How we better could support audiological services for children

Michael Boretzki, Manuela Feilner, Nicola Schmitt

Agenda

1. Real life hearing performance assessment with children
2. Phoneme perception testing for children

PHONAK

life is on

Real life hearing performance assessment with children

Manuela Feilner, Vanessa Barrera

PHONAK
life is on

What is
Real Life HUPA?

Real Life HUPA

Goals
- Method to evaluate hearing and usage performance in real life environments
- Improvement of hearing and usage performance in real life environments

Approach
- **R**eal **L**ife **H**earing and **U**sage **P**erformance **A**ssessment
  - Observation
  - Recording
  - Analysis
- Identification of potential improvements
  - Automatic actuator steering (SoundFlow, AutoSense OS)
  - Beamformer steering, inclusion of Roger
  - Other functionalities
- Engineering

PH**O**NAK
life is on

Purpose: Beneficial actuator steering
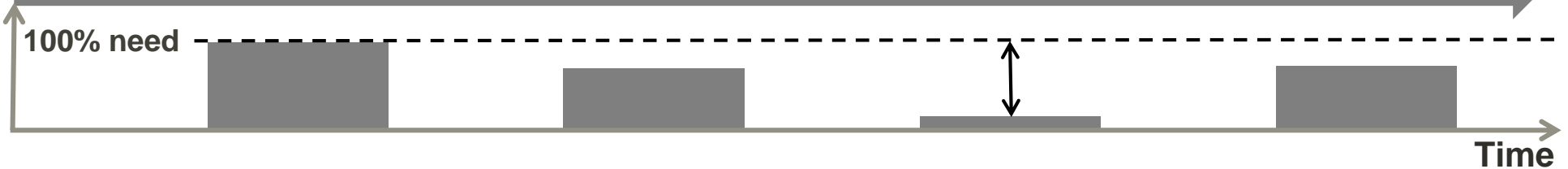
Flow of human activities
Flow of soundscape
Flow of hearing object selection

Wanted: Flow of needed and actual hearing performance

100% need

Time

Wanted: Flow of optimum actuator strengths = «ground truth»

E.g. beam former

?

Time

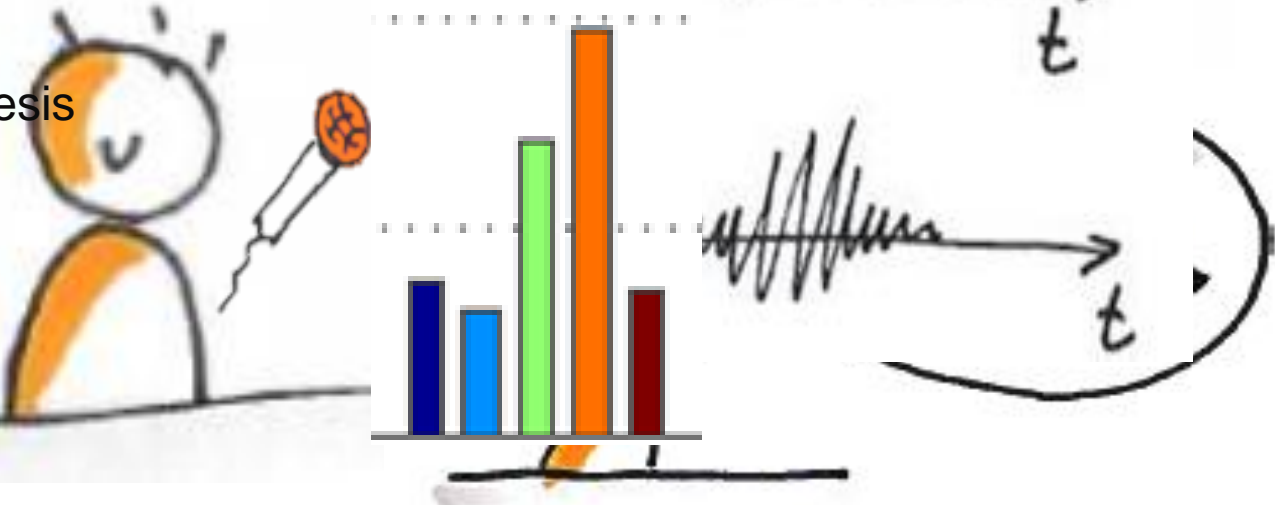# Real Life HUPA: Phases

1 Contextual interviews

2.1 Audio and video recordings in real life

2.2 Hearing performance observation in real life

3 Ground truth analysis and synthesis

4 Ground truth evaluation

Multiple simultaneous recordings

# Hearing performance observation – retrospective interview

- After lessons the boy (15 years old) is shown a photo of a group work situation which has been taken 40 min earlier.
- The boy is asked:
  - "How easy could you understand your colleague in this situation?"
  - "Did any sound disturb you?"
- The boy answers:
  - "This colleague was very difficult to understand, because many students were talking in the classroom and she was talking very softly."

What kind of insight does Real Life HUPA provide?

Hearing Situations at School

Scene Types	Coarse rating of hearing performance
Frontal instruction (with FM)	☺
Group work	☹
Interactive lessons (answers of students)	☹ ☹
Playing music	-
Physical activity	☹
Transition scenes	☹
1:1 conversation (pause)	☺
Distant speech or reverbereant speech	☹
Reproduced speech	☹ ☹
Working individually	☺
Swimming	☹

