



HNO-Klinik, Kantonsspital Aarau

Paedaudiology

Summerschool 2016



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Leiterin Audiologie, Neurootologie, Phoniatrie

Contents

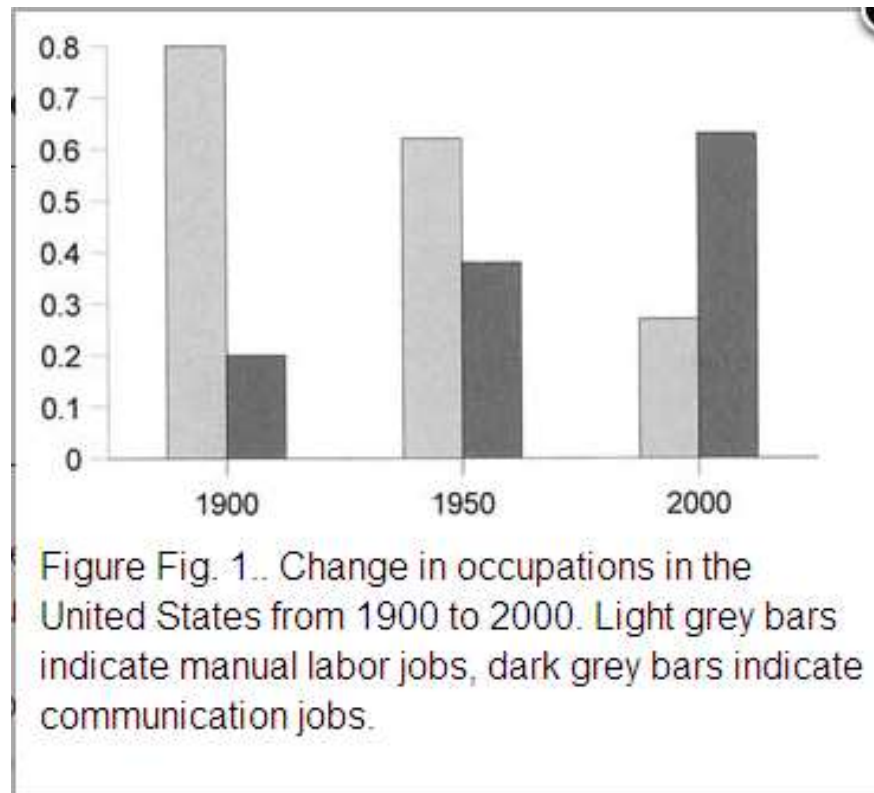
- introduction
- diagnostics of hearing impairment
 - case history
 - auditory testing
- treatment of hearing impairment
- beyond the cochlea





Introduction:

Development of Communication Dependent Jobs





Introduction

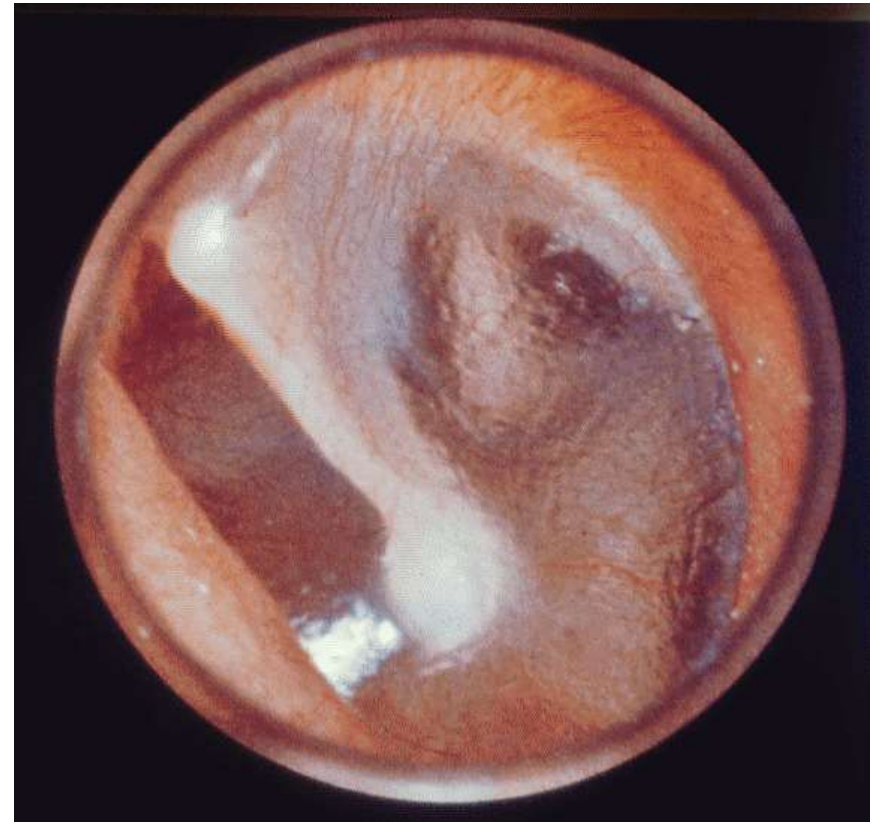
Diagnostics for Hearing Loss

- The earlier the better...
- ... at 3 months different reactions are observed to speech stimuli in the mother tongue as opposed to foreign languages.
- ... canonic babbling from approximately 6 months onwards is language specific.
- ... missing amplification results in impairment in the emotional, intellectual, linguistic and social development.



