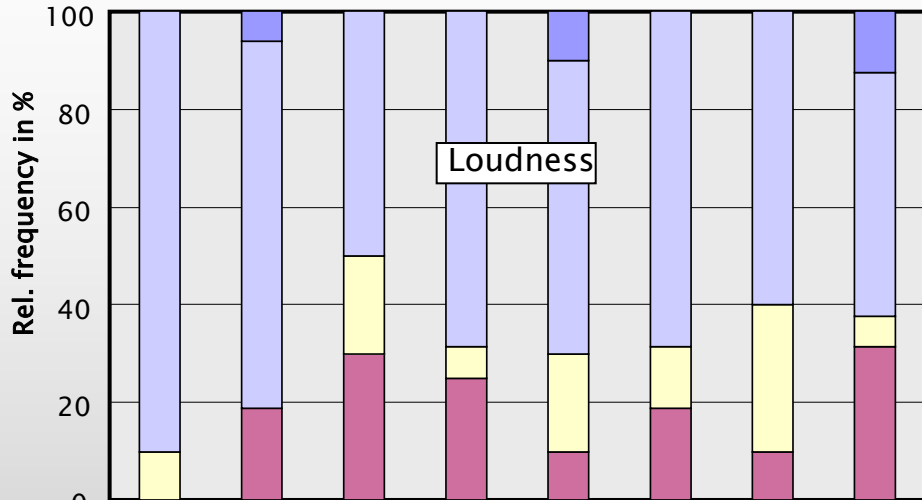
Comparison of fitting strategies

Study 1: “Compressive” vs. “Partly linear”



Comparison of fitting strategies

Study 1: “Compressive” vs. “Partly linear”

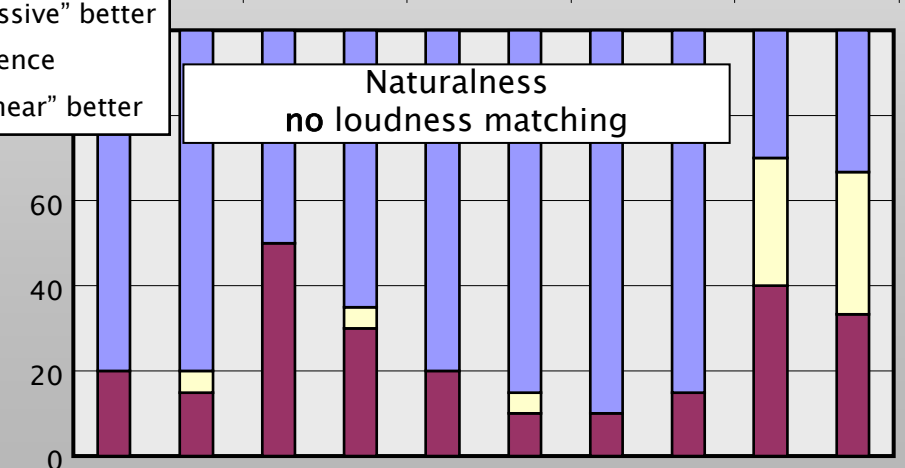
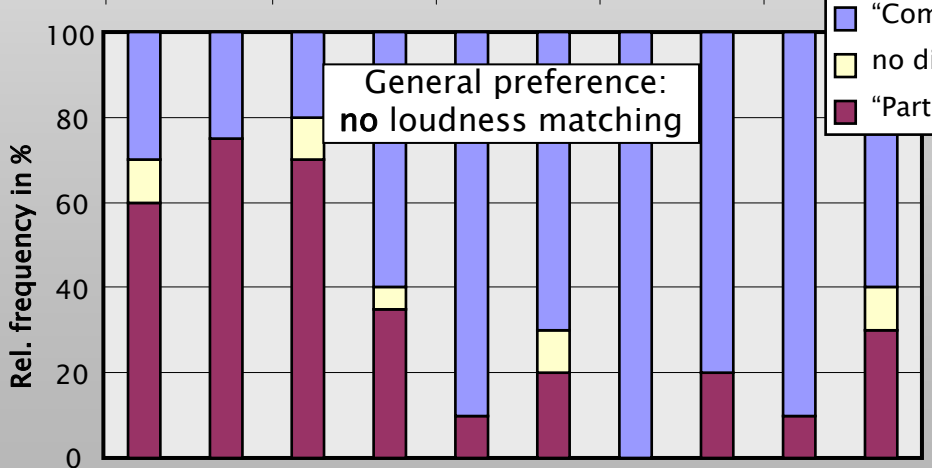
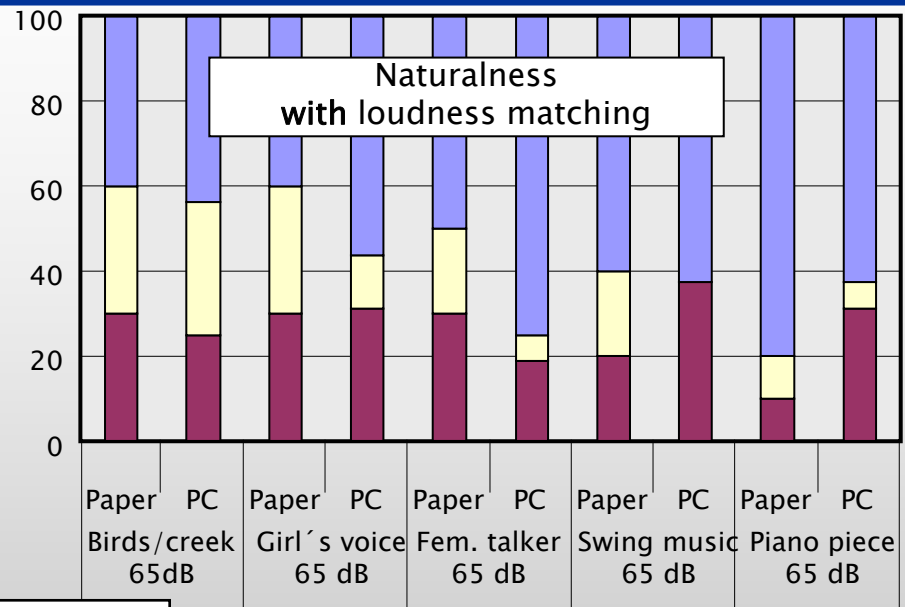
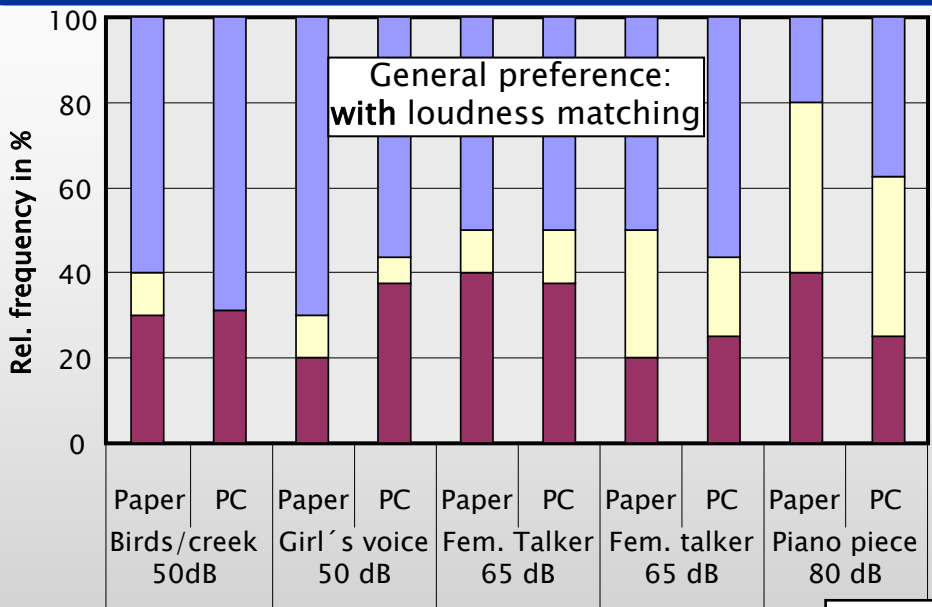