Ground truth analysis – Basic acoustic parameters
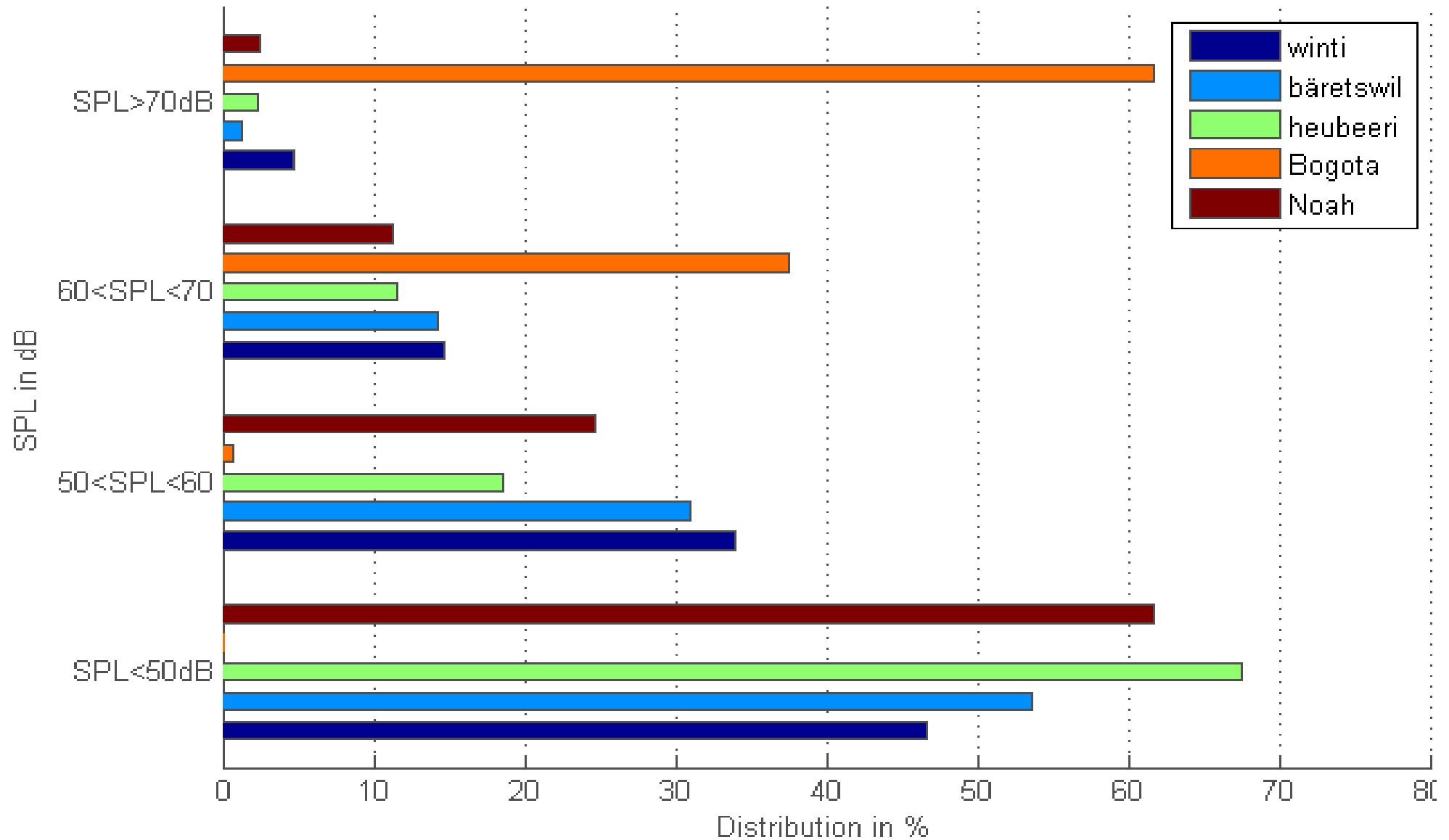
Ground truth analysis –
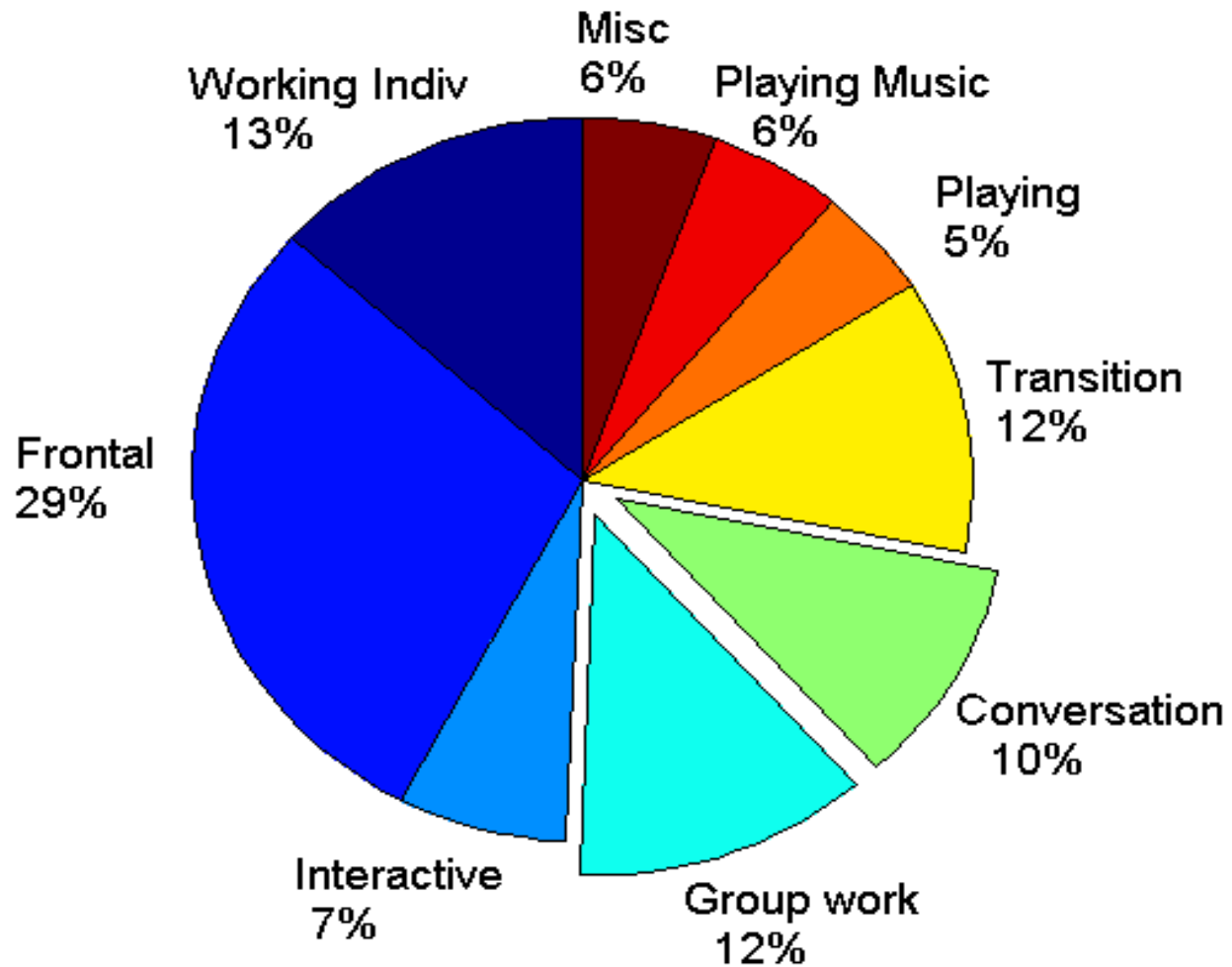