Diagnostics of Hearing Loss

- case history
 - hearing
 - general health
 - development (speech/motor)
- ENT examination
- audiological testing
 - subjective tests
 - objective tests





Diagnostics in Hearing Loss

Case History

- reactions to auditory stimuli
- evt. Little Ears Questionnaire (Medel)
- risk factors
- speech development
- Motor skills (gross and fine motor function)



Diagnostics – Case History

Development of Auditory Behaviour



from 0 – 24 months
development of auditory behaviour normalized
data

35 questions yes/no answers
In many languages

Comparison number of yes/no to normal
control group

Lit: Coninx F et al (2009) Int J Ped ORL
73, 1761



Case History

Risk Factors for Permanent Hearing Loss

- preterm birth (< 32 gw)
- perinatal hypoxia
- weight at birth < 1500g
- Apgar 5 minutes < 4
- ventilation in neonatal period
- transfusion for jaundice
- infections pre/postnatal (Toxoplasmosis, Rubella, CMV)
- meningitis, encephalitis
- ototoxic drugs
- abuse of medication, drugs, alcohol
- inpatient treatment for head trauma
- family history of hearing loss
- dysmorphic features

BUT: Above only account for 50% of hearing loss



Core symptom
impaired speech development



Diagnostics

Milestones of Speech Development

- 7. week	crying
6. week - 6. month	cooing/babbling stage non linguistic/pure motor vocalisation with vowels and consonants
6. month - 9. month	canonic babbling language specific- baba, lala
9. month - 12. month	intentional use of speech
12 month	one word utterances
18 months	two word utterances, questions
3 years	three word utterances
4 - 5 years	complex sentences lexicon > 1000 words



Diagnostics

Normal Speech Development

- **lexicon:** reference point age appropriate books
overgeneralization -> refinement
- **articulation:**
development from front to back
at age 5 all language specific sounds have to be present and should be used correctly

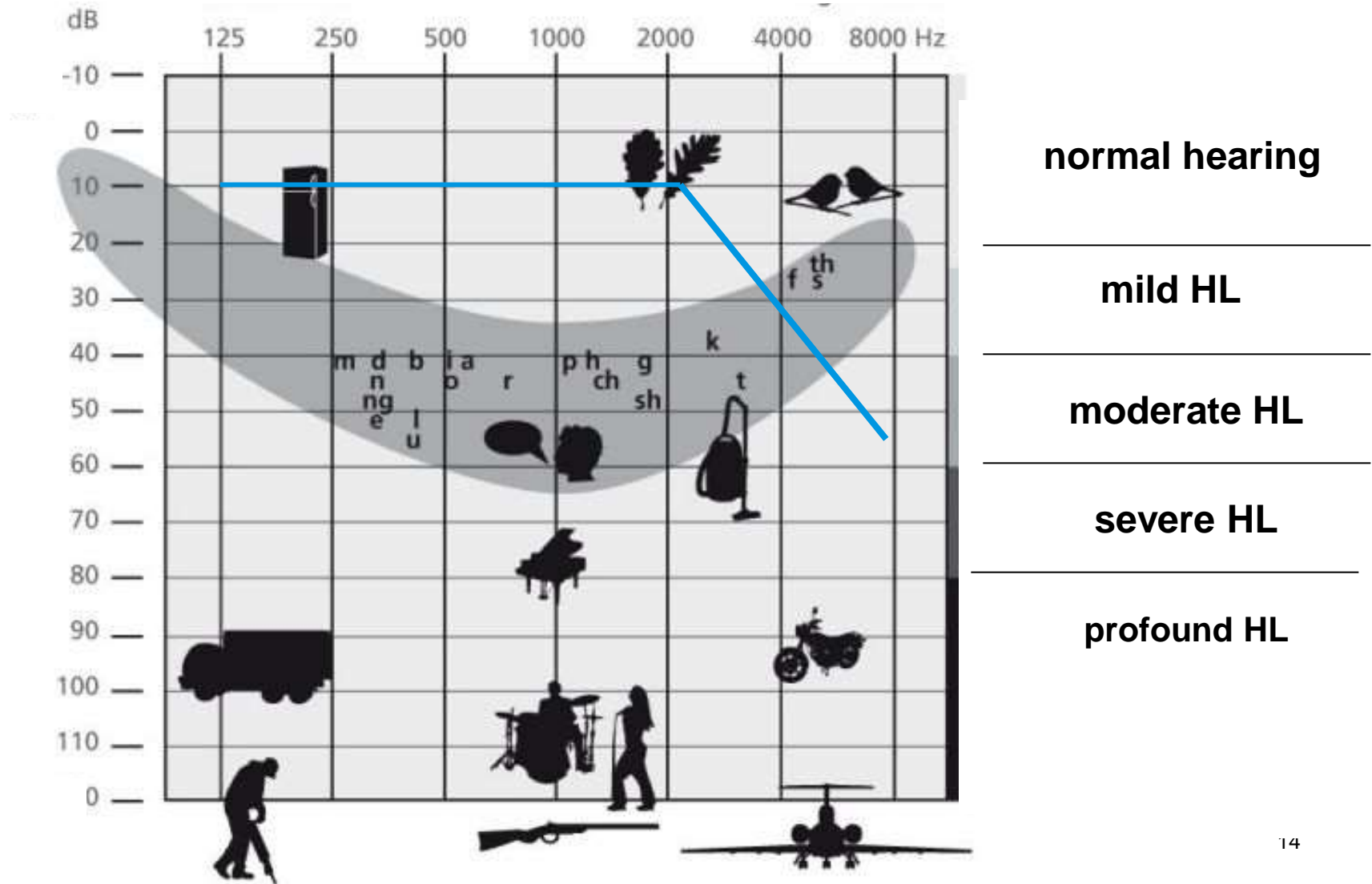


Diagnostics – Case History

Speech Development and Hearing Loss

	first word utterances	two word
normal hearing	9,8 months	17,8 months
mild hearing loss	12,8 months	22,5 months
moderate hearing loss	20,7 months	36,2 months
Severe/profound hearing loss	29,6 months	69,6 months

Field of Hearing with Speech Sounds



Diagnostics

Auditory Assessment

objective tests:

- impedance: tympanometry, stapedial reflex
- electric Response Audiometry: Bera, ASSR,...
- otoacoustic emissions: SOAE, TOAE, DPOAE

- **subjective tests:**

- active cooperation necessary
- pure tone audiometry
- speech perception with/without noise

age dependent measures



Diagnostics: Auditory Assessment - Objective Tests

Impedance

- tympanometry
- stapedial reflex
- use
 - middle ear diagnostics
 - screening of auditory nerve



??