- “Compressive” much louder
- “Compressive” louder
- Equal loud
- “Partly linear” louder
- “Partly linear” much louder

Result:
=> „compressive“ louder

Comparison of fitting strategies

Study 1: "Compressive" vs. "Partly linear"




■ "Compressive" better
■ no difference
■ "Partly linear" better

Result: Compressive gain is preferred over the partly linear approach implemented here

Comparison of fitting strategies

Own studies



Study 2:
“Individual” loudness-based
vs. “Universal” loudness-based

Comparison of fitting strategies

Study 2: loudness-based “Individual” vs. “Universal”

Test persons

- 12 experienced hearing aid users with moderate symmetrical sensorineural hearing loss

Loudness-based fitting strategies

- GiFit 101: compressive gain (WDRC) using *individual loudness functions*
- GiFit 204: compressive gain (WDRC) using *universal loudness functions*

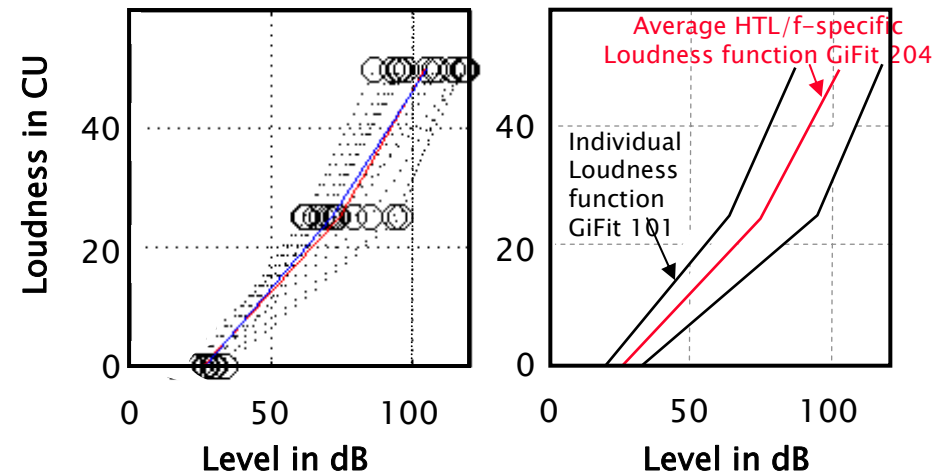
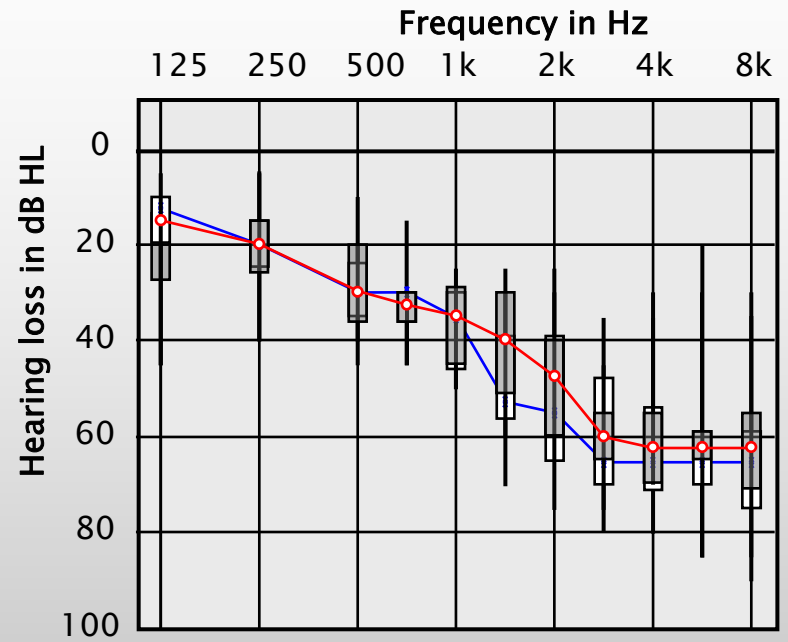
Evaluation methods

Quality rating by paired comparisons in terms of:

- General Preference
- Naturalness
- Loudness

Two procedures (counterbalanced sequence):