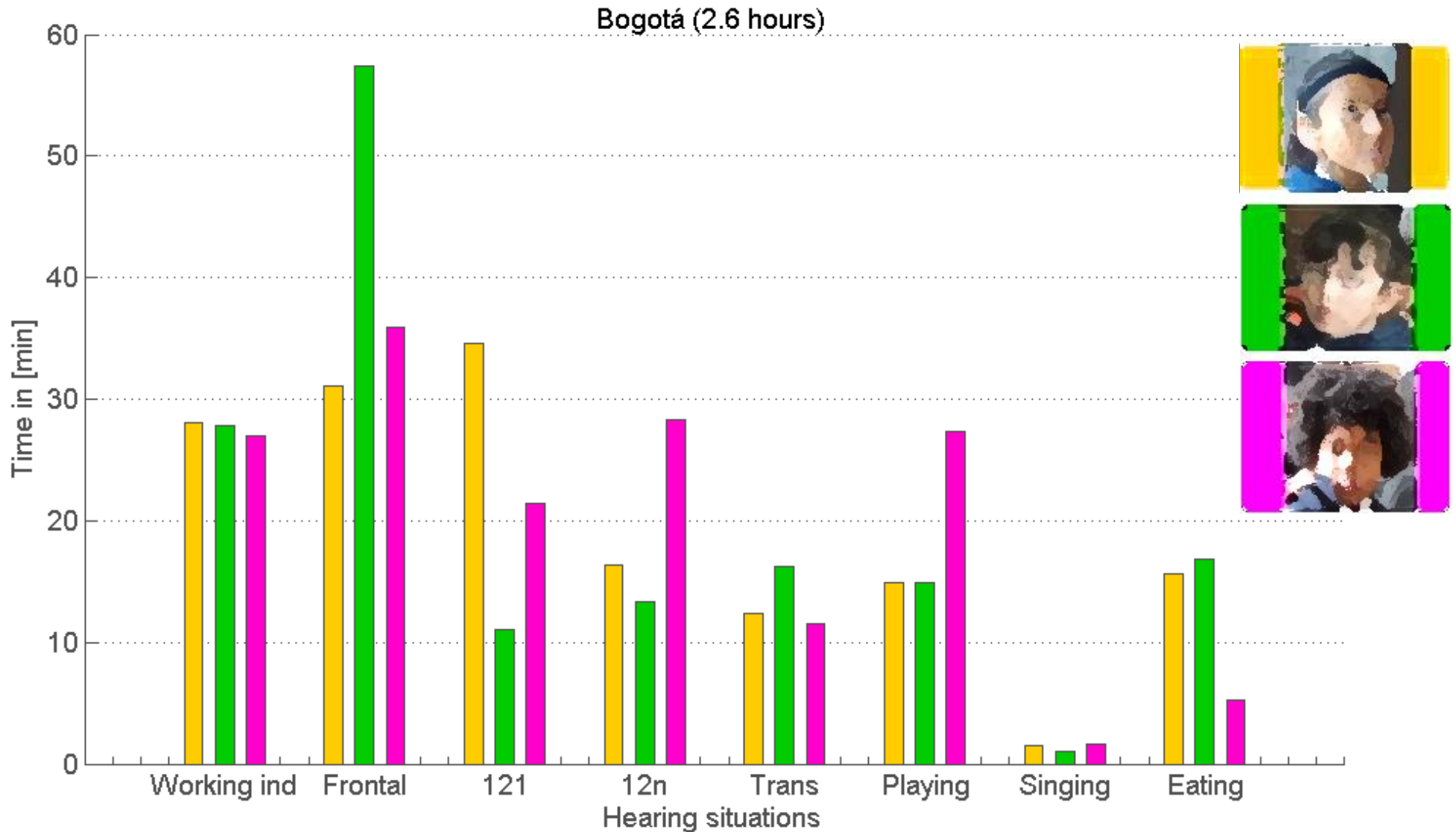# Behavior of current solutions and of prototypes
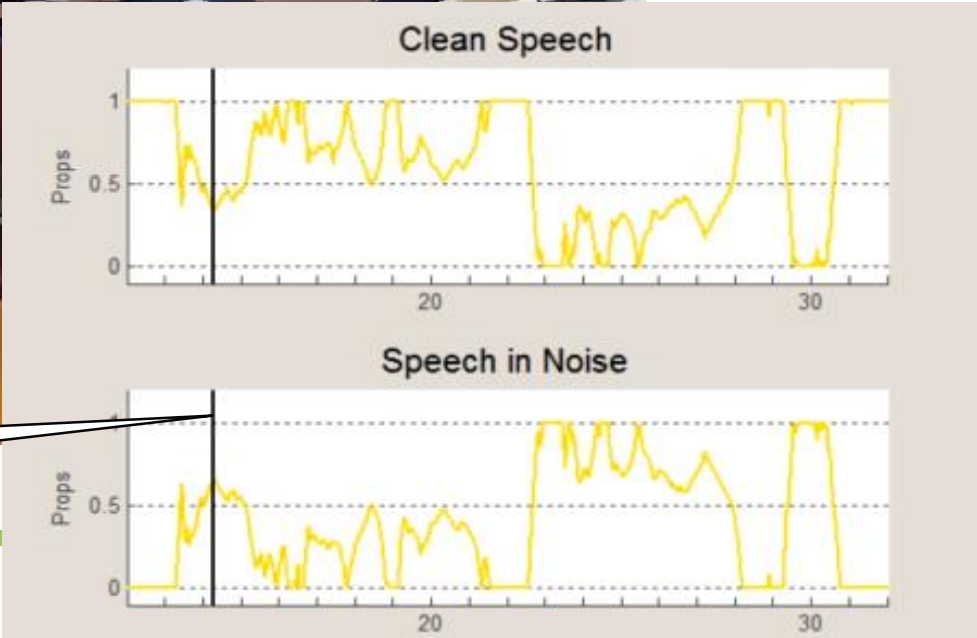
Ground truth analysis – Distribution of scene types