Diagnostics Auditory Assessment – Objective Tests

Otoacoustic Emissionens (OAES)

- spontaneous OAES
- evoked
 - transient evoked OAES (TOAES)
 - distortionsproduct emissionen (DPOAES)
- limited frequency and loudness specificity





Diagnostics Auditory Assessment – Objective Tests

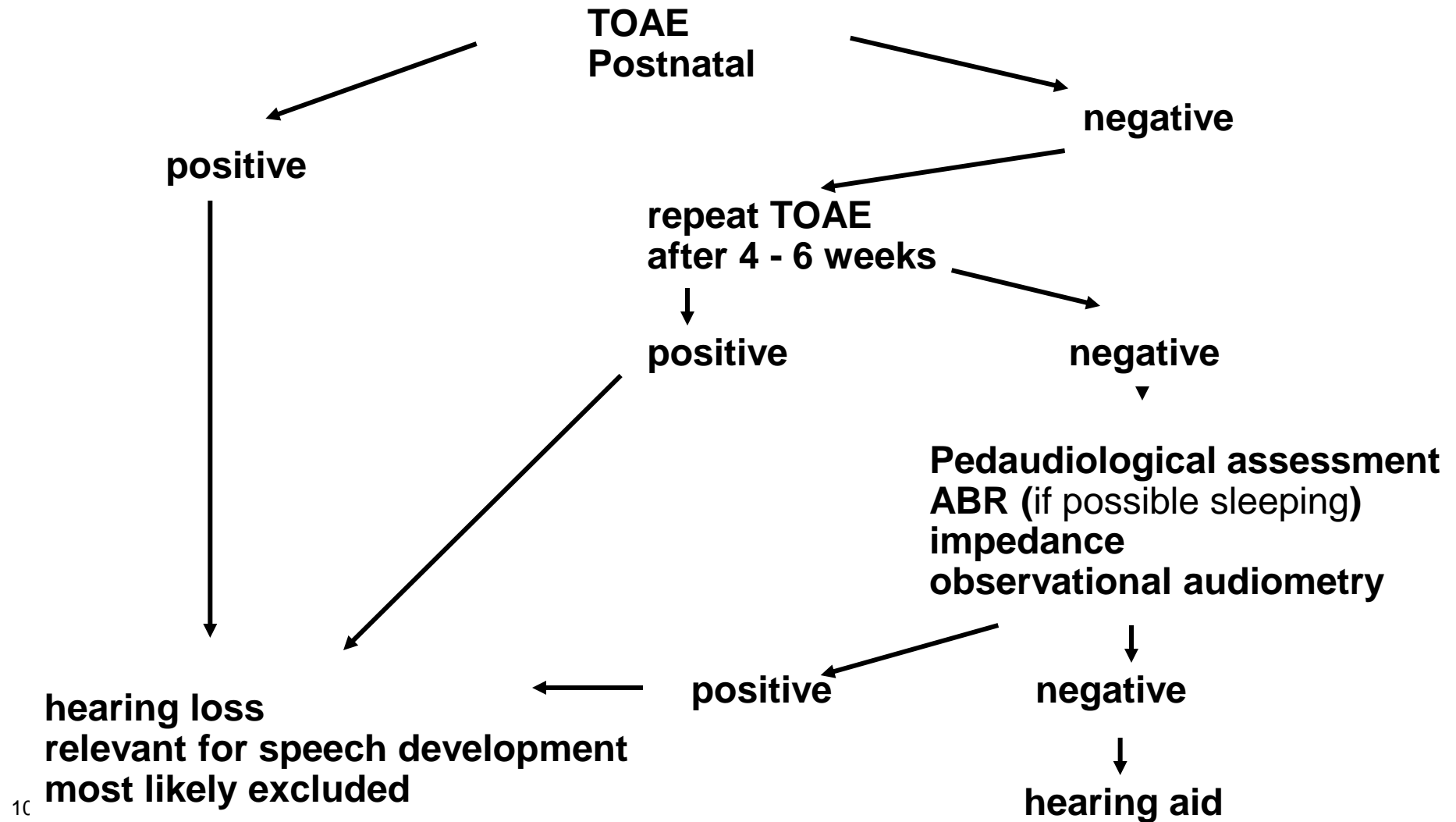
Transient Otoacoustic Emissions (TOAES)

- confirmation of subjective results
- Screening for hearing loss – universal neonatal hearing screening

Neonatal hearing screening makes sense because

- sensorineural hearing loss is the most common inborn defect
- even moderate hearing loss leads to relevant deficits
- we have good means of assessment available
- therapy is available