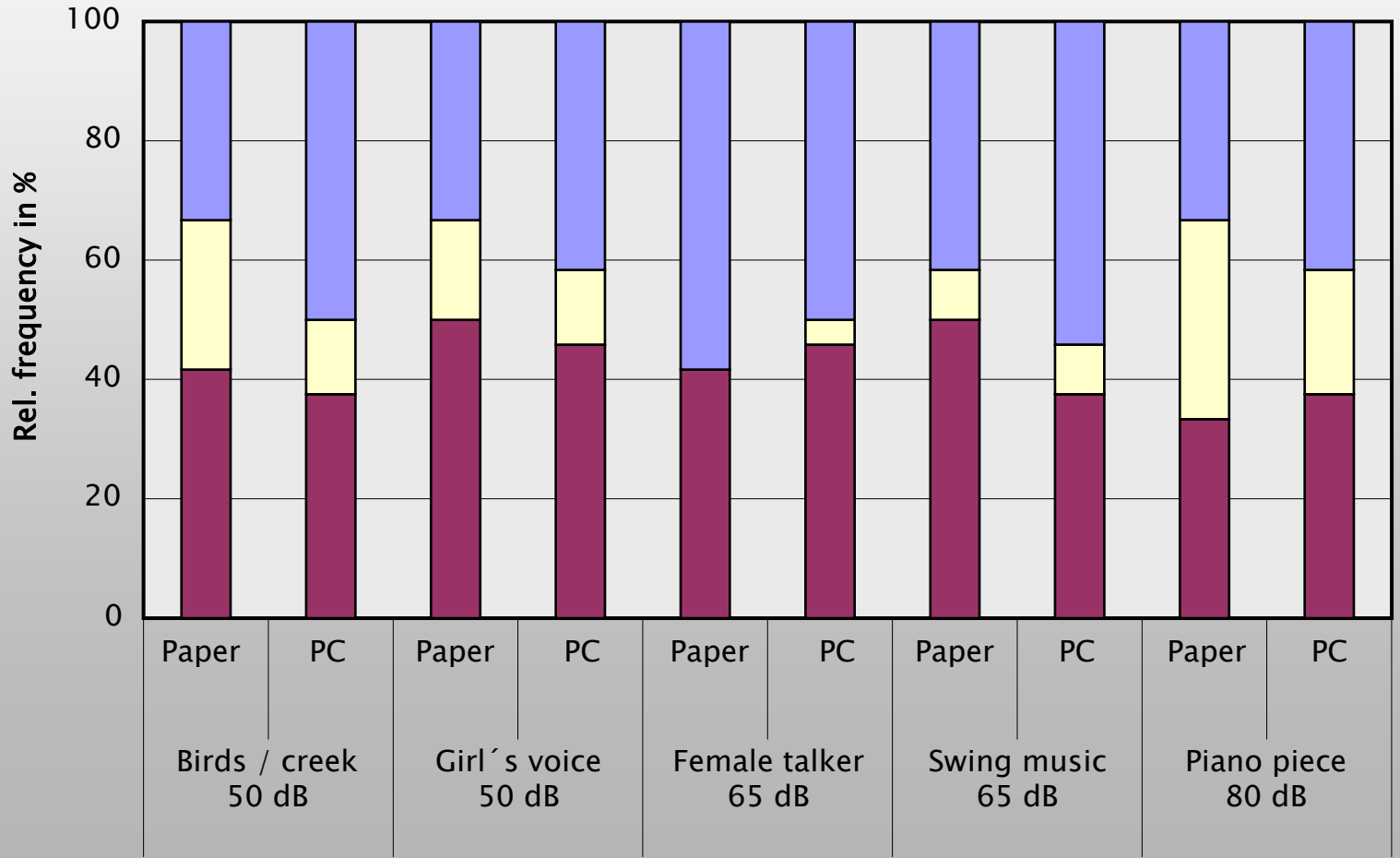
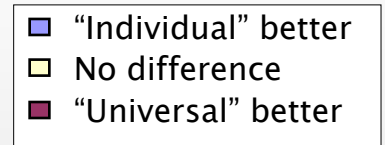
- By computer program (“PC”)
- By paper & pencil (“paper”)
- Speech test in quiet: SRT for logatomes: ata, asa, ascha, afa, aka
- Speech test in noise: SRT for OL sentence test OL-Noise @ 65 dB



Comparison of fitting strategies

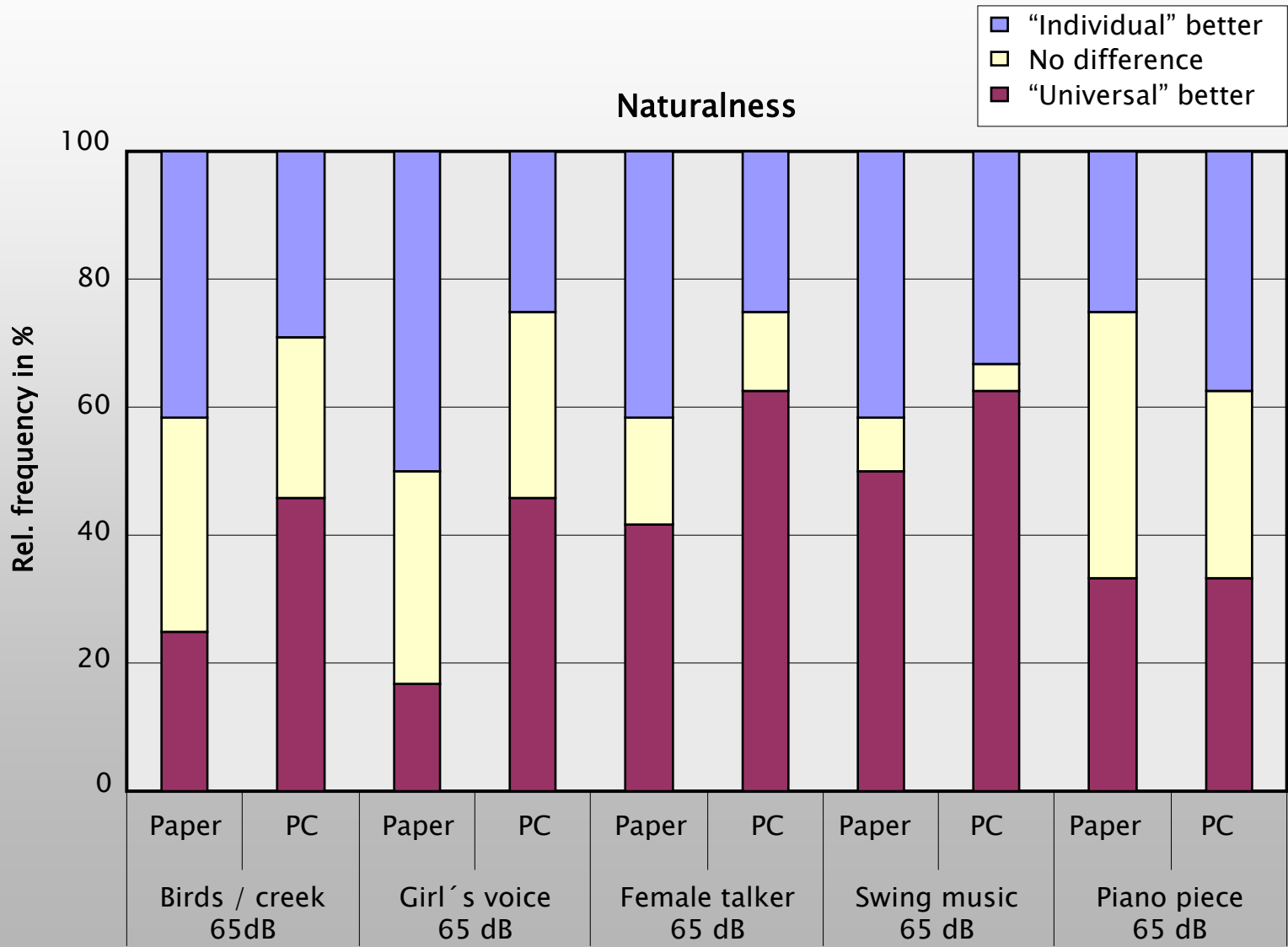
Study 2: loudness-based “Individual” vs. “Universal”