3 children
Age: 11 years
12 hours of recordings

PHONAK
life is on

Ground truth analysis –
"Labelled" scene types of different children in same class
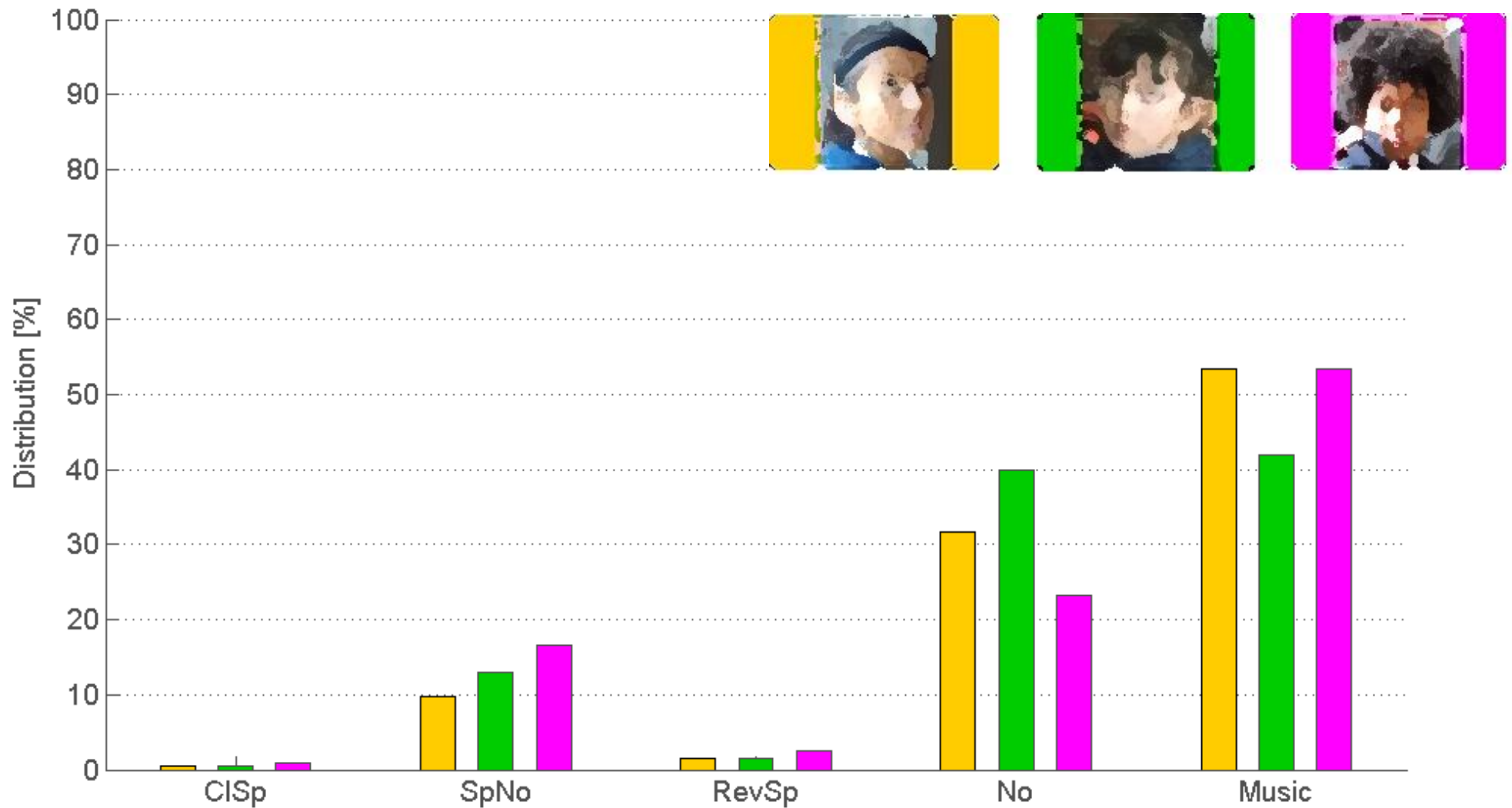

Bogotá (2.6 hours)

Ground truth analysis –
Distribution of scene types times HI sound classes
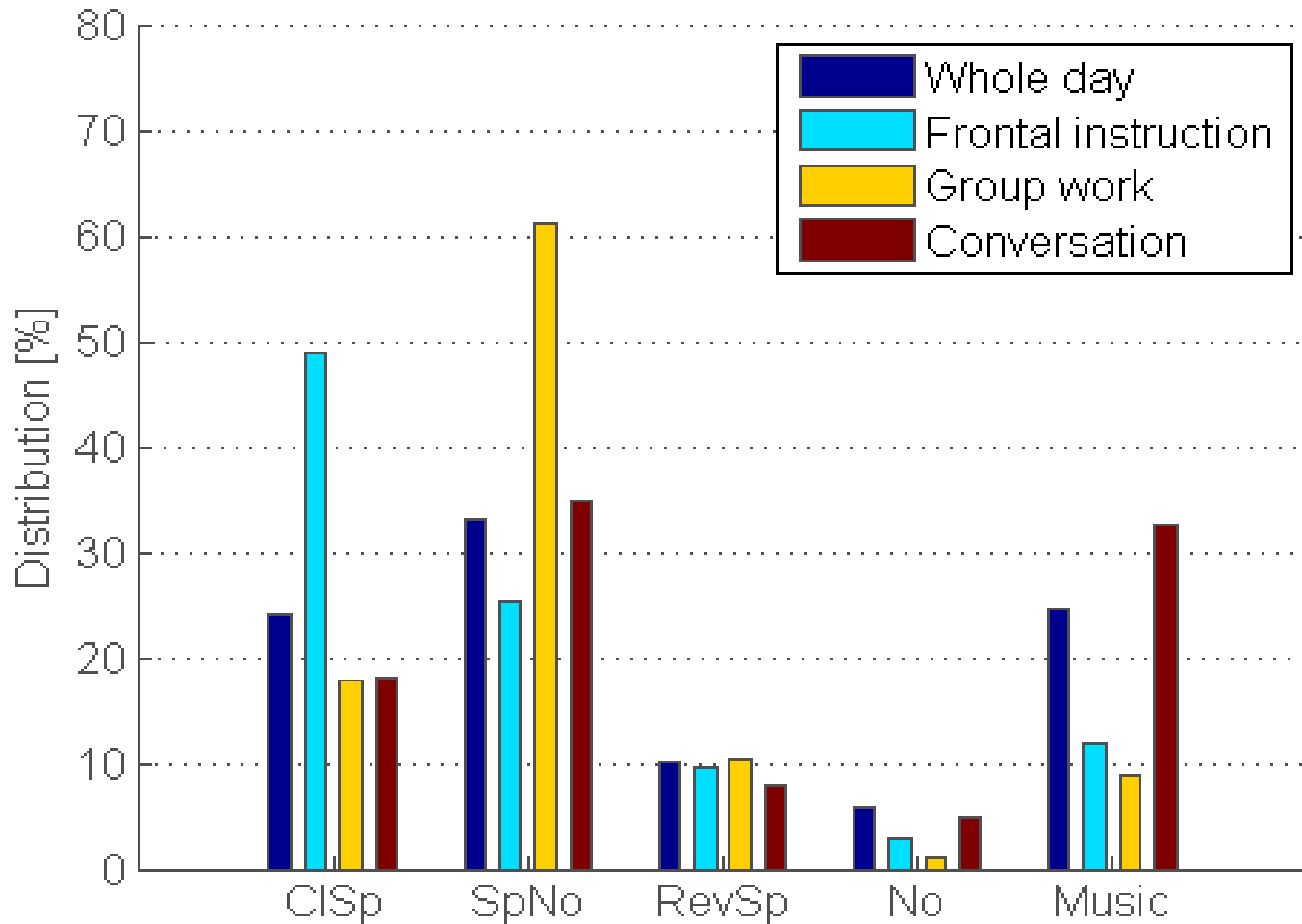
Ground truth analysis –
"Identified" sound classes of different children in same class

