Mental representations of and adaptation to speech transmitted via cochlear implants: How the impoverished signal finds its way to the mental lexicon

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Ethical review	Approved WMO
Status	Recruitment stopped
Health condition type	Hearing disorders
Study type	Observational non invasive

Summary

ID

NL-OMON44011

Source
ToetsingOnline

Brief title
MARCI

Condition

- Hearing disorders

Synonym
cochlear Implant users, Hard of hearing

Research involving
Human

Sponsors and support

Primary sponsor: Universitair Medisch Centrum Groningen

Source(s) of monetary or material Support: European Commitee through a Marie Curie fellowship to Dr. Anita Wagner

Intervention

Keyword: Cochlear Implant, Lexical activation, Mental representation of speech

Outcome measures

Primary outcome

The behavioural experiments will test listeners* discrimination sensitivity within and between phoneme categories (Exp. 1), and lexical effects on phoneme identifications (Exp. 3). The ERP recordings will measure participants* Acoustic Change Complex (ACC) for the stimuli used in Exp. 1 (Exp. 2), and the Phonological Mapping Negativity (PMN) for stimuli used in Exp. 3 (Exp. 4). The primary outcomes in Study I will be (1) a correlation between listeners* psychometric functions (Exp. 1) and ACC, and (2) the normative data for lexical effects collected in Exp. 3 and 4. The outcome of the eye-tracking experiment will be (1) normative data in form of growth curves of looks towards a target, and (2) correlation between individual and data from Exps. 3 and 4. The primary outcome in the longitudinal observation is a measure of adaptation and change in ACC, PMN, and working memory load while processing speech through CIs. This combination of measures will allow for a systematic investigation of speech processing at various levels in a within-subject design. Through such a novel approach we will account for individual variability in speech perception (e.g., Hazan & Rosen, 1991), which can be assumed to be particularly high for the target population.

Secondary outcome

none

Study description

Background summary

Cochlear implants (CIs) allow deaf people to re-gain their speech perception. After implantation listeners need to adapt to a very different sensory experience, facilitated through the electric stimulation of the auditory nerve. While this adaptation is utmost important for a successful outcome of the CI, there are substantial individual differences in the success of this adaptation and the factors that cause such variation are not well understood. This project aims at examining causes of such individual variation by relating speech processing with CIs to models of speech perception and lexical access. These models explain differences in processing efficiency with degrees of match between the input signal and the mental representations on various levels. As long as the representations are accurate there is a constant flow of information between levels of processing, such as semantic, lexical and sub-lexical levels. This interaction secures the efficiency of speech processing, it minimizes the listening effort, and offers means to compensate for mishearing and to build up predictions about upcoming events. However, such a perfect match is rarely the case in CIs. The acoustic input does not match the representations because only parts of the acoustic information from the natural signal are transmitted in CIs, and, more importantly, listeners' mental representations and their processing of speech may have been altered through long-term exposure to degraded signals.
This project will examine how speech processing with CI fits within the architecture of models of speech perception. The study aims to give a comprehensive perspective on speech processing in CI and to track the way in which the CI signal maps onto the lexicon. If long-term exposure to degraded signals alters the cognitive-perceptual processing of speech then individuals may continue to use such non-optimal type of processing even after their sensory processing has been improved. The questions in this project are thus relevant for our basic understanding of speech perception, and for development of new methods in hearing rehabilitation, especially for CI end-users.

Study objective

The project has three main scientific objectives:
(1) To investigate how speech processing with CIs affects listeners* mental representations at lexical and sub-lexical levels, as well as the flow of information between these levels;
(2) To study how mechanisms of speech perception relate to measures of cortical processing, at the level of sensory processing and at the level of predictive

computing;
(3) To investigate the reverse plasticity of mental representations as a response to long-term sensory deprivation in long-term users of CI, and the recovery plasticity as a response to the processing of a different sensory information in new users of CIs.

Study design

The project will consist of two parts. Part I will combine behavioural experiments with event related potential (ERP) recordings and an eye-tracking experiment. This part will compare the performance of long-term CI users with normal hearing (NH) listeners, in normal and in CI-simulated situations. Part II will be a longitudinal study of new users of CIs after the fitting with a new CI. These participants will be tested on the set of experiments used and developed in Part I, at three points in time: within 2 weeks, within 2 months and 3-5 months after the fitting. Comparisons will be drawn across groups (CI-users, NH, NH with CI simulation), and correlations across experiments will be made within subjects. The longitudinal experiments will lead to within-subject comparisons across the testing sessions.

Study burden and risks

There is no known risk, nor benefit associated with participation. All experiments are non-invasive in nature. A test session will last for a maximum of 4 hours per listener, including breaks. Session duration will be accommodated on the request of the participant as needed. The sound level will always be adjusted to a comfortable listening level for the participant.

Contacts

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Trial sites

Listed location countries

Netherlands

Eligibility criteria

Age
Adults (18-64 years)
Elderly (65 years and older)

Inclusion criteria

Native speakers of Dutch
Between 18-80 years old
Part I: users of cochlear implants (CI) with a minimum of 6 months of experience
Part II: new users of CI

Exclusion criteria

Dyslexia
Non-native speakers of Dutch

Study design

Design

Study type:	Observational non invasive
Intervention model:	Other
Allocation:	Non-randomized controlled trial
Masking:	Open (masking not used)

Primary purpose: Other

Recruitment

NL

Recruitment status:	Recruitment stopped
Start date (anticipated):	16-12-2013
Enrollment:	268
Type:	Actual

Ethics review

Approved WMO Date:	16-09-2013
Application type:	First submission
Review commission:	METC Universitair Medisch Centrum Groningen (Groningen)
Approved WMO Date:	06-05-2014
Application type:	Amendment
Review commission:	METC Universitair Medisch Centrum Groningen (Groningen)
Approved WMO Date:	22-11-2016
Application type:	Amendment
Review commission:	METC Universitair Medisch Centrum Groningen (Groningen)

Study registrations

Followed up by the following (possibly more current) registration

No registrations found.

Other (possibly less up-to-date) registrations in this register

No registrations found.

In other registers

Register	ID
CCMO	NL43638.042.13

Study results

Date completed: 07-06-2017

Actual enrolment: 186

Summary results
Trial is onging in other countries