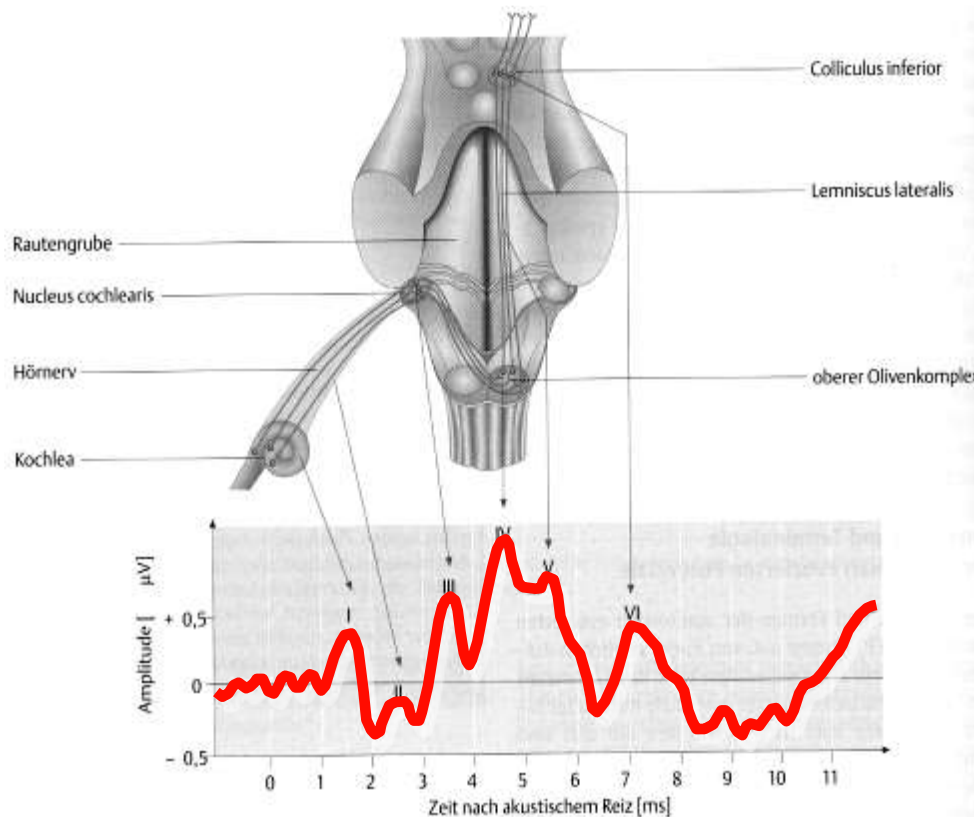
Neonatal Hearing Screening





Diagnostics Auditory Assessment – Objective Tests

Click-ABR / Notch – Noise – ABR



- EEG-based measures
- Click ABR:
- limited
- frequency specific
- 1 – 4 kHz
- loudness specific
- Notch-Noise-ABR/ASSR:
- loudness specific
- frequency specific
- low frequencies 0.5 – 1kHz



Diagnostics Auditory Assessment– subjective tests

Pure Tone Audiometry - Adaptation for Children



free field
observational audiometry



Diagnostics Auditory Assessment– subjective tests

Pure Tone Audiometry - Adaptation for Children



visual reinforcement
Audiometry (VRA)

[https://
www.youtube.com/
watch?v=S21D7vfP6Go](https://www.youtube.com/watch?v=S21D7vfP6Go)

play audiometry
(no picture)

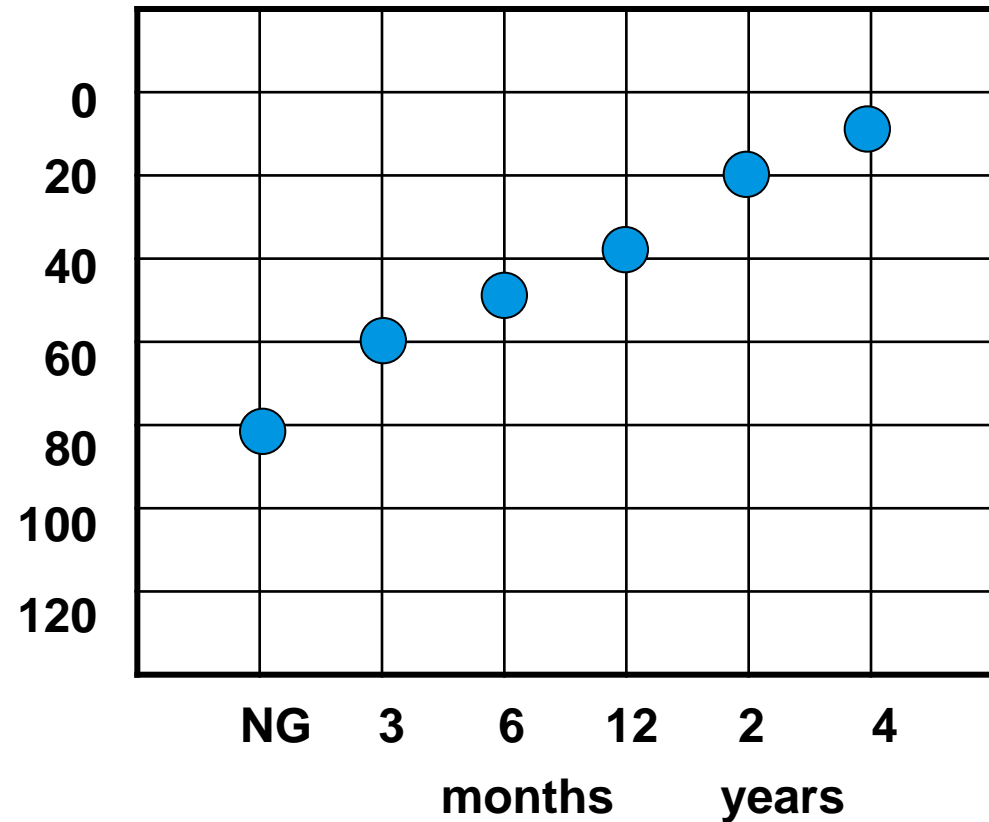
[https://www.youtube.com/
watch?v=_eKn-lrGYZo](https://www.youtube.com/watch?v=_eKn-lrGYZo)



