Speech perception training for postlingually deafened adult cochlear implant users

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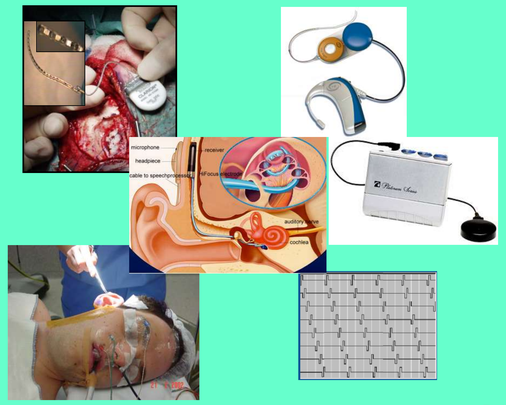
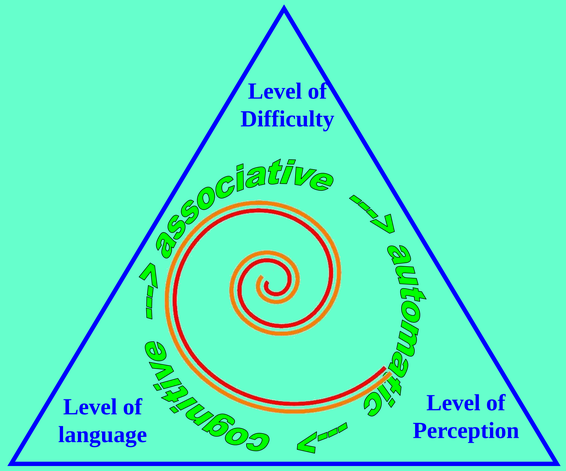
Cochlear Implant & Speech processing



Learning Model



Exercises

Detection → Discrimination → Recognition

Detection	Discrimination	Recognition
The car is in the street. Therapist: How many syllables are there in this sentence? CI-user: 5 Therapist: this is correct!	Therapist: ugu ufu, ufu CI-user: ugu Therapist: this is not correct, not ugu, but ufu, do you hear the difference? CI-user: yes, ugu is louder	Therapist: The cat is in the street. CI-user: The cat is asleep. Therapist: not asleep but in the street! CI user: the cat is in the street Therapist: Yes this is correct.

chain-sentences:

I sit

I sit on a chair

I sit on a chair in a room

I sit on a chair in a room in the hospital

fase 3	fase 4		fase 6	
aa uu	oefoe	oeboe	fop	dolf
aa eu	oepoe	oewoe	koorts	stok
aa u	oemoe	oevoe	riem	win
	oetoe	oegoe	groen	boer

Speech Therapy

Repetition: Intensive start Practice at home with co-therapist

Metacognition: Knowing the Difference

Multi Media support

CO-Therapist

Cloth Shield to prefent lip-read

Exercises on Paper

Hearing the difference: Opposing right and wrong answer

Direct Feedback By Therapist

Introduction

For the deaf and hard of hearing for which the conventional hearing aid does no longer suffice the cochlear implant (CI) offers a new chance for auditory perception. The CI, an electronic device implanted in the inner ear (cochlea), directly stimulates the auditory nerve with electric pulses patterns generated by a speech processor. These patterns differ from natural speech patterns. For effectively learning these new patterns and for maximum profit from the CI a Learning program has been developed for the postlingually deafened adults.

The Leiden Cochlear Learning program features 10 training levels with increasing difficulty from a linguistic viewpoint. Educational psychological insights emphasize the importance of training details, repetition, and the role of the three-track growth-potential in the methodological sequence. The results are worthwhile, as demonstrated by monosyllabic word and speechtracking-test scores.

1. Sounds (verbal and non-verbal)
2. Suprasegmental features (length, duration, stress assignment)
3. Vowels
4. Consonants
5. words (syllablestructure)
6. Word recognition
7. Sentences (closed set)
8. Sentences (open set)
9. Telephone conversation
10. Conversation, speech with background noise

Methods

Analysis of present practice

Linguistic view: Level of language, Perception and Difficulty. From Linguistic view the level of difficulty of the exercises is adjusted by varying the prosodic, acoustic and semantic properties.

Vowels that are close together in the "**vowel triangle**" (see fig. 1) are harder to distinguish in speech.

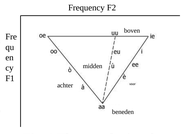


Fig. 1 The vowel triangle

Selection and synthesis of Learning Models

From a list of Learning Models the learning models introduced by Fitts (1964), Gathercole (1999) and Baddeley (2000) are selected and form the starting point for the translation of our daily practice into our new model.

Training of details Recognition of small paaterns will result in flexible routines. Small differences can be detected without context and the CI-user learns to listens instead of to gamble

1. **Cognitive (verbal) stage**
   Conscious focus on the process (sub) vocal rehearsal of tasks and rules
2. **Associative stage**
   Less conscious focus
   Gradual decrease in errors
   Development of internal (sensory) reference of correctness
3. **Autonomous (automatic) stage**
   No conscious focus
   Based upon automatic routines

Importance of repetition:

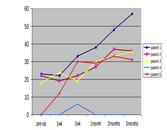
Without practise word recognition will not be automated and will be to slow to enable speech recognition at normal speed

Metacognitive skills:

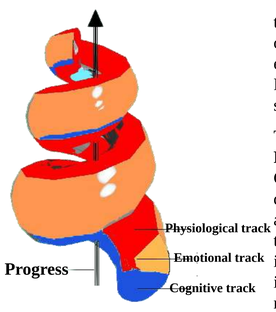
Knowledge about language, learning and strategies how to use this knowledge enables the CI-user to more effective speech recognition skills

Results

wordscore in words/ minute



CVC-score in % correct



Speech perception

Both the speech tracking test and the socres on the CVC-wordlist test show significant improvement in speech perception for all patients. All patients reach a considerable amount of openset speech perception. Improvement in speech perception from year one to two can be accredited to the use of a positioner.

The Coclear Learning Model

The Cochlear Learning Model uses the the **linguistic perspective** as a oragnisational tool to describe the exercises. The Level of language, Perception and Difficulty are used in sequential decisional matters.

The **Educational-psychological Perspective** describes the Three Track Growth Potential which helps us to decide which track needs to be amfisized during a trainingsession. The three stage learning process gives insight in the learning process and the importance of learning details and repetition.

Conclusion

The use of the cochlear training model, the intensive start of the aural rehabilitation and the counselling by specialized therapists, contribute to the CI-users' fast and effective adaptation to their cochlear implant. Describing the exercises from a Linguistic perspective enables us to adjust the level of diffuculty of the exercises and provides a clear framework for communication with other fields of expertise. For further research in the field of instructional strategies the Cochlear Learning Model offers a good framework. The three track growth potential identifies three potential areas of research: the physiological, the emotional and the cognitive area. In the latter, the learning process can be studied as a product of instructional strategies and personal qualities of the CI-user. In the research of the learning process the three most important questions we identified are: (1) Is the training of details in the aural training necessary? (2) What is the importance of the instructional sequence? And (3) Does the training of metacognitive skills improve the word recognition skills of CI-users?

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