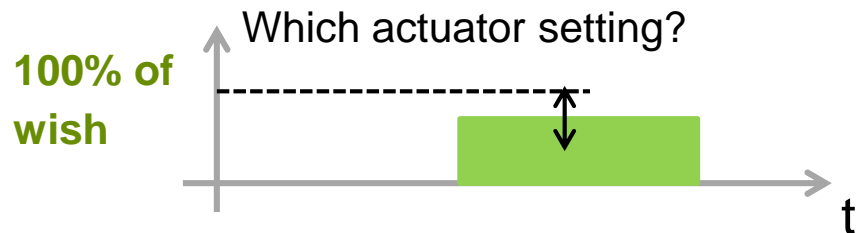# Ground truth analysis – Example: Yelling

Interviews:

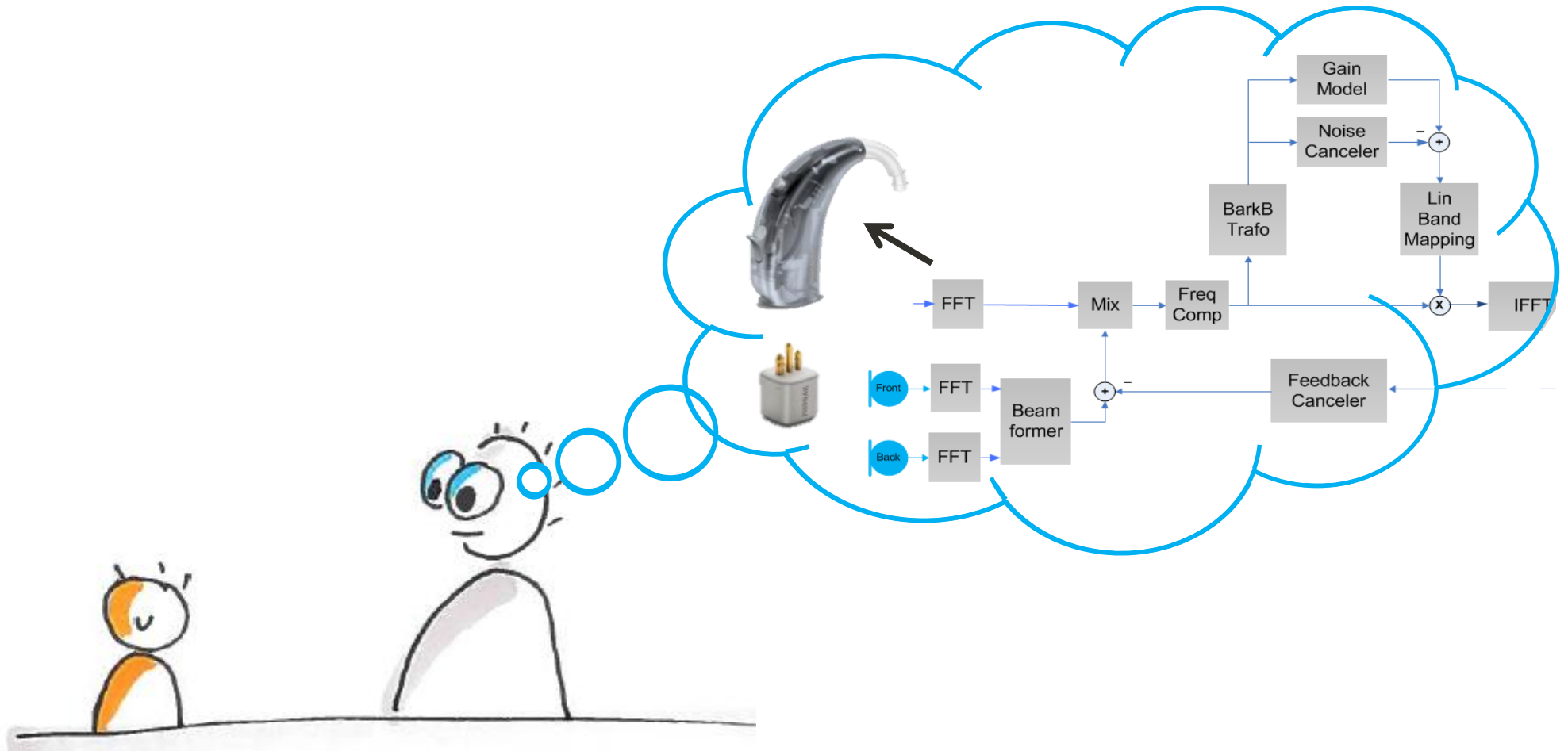▪ Yelling happens in playing, sports, warderobe, pause

Observation:

▪ Child removes hearing aids

Ground truth analyis:

– Yelling so far is recognized as music

– To be recognized as what, processed how?

YELL

100% of wish

Which actuator setting?

t

Ground truth synthesis –
Hearing performance targets, system engineering

Preliminary results –
Variabilities of activities, soundscapes, hearing performance

Age (teenagers, young children)

- Different teaching styles
- Voices (yelling)
- The older → the sharper the structure of classes,
- The older → the more quiet

School

- Room acoustics
- Size of class
- Voice and style of teacher

Culture (Switzerland, Columbia)

Preliminary results –
Hearing performance challenges

Clarity
- Group work: high noise level in the class room, students are talking too softly
- Interactive lessons: students' (distant) speech too soft
  - Localization of the speaker/talker is difficult → causes a delay for lip reading
- Intelligibility of whispered speech
- Understanding of reproduced speech (movie, foreign language CD)
- Fast changes between different forms of teaching lessons
  - Orientation: Who is talking?, high noise floor
- Swimming

Hearing comfort
- Roger and high background noise level → teacher like a "crow" on the shoulder
- Too loud and uncomfortable when children are yelling

Phoneme perception testing for children

Nicola Schmitt

PHONAK
life is on

Why a Phoneme Perception Test?