Diagnostics Auditory Assessment– subjective tests

Pure Tone Audiometry - Adaptation for Children

- frequency specific
- volume specific
- age adapted mode:
 - Observational up to 1 yr
 - Pure tone audiometry with conditioning
 - from 1 year of age
- Problem:
 - volume needed for reaction is
 - age dependent
 - cooperation dependent





Diagnostics Auditory Assessment– subjective tests

Speech Perception Tests

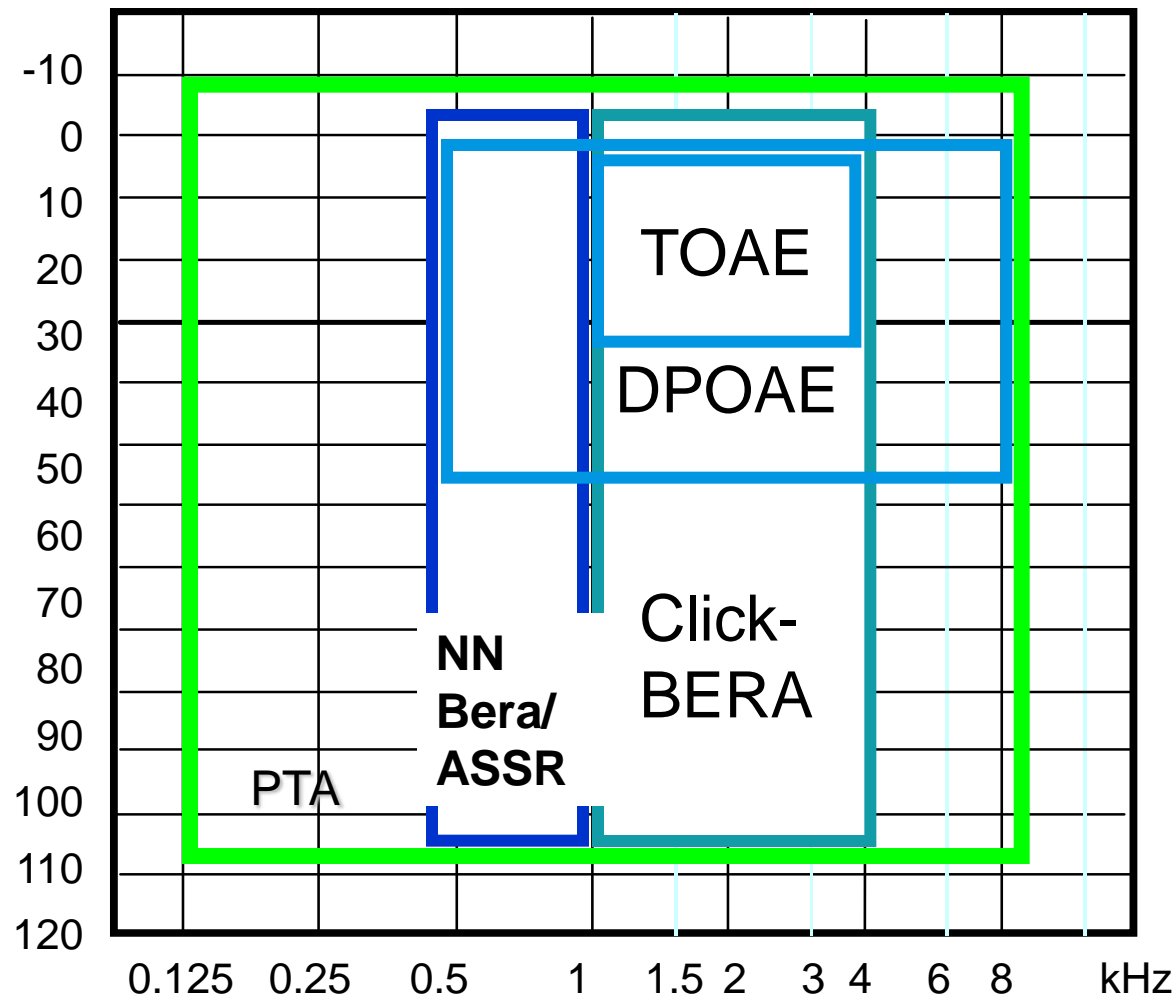
age specific vocabulary
 with and without noise
close set/pictures from age 2
open set/oral answers from age 4

