

# Verification of a Set of Speech Perception Tests for Children with a Cochlear Implant

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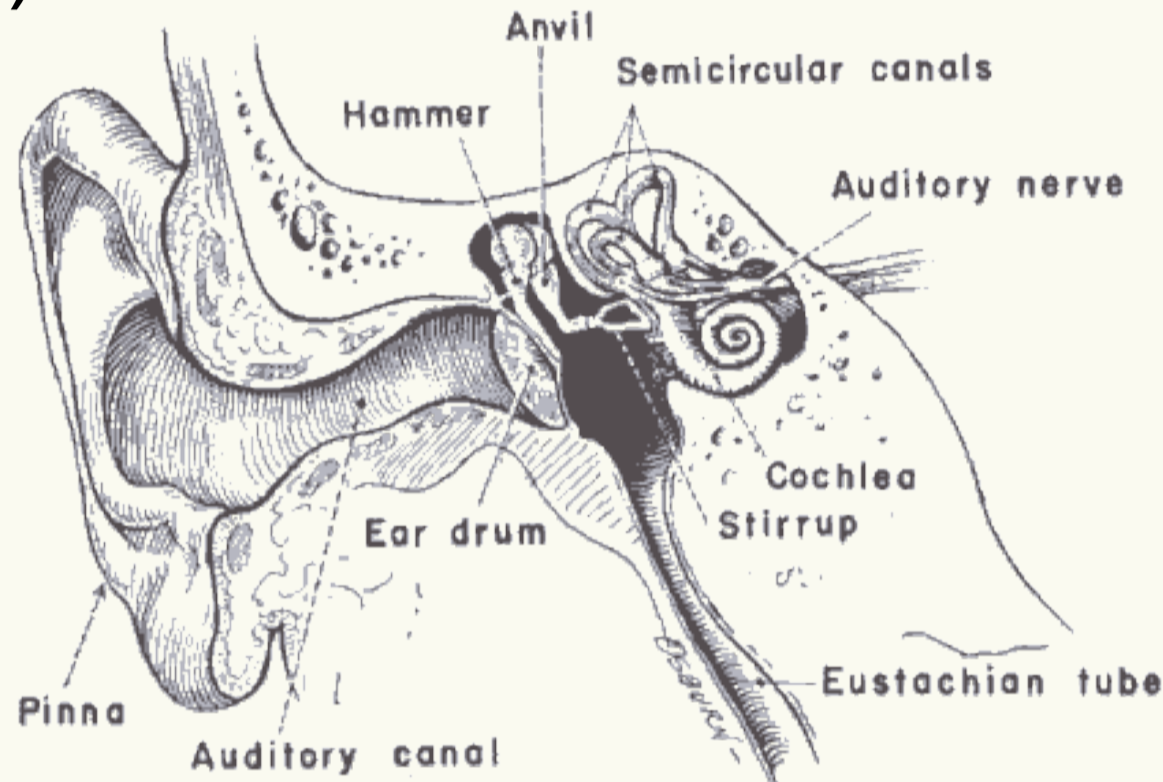
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## Speech perception tests

- Essential component of human communication
- Different kinds:
  - labelling / discrimination
  - sometimes synthetic speech
    - speech-like stimuli enable careful control
- Test series for children with cochlear implants
- Need 'to test the tests'