Phoneme Perception Test

- **Purpose:** Evaluation and fitting of
  - Amplification
  - Frequency lowering

- **Test principle**
  - Meaning-free speech material
  - Subtests with high-pitched phonemes for
    - Audibility
    - Distinction
    - Intelligibility

- **Test validity:** Test results co-vary with
  - Hearing loss
  - Gain settings
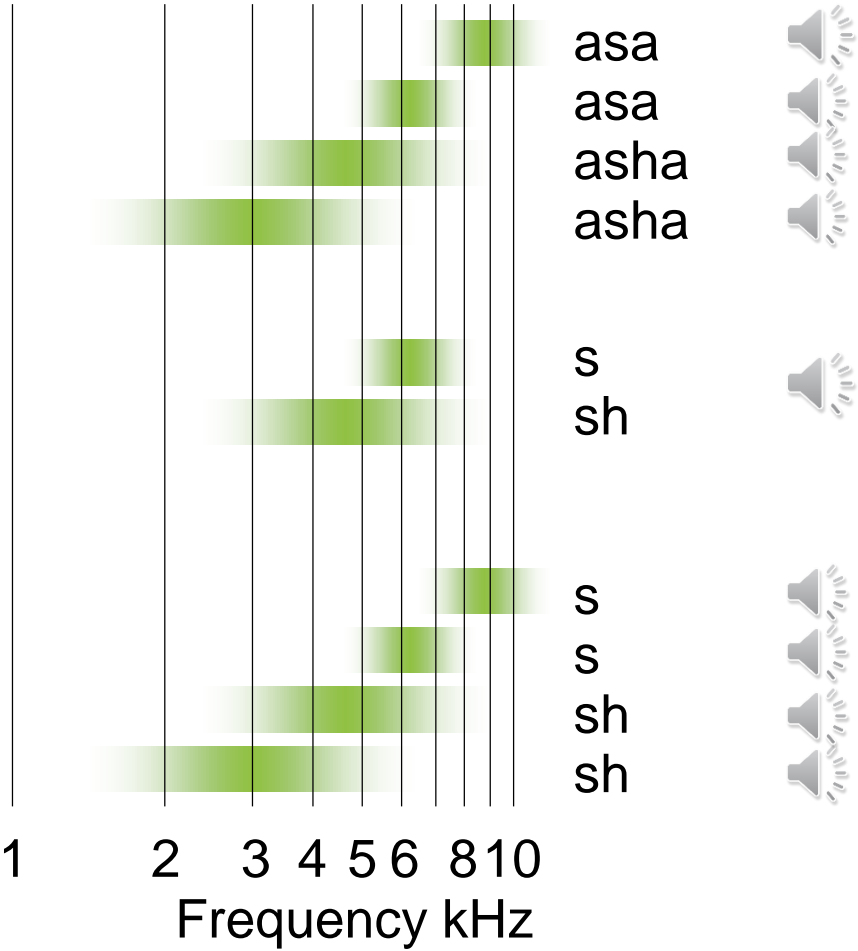 - Settings of frequency lowering

PHONAK

life is on

Subtests

Recognition test

Distinction test

Detection test

asa
asa
asha
asha

s
sh

s
s
sh
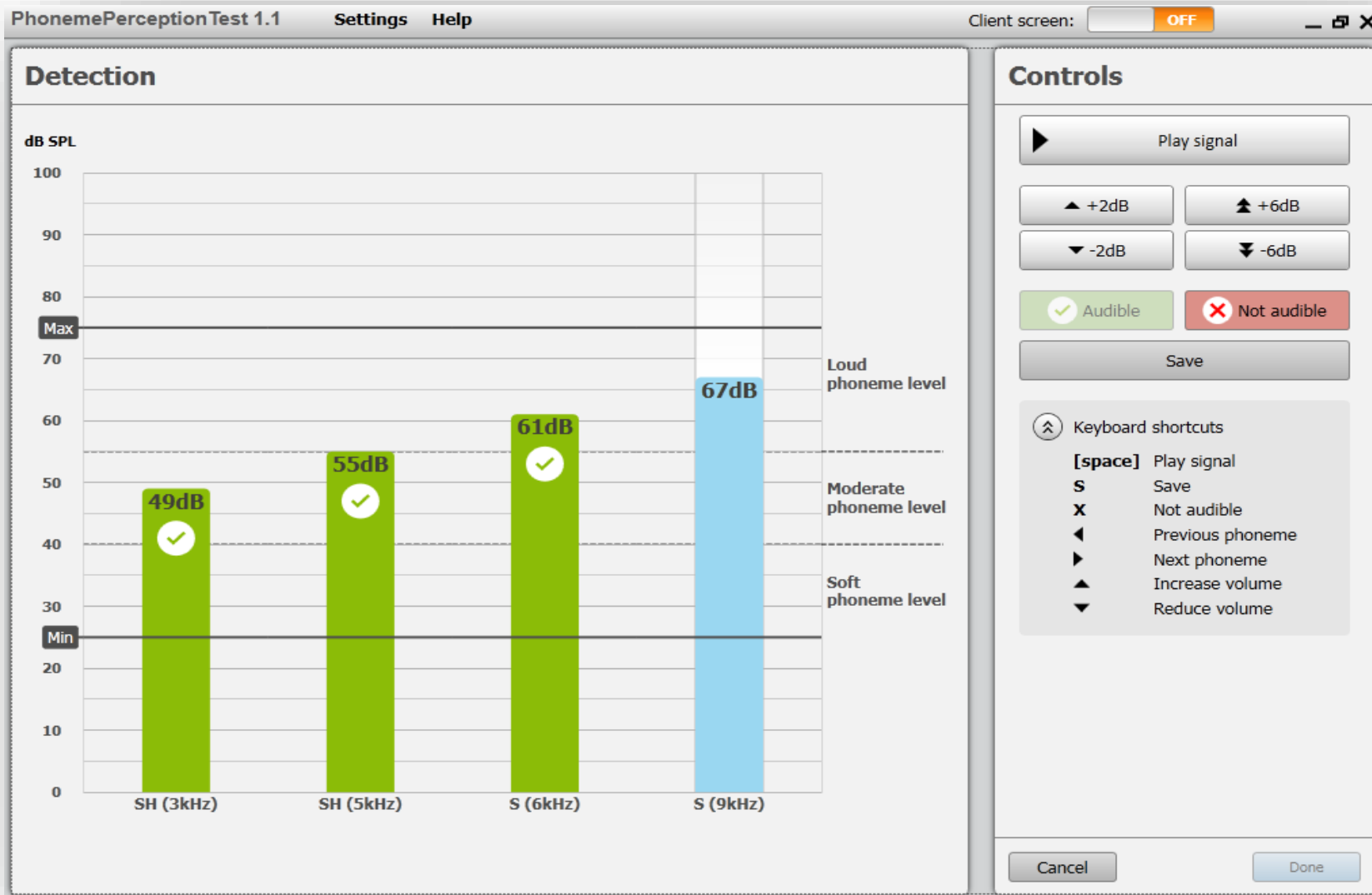sh

1   2   3 4 5 6 8 10
Frequency kHz

PHONAK
life is on

How do the subtests work?