problem: speech development
 language

mostly used for hearing aid assessment



Summary Auditory Assessment Objective + Subjective Auditory Assessment

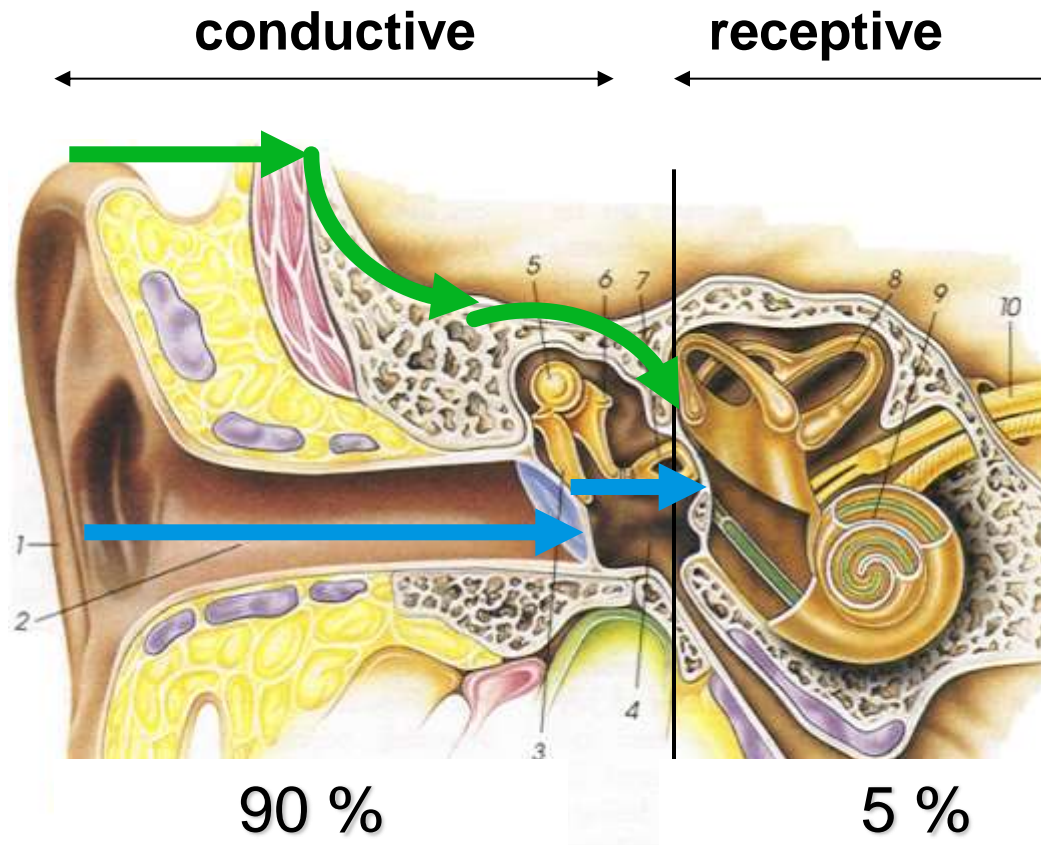


..therefore

- Only a combination of
- **objective + subjective assessment**
 - **+ developmental data**
- allow optimal treatment decisions

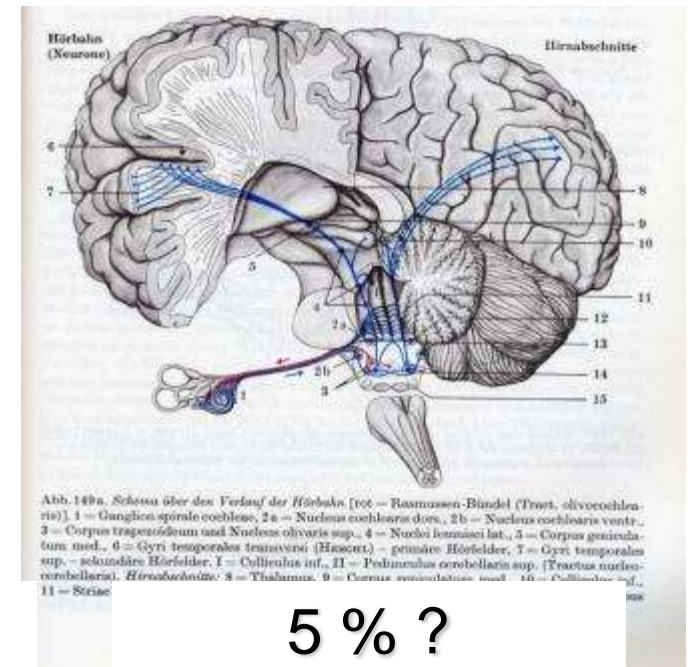


Different Types of Hearing Loss



**conductive
hearing loss**

**sensorineural
hearing loss**



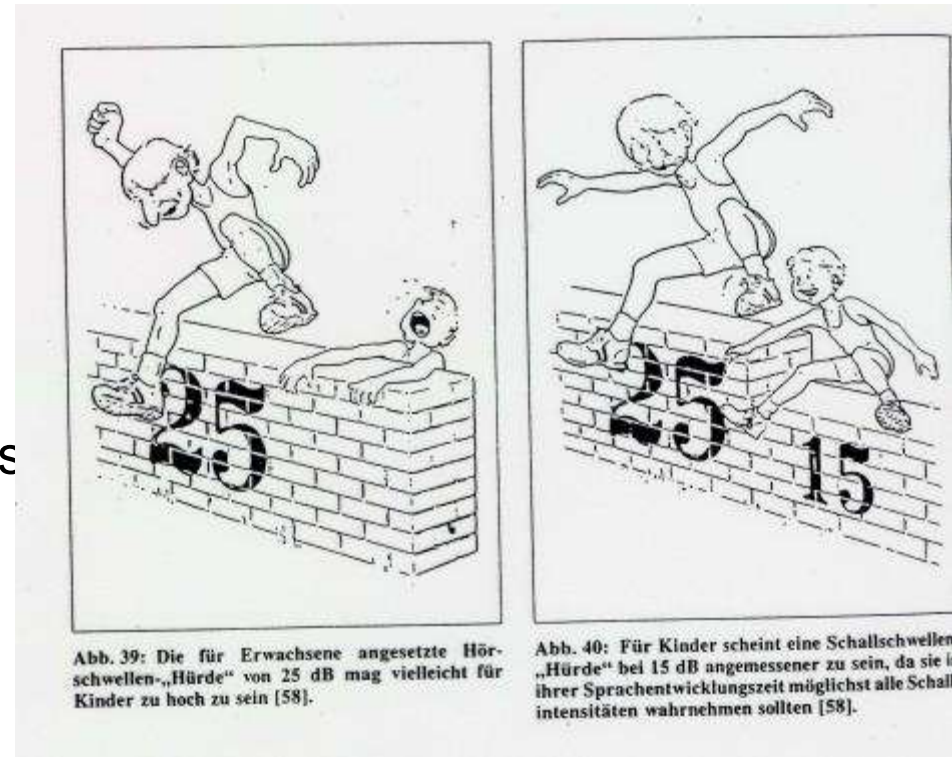
**central auditory processing
disorder**