General Preference



Comparison of fitting strategies

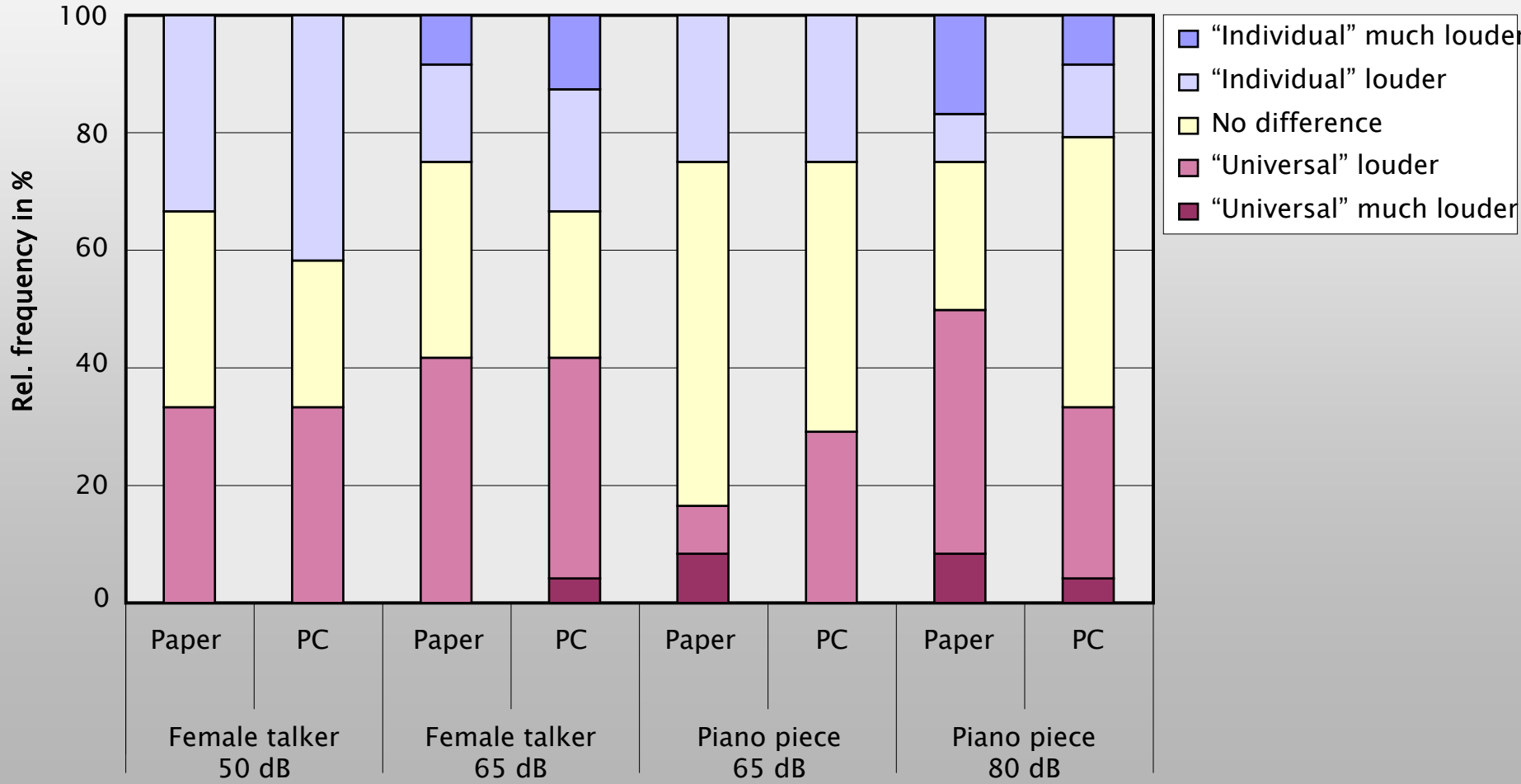
Study 2: loudness-based “Individual” vs. “Universal”



Comparison of fitting strategies

Study 2: loudness-based “Individual” vs. “Universal”

Relative loudness

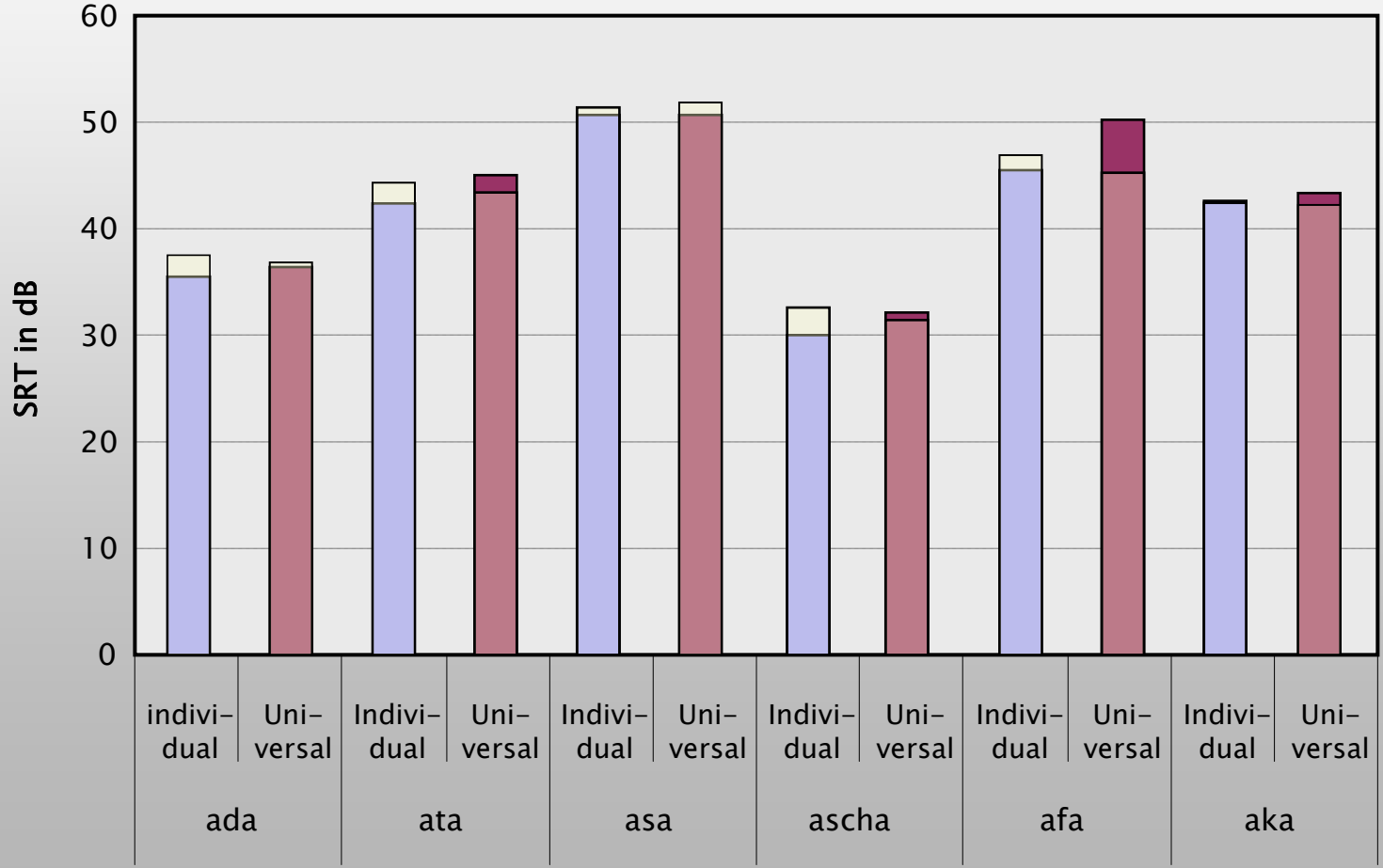


Comparison of fitting strategies

Study 2: loudness-based “Individual” vs. “Universal”