Detection Test

- Method: Same as in pure tone audiometry
- Question to the client: Is the sound audible or not?
- Hearing care professional controls measurement
- Duration: 5 minutes

Detection Test

Recognition Test

- Method: Interactive, adaptive recognition threshold measurement
- Question to the client: Which phoneme is heard in the middle of the word?
- Hearing care professional can interact if client is not able or willing
- Duration: 10 minutes

PHONAK
life is on

Recognition Test

Distinction Test

- Method: Interactive test with repeatedly five sounds being presented – four are identical and one is different
- Question to the client: Which presentation was different?
- Hearing care professional can interact if client is not able or willing
- Duration: 5 minutes

PHONAK

life is on
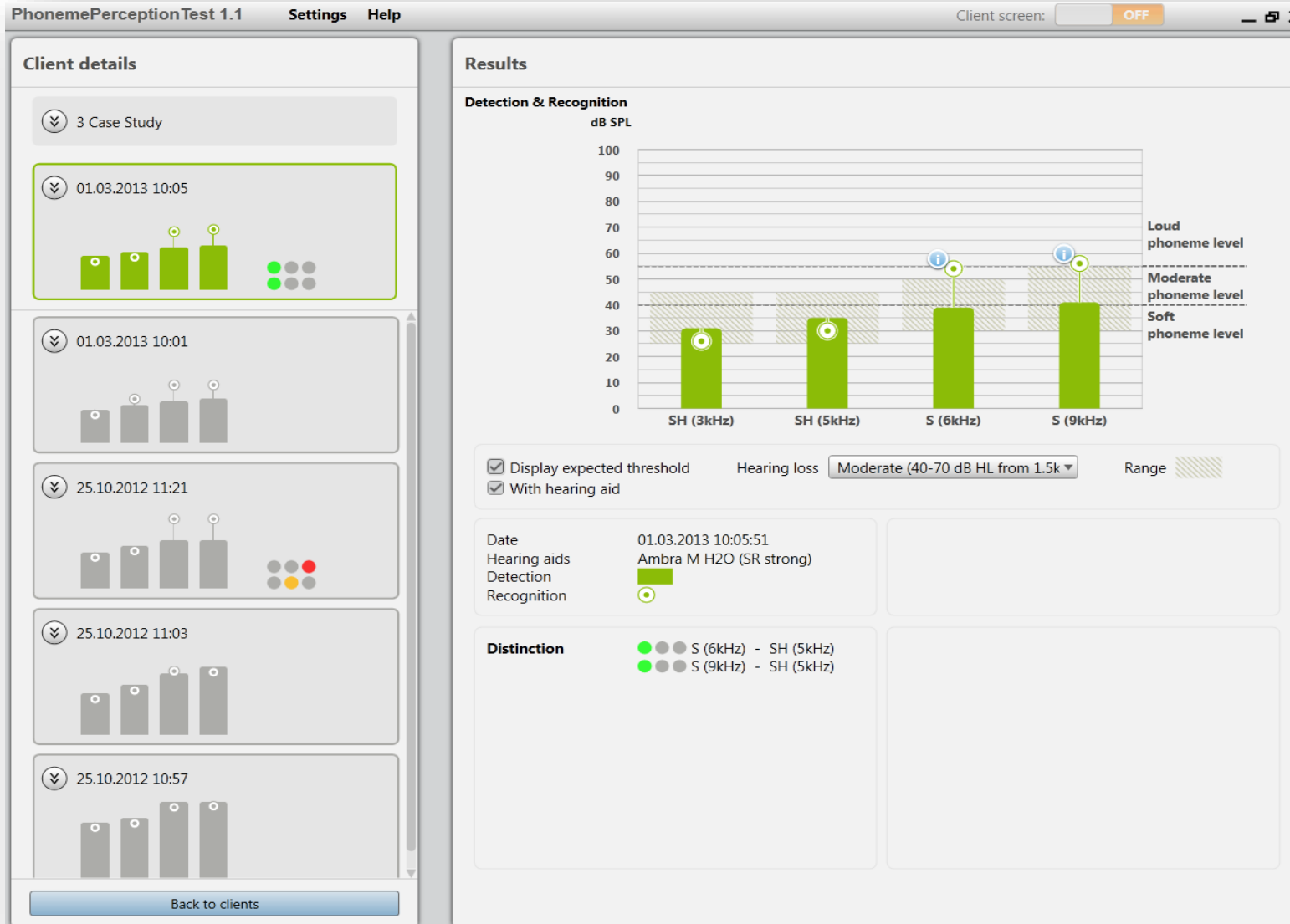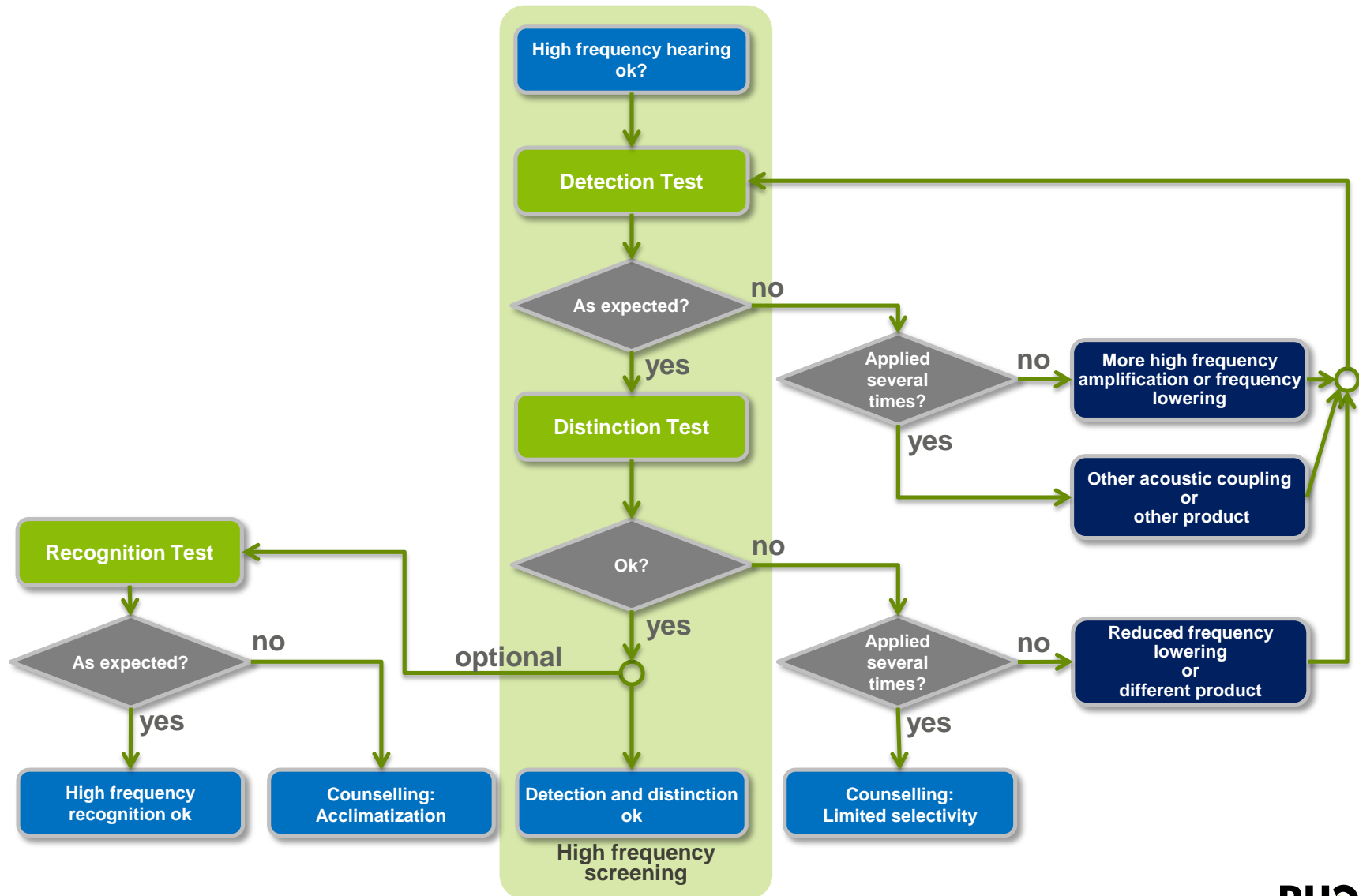
Distinction Test