Therapy of Sensorineural Hearing Loss in Children

- like in adults but if necessary and possible
- always bilateral
- conventional hearing aids always BTE
- bone conduction hearing aids
- implantable hearing aids
- cochlear implant
- FM-Systems

Therapy of mild hearing loss

- Hearing impairment :
- 20 – 40 dB
- Symptoms:
 - delay of speech development
 - impaired understanding in noise
- Therapy:
 - Hearing aid





Therapy of Sensorineural Hearing Loss in Children

- FM Systems





Therapy of hearing loss in children

Unilateral hearing loss

Hearing impairment :

normal thresholds one ear

any grade of hearing loss other ear

Symptoms:

impaired understanding in noise

impaired directional hearing

Therapy:

hearing aid evt. Cross aid

Baha

FM



Therapy of Hearing Loss in Children

Cochlear Implant

Indication

threshold > 70 - 90 dB

poor speech development

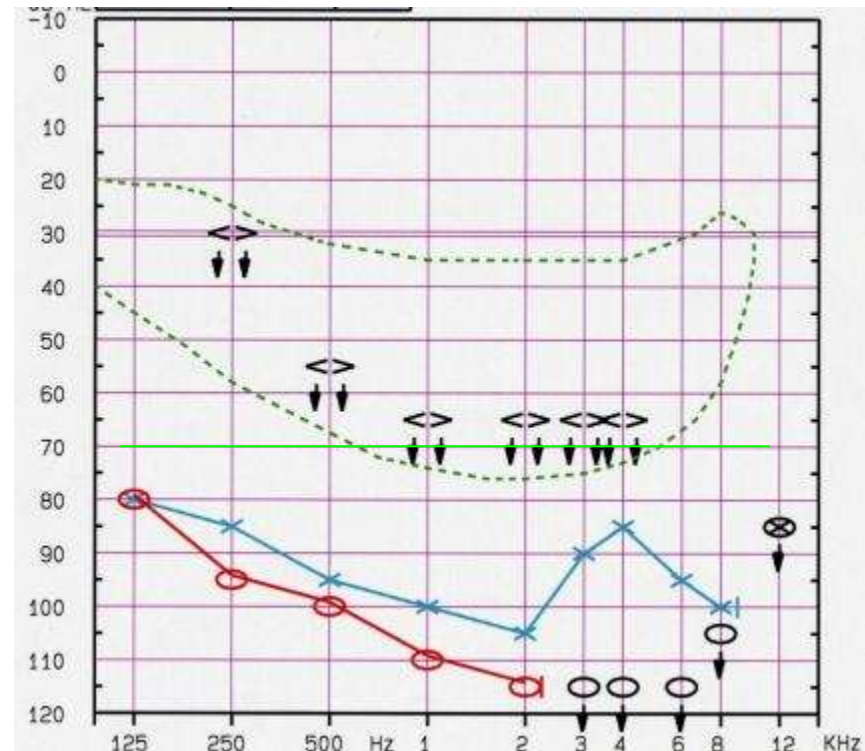
after optimal

hearing aid trial of 6 months

support of family/audiopedagogues

if no speech development

implantation if possible around
age 1



Conduct

External Ear Canal Atresia

- **After Birth**
- ABR
- mostly normal inner ear
- 60 dB conductive hearing loss
- bone conducting hearing aids
- **6 – 9 months**
- repeat ABR if dubious
- **Approx 5 – 6 yrs**
- CT
- Baha, implantable hearing aid,
- plastic surgery



Courtesy C. Schwob

Therapy of Hearing Loss

Unilateral External Ear Canal Atresia

- **After birth**
 - OAES normal contralateral
 - => counselling
 - talking to open side
- **monitoring of speech development**
- **Further treatment dependent on problems**
 - BAHA/implantable hearing aid
 - plastic surgery

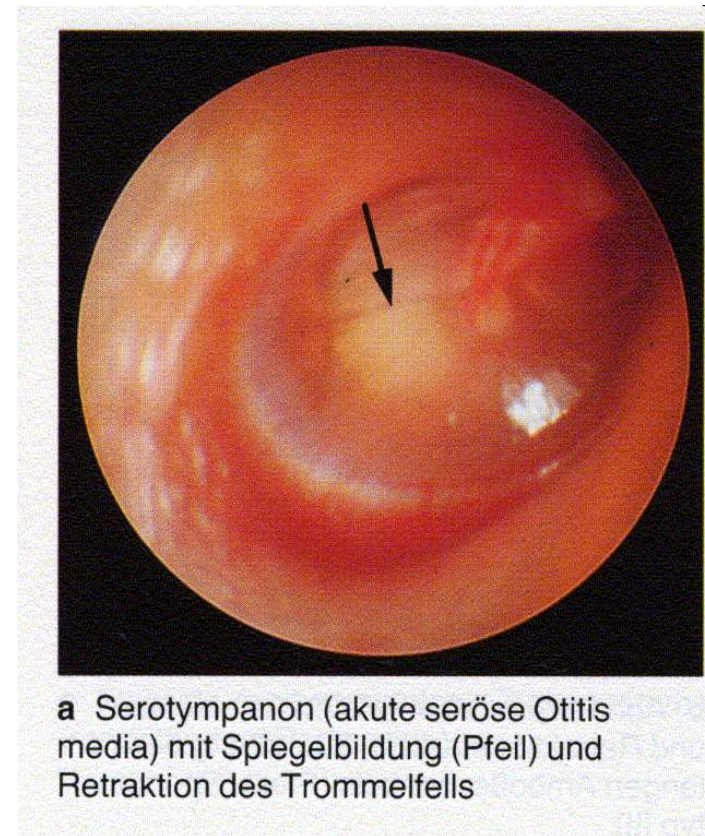




Therapy of Hearing loss

Chronic Otitis media with effusion

- **Therapy**
- **Conservative**
- Steroids
- Otovent
- If persistent tubes
- time scale
- dependent on speech development





Beyond the Cochlea: Auditory Neuropathy

Mixtures of Pathologies

- Symptoms:
 - Speech perception and development impaired
 - Symptoms extremely variable and fluctuating
- Results of audiological testing
 - Otoacoustic emissions present
 - ABR pathological
- Therapy:
 - hearing aids
 - cochlear implant

Summary

Therapy of Pediatric Hearing Loss

Similar to adults

BUT

TAKE SPEECH DEVELOPMENT
INTO ACCOUNT





Beyond the Cochlea

And there are some different kids....