SRT in quiet for logatomes

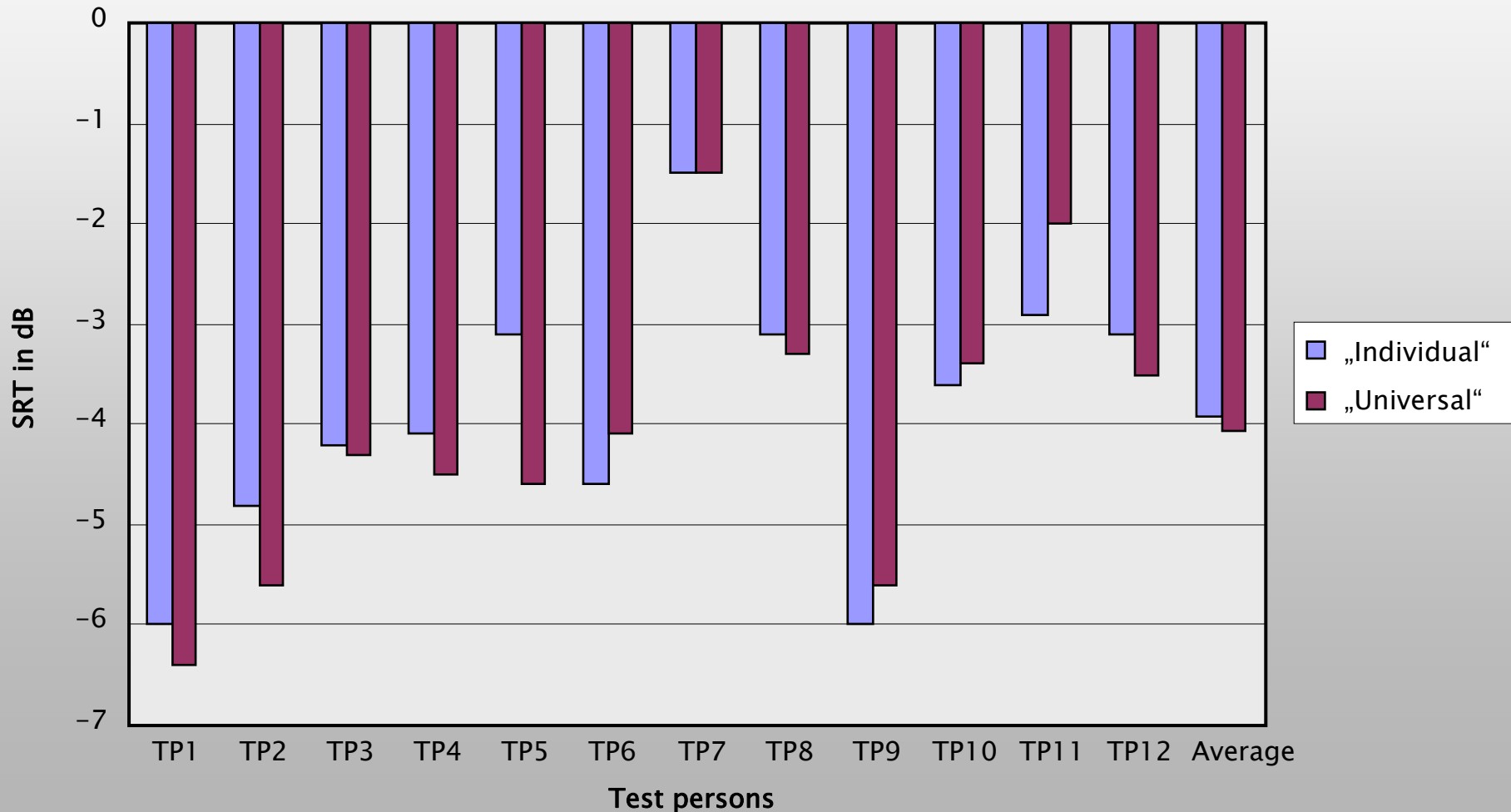
■ Avrg. Test
□ Avrg. Retest



Comparison of fitting strategies

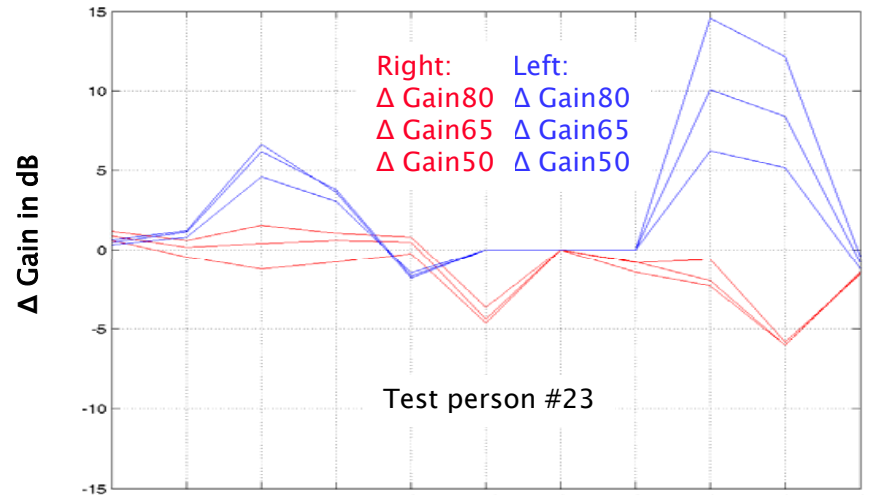
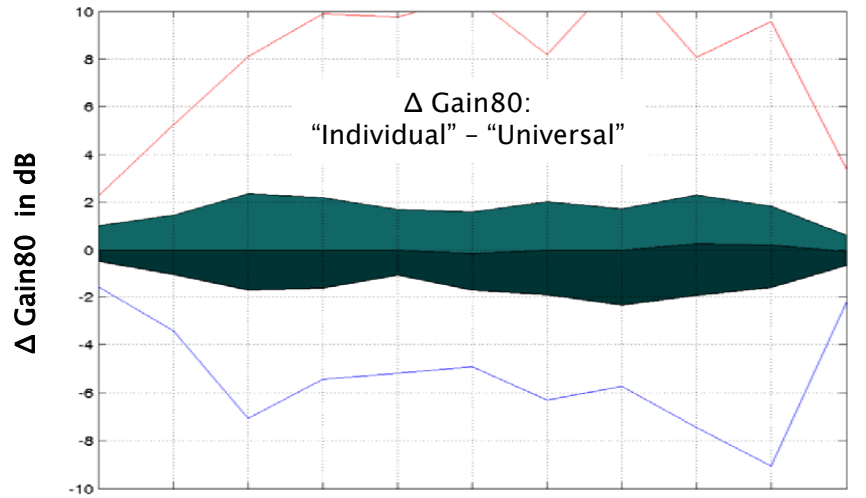
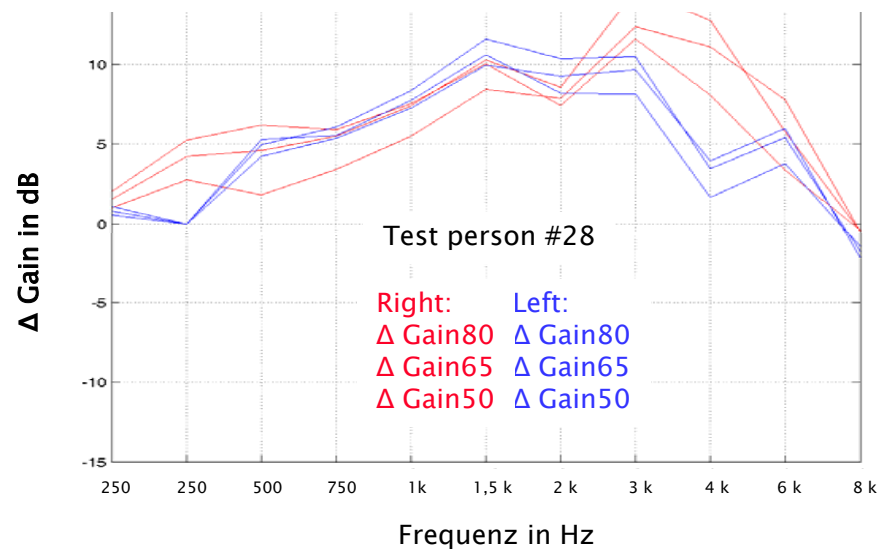
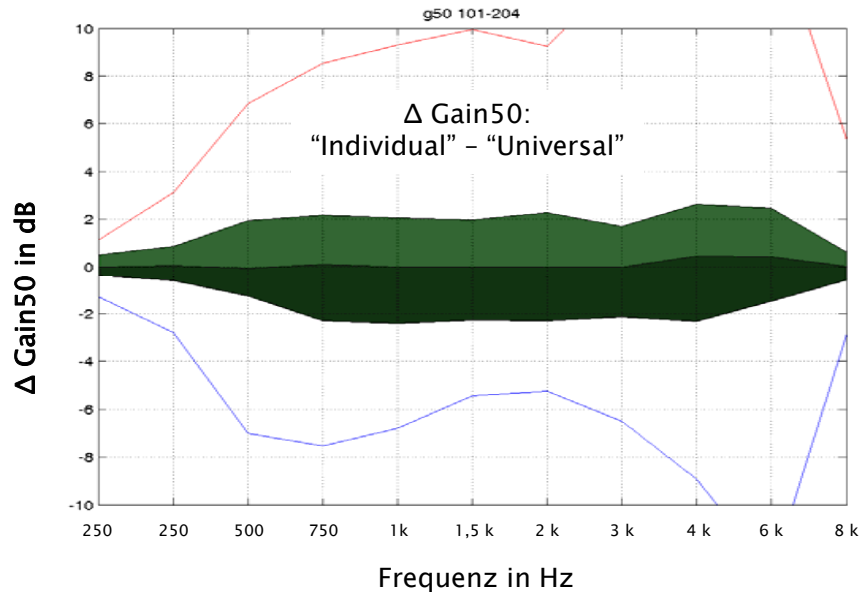
Study 2: loudness-based “Individual” vs. “Universal”

SRT in OL noise



Comparison of fitting strategies


Study 2: loudness-based “Individual” vs. “Universal”



Result: universal fit is rated similar as the time-consuming customized approach