Display of Results

Application in clinical practice

PHONAK
life is on

How could a Pediatric Version look like?

Methodic approaches for a pediatric version
Target group: 4 to 7 year old children

|	Detection measurement	Distinction measurement
Psycho-physical method	1I-2AFC method Choices: heard, not heard	2I-2AFC method Choices: equal, different nIFC method Choice: the one which is different
Attraction of attention	• Check if jumping animals make a sound • Check if animals make a sound if you touch their belly Make stamps on a picture • Play audiometry principles • «Circus Game»	• Sound «memory» game: Find the pairs of «same» sounds • Find the sound with is different

Principle 1: Attractive game-like measurement

- Children not only want to play. They sometimes want to do very serious stuff – like adults.

- The measurement approach needs to be attractive enough to keep the child's attention.

PHONAK
life is on

Pediatric Version: Jumping Animals
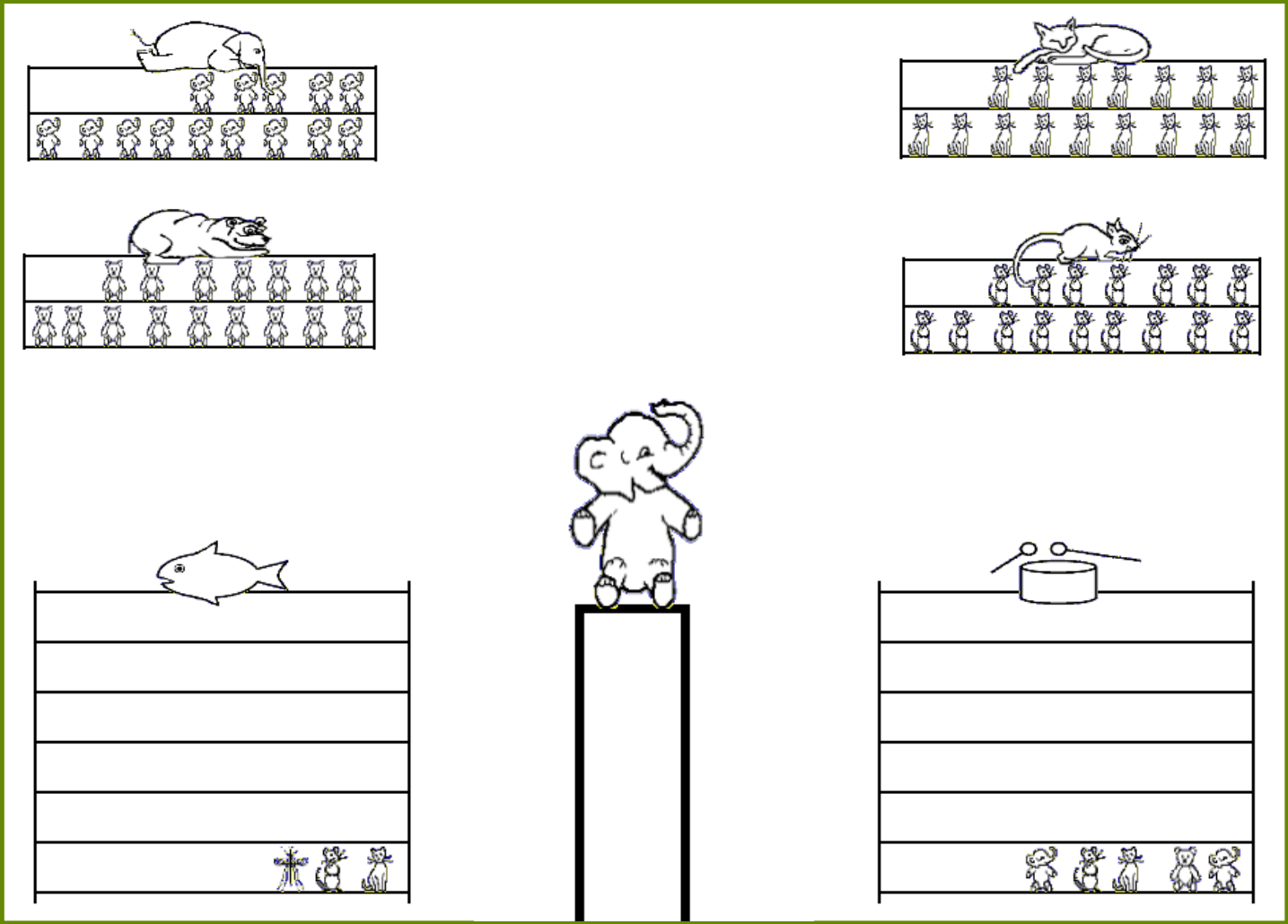
Pediatric Version: Stamping a Picture

PHONAK
life is on

Pediatric Version: Creating a cartoon character

Pediatric Version: Circus Game

PHONAK
life is on

Pediatric Version: Circus Game

Animals jump automatically into the arena

Click on pedestal when animal makes noise

Click on trampoline to check if animal makes noise

Click on straw when animal makes no noise

PHONAK
life is on

Principle 2: Economic use of the childrens' attention

- The children themselves pace the execution of the test.

- They know best when they are able to actually attend to the stimulus presentations.

PHONAK
life is on

Summary

Real life hearing performance assessment with children

- Identifying opportunities to improve solutions for children
- Engineering in real life

Phoneme perception testing for children – 4 to 7 years

- Detection measurement
- Distinction measurement

Thank you for your attention!

PHONAK
life is on