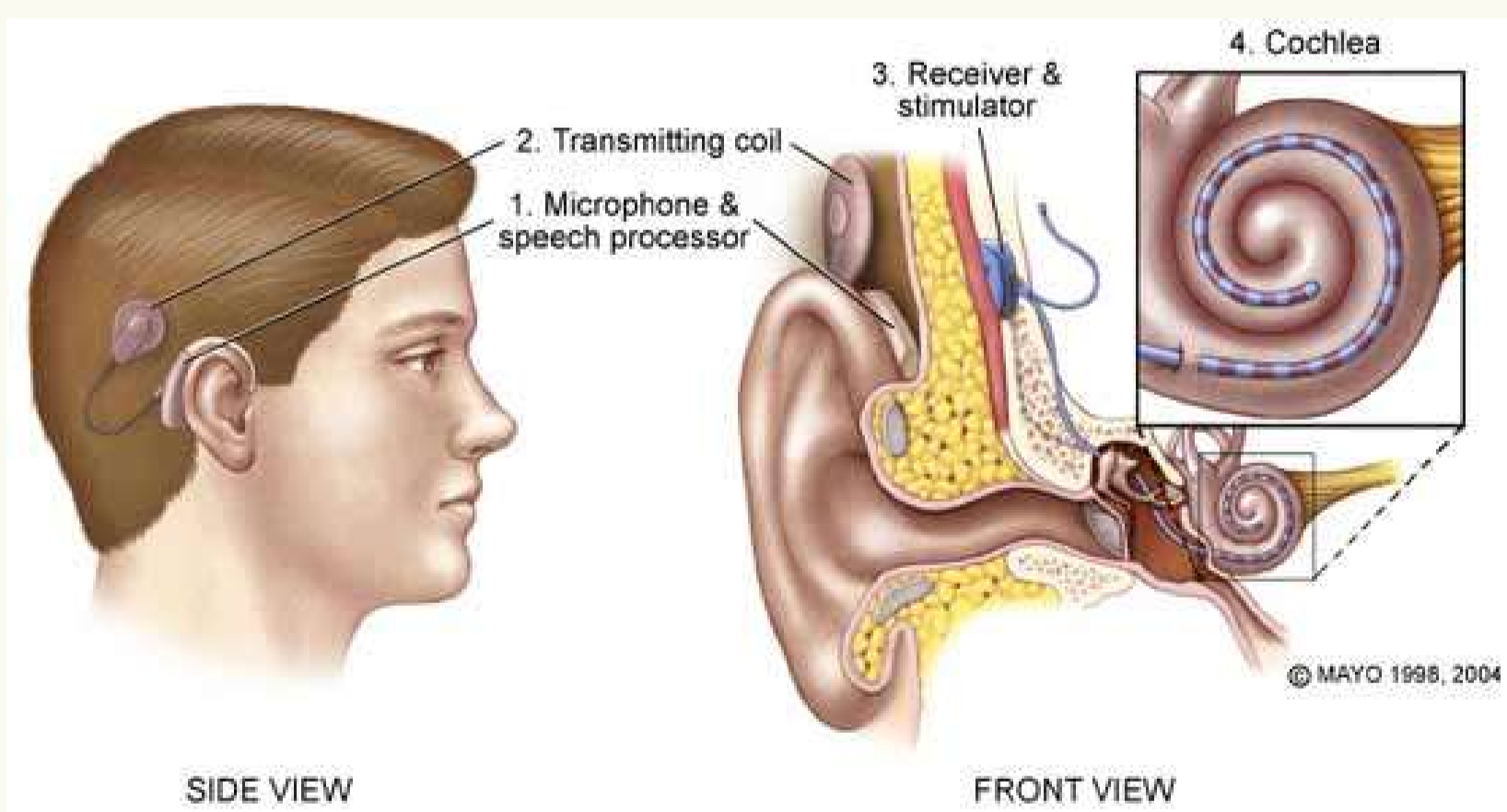
## The hearing mechanism

- Sound enters the outer ear (pinna, auditory canal)
- Sound is amplified in the middle ear (ossicles: hammer, anvil, stirrup)
- Sound is analysed in the inner ear (cochlea: basilar membrane, organ of Corti)



## Cochlear implants

- Microphone: speech input
- Speech processor: filters and digitizes sounds into coded signals, sends these through a thin cable to transmitter
- Transmitter: magnetic pad behind outer ear, transmits processed sound signals by electromagnetic induction
- Receiver/stimulator in bone under skin converts signals into electric impulses, sends them through internal cable to electrodes
- Array of electrodes collects impulses from receiver/stimulator, sends them to different regions of auditory nerve



## Not testing implants - testing the tests!

Testing implants and testing the tests are two separate areas of research.

1) NOT: evaluation of the cochlear implant efficacy, properties of the cochlear implant and effect of these properties on perception and understanding.

2) BUT: evaluation of the level of efficiency, ergonomics, motivation and suitability of the tests for the subject.

## Functional requirements specification

- Subjects: children with hearing deficiency and cochlear implant
- Stimuli: verbal
  - acoustic cues only
  - no visual cues
  - therefore no lipreading
- Content:
  - Voice identification
  - C and V segment identification
  - Word/logatom segment identification
  - Memorisation of units
  - Recognition and intelligibility of phrases
    - simple
    - complex
  - Recognition and comprehension of continuous speech
  - Child asked to draw Mr. Potato



## Equipment

- Computer with Windows
- Loudspeakers
- Touchscreen (or screen + mouse)

## Ergonomic properties

- Tests of different levels of difficulty
- Different tasks assigned to keep the testee interested
- Finish test at any time
- Simple statistic function built-in
- No database – disadvantage
- Touchscreen used – command of using computer mouse not necessary

## Intelligibility

- Easy and intelligible instructions
- Pictures match stimuli
- Readable pictures
- Correctly recorded sounds of the highest quality
- Synthetic speech used to avoid problems of speakers' pronunciation

## Attractiveness

Attractiveness is the key to success:

- sophisticated graphics to attract attention
- different kinds of tasks to avoid monotony
- real images render tests less attractive from children's point of view

## Dialogue modelling

Model a dialogue between child and computer:

- clear and understandable instructions
- computer shows child that his/her answers are correct or incorrect
- no doubts about correctness and incorrectness of answers
- encourage child to do the tests – good positive reinforcement!

## Method: administration of tests

- Designed for children with a cochlear implant
  - able to comprehend speech
  - unable to give verbal responses
- Designed for audiologists to help program cochlear implant
- Designed for speech therapists
  - achievement test
  - teaching material
- For parents' use to help in home therapy
- Tests are composed of two parts:
  - teaching module – familiarisation with content
  - tests – assessment of perceptive and linguistic skills

## Verification and results of tests

- A group of 57 children with normal hearing (4-6-year-olds)
- A group of 15 children with a cochlear implant (2,5-11-year-olds)
- Children as young as four years old had command of using computer mouse
- Similar needs of both groups of children
  - attractiveness and liveliness
  - got bored quickly
  - cartoon-like images preferred
  - some sounds and images were not recognised
  - quality of pronunciation affected level of recognition
  - dialogue modelling insufficient - search for sign of confirmation from testers/parents
- Lip-reading by children with cochlear implant
- Children willing to do tests
- Correctness of answers improves when stimuli were heard more than once (no quantitative results available yet)

## Conclusion

- stimulus attractiveness needs improvement
- improvement of dialogue between child and computer

## References

- [1] Ashby, M. and Maidment, J. 2005. *Introducing Phonetic Science*. Cambridge: Cambridge University Press.
- [2] Clark, J. and Yallop, C. 1995. *An Introduction to Phonetics and Phonology* Second Edition Oxford: Backwell Publishing.
- [3] Pruszevicz, A. (Ed.) 1994 *Zarys audiologii klinicznej*, 1994, Poznań: Wydawnictwo Akademii Medycznej
- [4] Ogórkiewicz, J., Bachan, J., Mazur, M., Komar, M. and Demenko, G. 2005. *A set of speech perception tests for children after cochlear implants - preliminary evaluation*. Poznań: Polskie Towarzystwo Fonetyczne.