Comparison of fitting strategies

Own studies



Study 3:
Individual loudness-based
vs. NAL-NL1

Comparison of fitting strategies

Study 3: Loudness-based GiFit 101 vs. NAL-NL1

Test persons

- 10 experienced hearing aid users with moderate symmetrical sensorineural hearing loss

Fitting strategies

- GiFit 101: individual loudness-based (WDRC)
- NAL-NL1

Evaluation methods

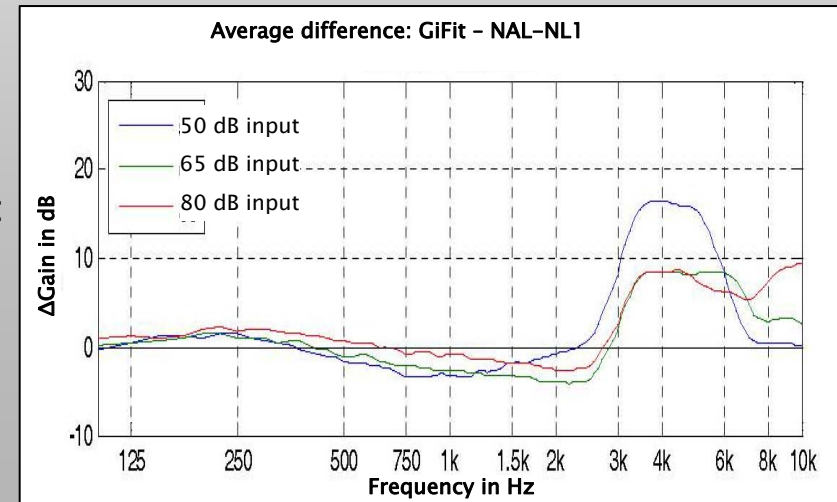
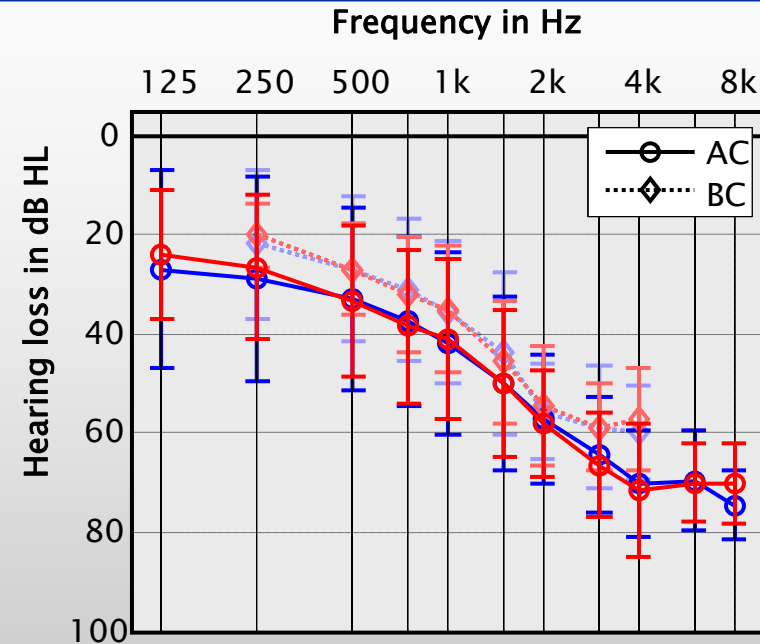
Quality rating by paired comparisons of