- **History** : difficulties at school, dyslexia
 - problems auditory memory, hearing in noise,
 - discrimination of sounds, directional hearing
 - **Results ENT**: normal peripheral hearing
- *Suspected*
- *Central Auditory Processing Disorder*
 - *(CAPD)*



Beyond the Cochlea

Central Auditory Processing

- ... processes in the auditory pathways from brainstem upwards
- auditory memory
- auditory selection selection of information from background noise
- binaural summation fusion of different parts of one word presented to both ears
- auditory localisation recognition of direction of sound
- auditory separation evaluation of different information from both ears at the same time
-



Beyond the Cochlea

Central Auditory Processing Disorders

Prior to assessment for CAPD exclusion of

- sensorineural hearing loss
- intelligence deficiency
- attention deficit disorder

Diagnostics:

- all processes have to be tested
- not for all processes test available
- often no age dependent norm group
- no common standard



Incidence of Pathological Testing in CAPD

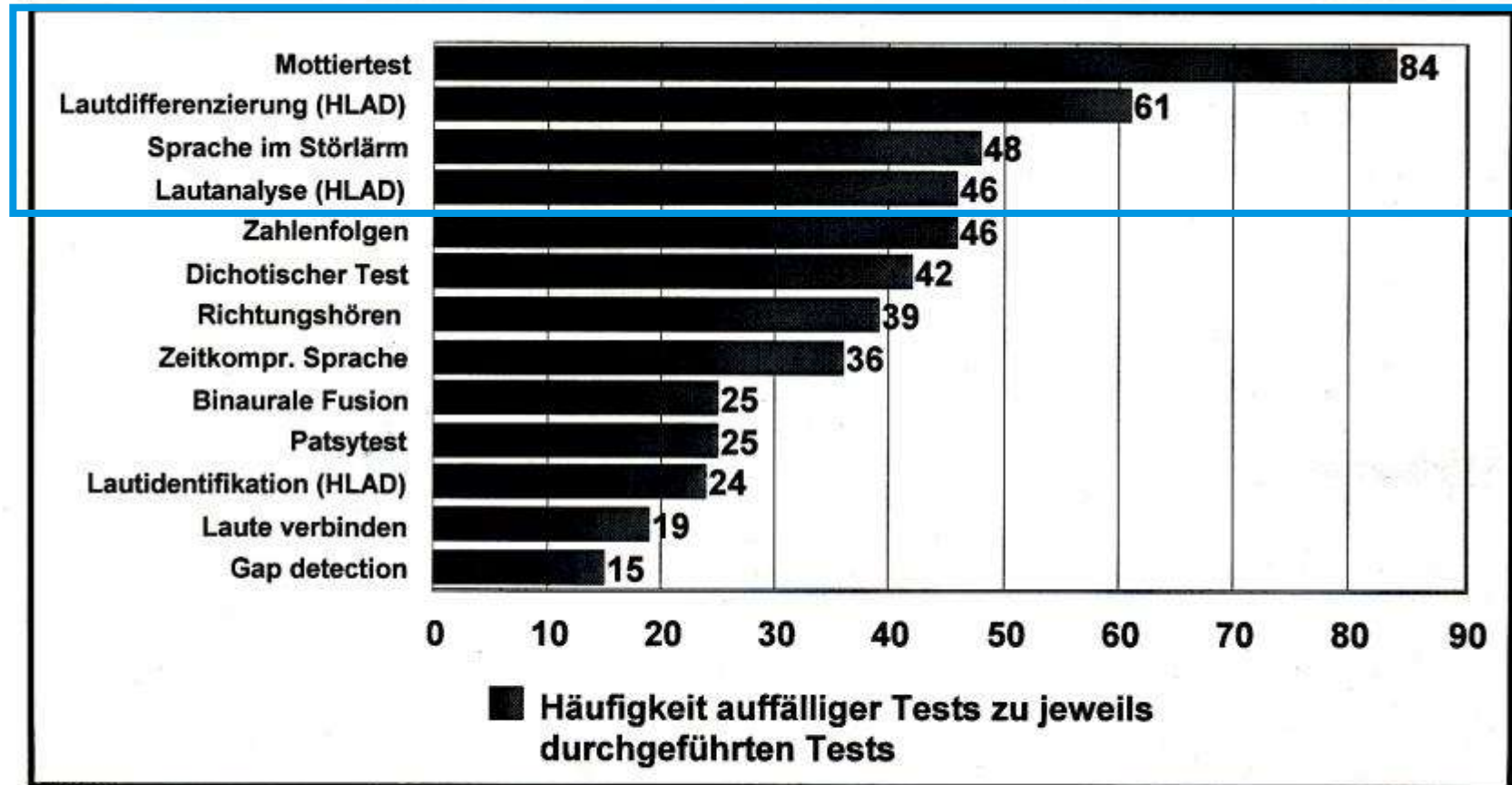


Abbildung 2: prozentuale Häufigkeit auffälliger Tests bei 79 Kindern mit modalitätsspezifischer AVWS



- **Thank you for your attention**