1. ... sound samples in the lab

- General Preference
- Naturalness
- Loudness

2. ... defined real-life environments (“Giessen Circuit”):

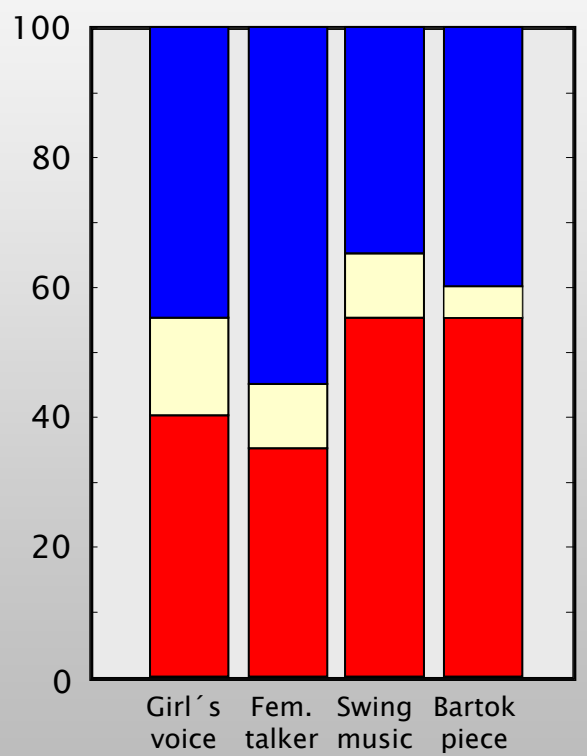
- Office room
- Reverberating hall
- Busy street
- Midsize food market



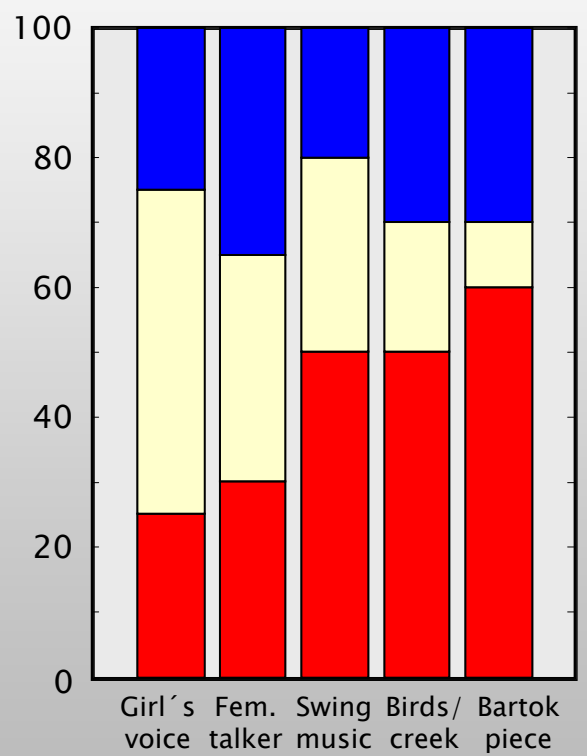
Comparison of fitting strategies

Study 3: Loudness-based GiFit 101 vs. NAL-NL1

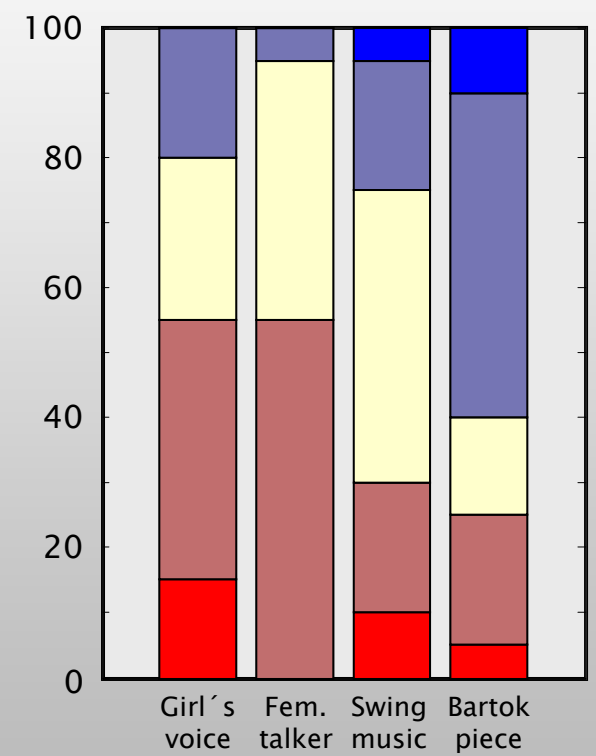
Paired comparison in the lab:
General Preference



Paired comparisons in the lab:
Naturalness



Paired comparisons in the lab:
Loudness



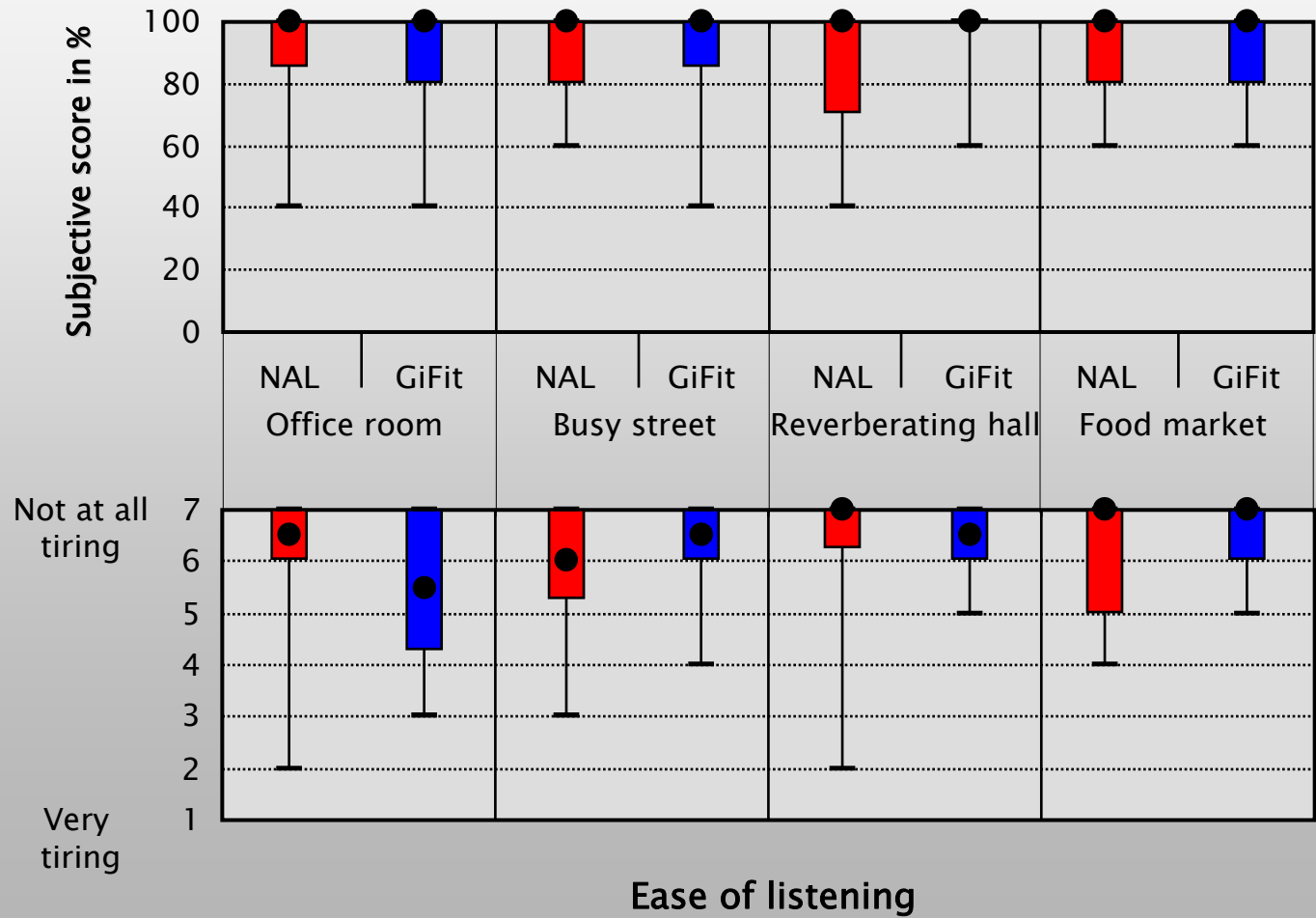
■ NAL better
■ No difference
■ GiFit better

■ NAL much louder
■ NAL louder
■ No difference
■ GiFit louder
■ GiFit much louder

Comparison of fitting strategies

Study 3: Loudness-based GiFit 101 vs. NAL-NL1

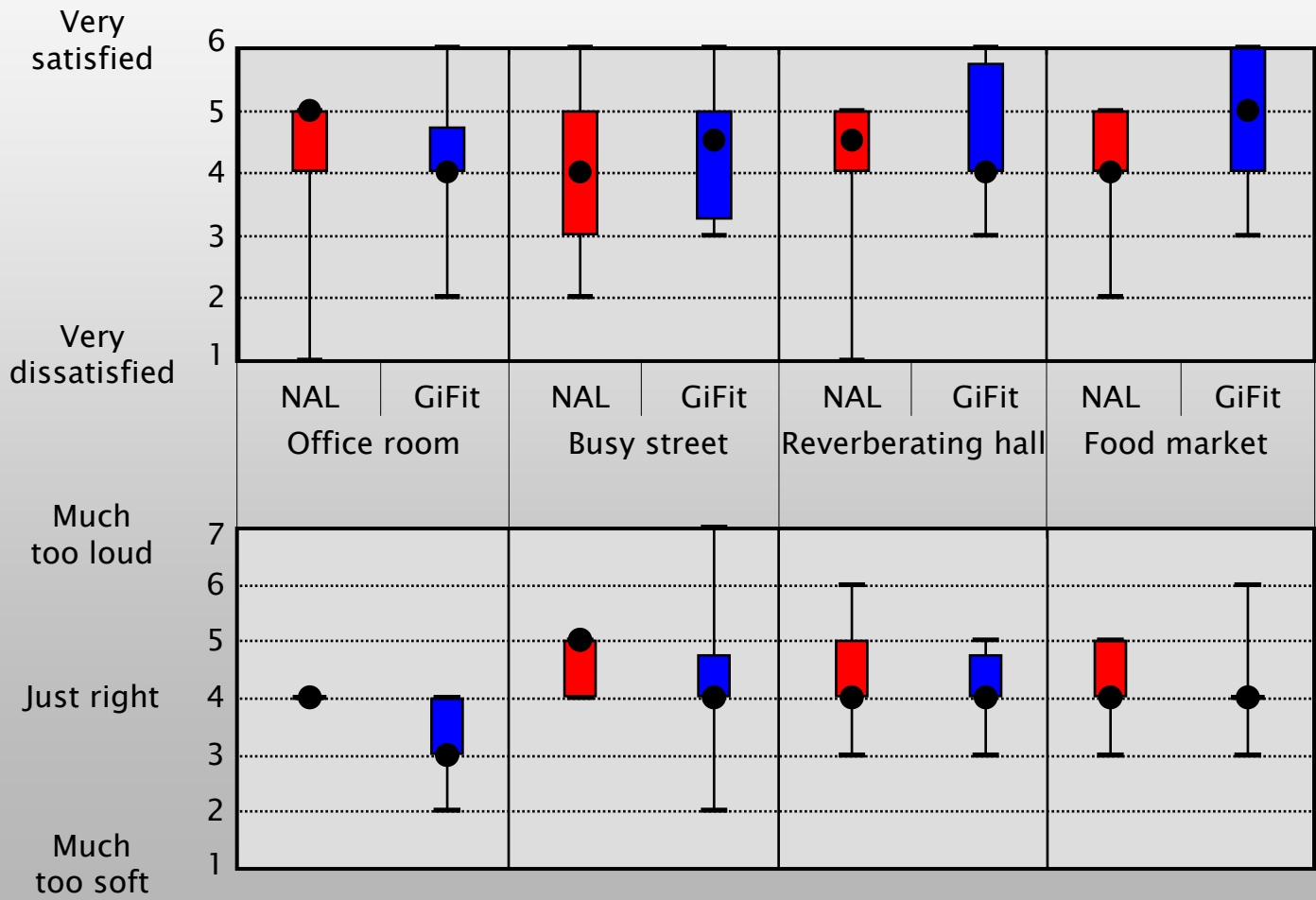
Circuit through real-live environments:
Speech intelligibility



Comparison of fitting strategies

Study 3: Loudness-based GiFit 101 vs. NAL-NL1

Circuit through real-live environments:
Satisfaction



Result: the loudness-based "Giessen Fit" is rated similar as NAL-NL1

- Hearing aid fitting has to keep up with the development of hearing aid technology
- Both generic and product specific fitting rules are steadily refined; product specific rules will gain increasing importance over time
- Fine-tuning is an indispensable tool today and in the future
- Self-learning systems will help to improve fine-tuning strategies taking acclimatization processes into account
- Lessons learned from own studies:
 - Wide dynamic range compression seems to be preferred over the partly linear approach implemented in our study
 - Loudness-based fitting utilizing universal loudness functions is rated almost the same as the time-consuming customized approach both in terms of overall preference and naturalness
 - Our loudness-based “reference” fitting rule (GiFit) is about even up with NAL-NL1
 - **Caution:** these experiences are derived from lab/near **lab studies** accomplished with a **research hearing aid!**