AudiRex

computer-led speech audiometric screening in toddlers

Applicants

Eligible proposals must have two (and only two) applicants from different disciplines within the Network Institute.

Supervisor Name	Department/Group	Faculty
1. Martine Coene	Language, Communication and Cognition Language and Hearing Center Amsterdam	FGW
2. Michel Klein	Computer Sciences	FEW

Project description

Provide a brief description of the project (max. 300 words)

For young children access to speech is essential for the development of oral language. Reduced speech intelligibility due to congenital deafness or severe hearing loss increases the risk for permanent language impairment. Thanks to the recently adopted UN resolution and the Dutch law on 'Tailored education' , a steadily growing number of children with hearing impairment are now participating in mainstream education programs. For teachers, parents and caregivers, it is important to get a proper evaluation of the speech understanding of these young children in daily listening situations.

In adults, such aspects of functional hearing are often measured through a 'listen-and-repeat'-task based on sentences. However, speech test materials are not readily available for children under six. In this project, we want to address this issue by developing a new linguistically controlled speech audiometric screening instrument that is suitable for children from 2 to 6 years old and to gather normative data of hearing children in this age group.

During the last year, a pilot study was set up leading to a bèta-version of such an audiometric screening test. The test is now running in a C#.net environment. It was developed as a 'picture-pointing' task using words and short sentences that are adapted to the developmental language level of the target group and includes diagnostic features. In this project, we would like to fine-tune and finalize our prototype so that it can be used in specialized audiological centers. In order to do so, a number of scientific and technical challenges need to be addressed, namely to determine (i) the exact contribution of non-auditory (linguistic) factors in speech understanding at this young age; (ii) the effect of picture-pointing vs. verbal repetition on the reliability of test outcomes; and (iii) the beneficial effect of computer-led procedures on test compliance in very young children.

[300 words]

Project Organization
Each proposal requests two Academy Assistants from different disciplines. Describe their roles and describe the skills and expertise required from them. (max. 300 words)

The two SAs will work together to answer the following central research question in this project: "*is it possible to obtain reliable insight into the speech reception skills of children under six years old by using a computer-led word- and sentence-identification task which takes into account the cognitive and linguistic skills of (very) young children?*" Within 3 MA research projects, the first steps have already been made to develop word and sentence test materials [1-3]. The test sentences have been generated in such a way that they take into account the phonological and lexical level of two-to-six year old children on the basis of their receptive vocabulary (*Lexilist*, [4], N-CDI, [5]) and grammatical development (short 4-to-7 syllabic Subject-Verb-Object sentences). The target words consist of depictable monosyllabic CVC nouns (e.g *bal*) that form phonemic minimal pairs with each other (e.g *bal - bad*).

SA1 will be a MA student in (applied) linguistics or speech-language pathology who wishes to gain further experience in language testing. (S)he will first inventorize the pro's and con's of picture pointing vs. verbal repetition tasks in the target group, and examine a number of non-linguistic constraints that may affect the testability of these children (e.g. limited attention span).

SA2 will be a MA student with a proven background in computer sciences. Together with the supervisors of the project, (s)he will establish a list of factors that may potentially affect the adoption of computer-led hearing screening by small children and inventorize potential work-arounds to reduce test complexity. (S)he will also work towards the actual implementation of the improved test in a software environment that will be used to obtain speech audiometric reference data in a control group of hearing children. Both SAs will participate in gathering these data with the help of *KinderRijk*, an organization that provides the VU/VUmc daycare facility and with whom arrangements for participation have been made.
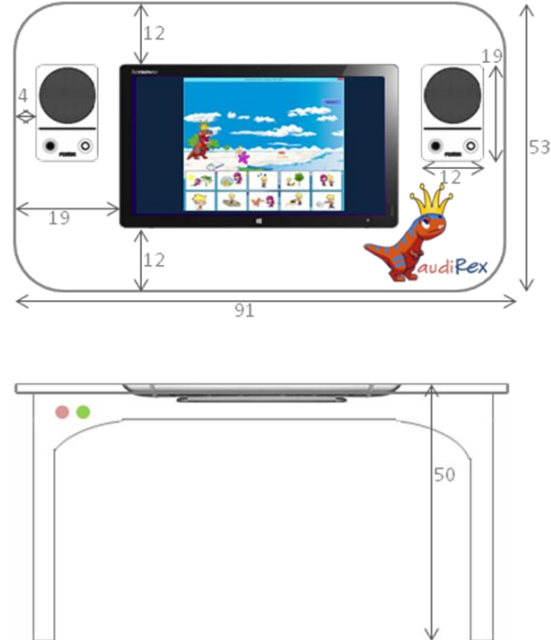

Figure 1. Left. 5-year old girl executing a sentence identification task. **Right.** Design of the table with integrated Lenovo Horizon2e Win8 and professional Fostex 6301 studiomonitors

Figure 2. Left. Example of 4 picture set of words (all *Nijntje* related pictures, used with permission of Bruna editors) presented with an oral word stimulus *boom* (response options: *bad, boot, boom, huis*). **Right.** Example of a list of test sentences with the corresponding 10-picture set (written sentences are added for explanatory purposes and are not seen by the child). Children are asked to listen to the orally presented test stimuli and click on the most appropriate picture.

Collaboration
Describe how your research improves collaboration and cross-pollination between the disciplines involved (max. 300 words)

Advances within the project's field of research are highly dependent on the interaction amongst different disciplines in order to combine expertise with respect to hearing impairment, speech perception and computational models of human cognition and behavior. Important efforts have been made to develop a joint multi-disciplinary research platform within the Network Institute & EMGO+, bringing together insights on language (Applied Linguistics, Humanities) and hearing and language disorders (ENT/Audiology, VUmc). This has led to the recent opening of the *Language and Hearing Center Amsterdam* (LHCA). Within LHCA researchers and clinicians from different disciplines such as audiology, applied linguistics, otorhinolaryngology, psychology and computer sciences are active in fundamental and applied research and care on language and hearing, with a special focus on the interplay between several domains of cognition involved in speech understanding.

The center works closely together with companies with an interest in innovative research (e.g., Cochlear,Phonak,Otoconsult). Within this framework, a scientific collaboration between the faculties of Humanities and Exact Sciences has been set up in a previous FP7 program (FP7-SME-1-2010-262266 "OPTI-FOX") between the chair of Applied Linguistics (coordinator) and the department of computer sciences (Prof.dr.G.Eiben; Dr. W.Kowalczyk; Dr.Z.Slavic).

Against this background, we would like to consolidate our multi-disciplinary research platform, building an expert team of applied linguists and speech-language pathologists on the one hand (LCC/LHCA), and computer scientists and engineers on the other hand. We believe that our joint expertise will make it possible to do innovative research on new diagnostic techniques in the field of language and hearing disorders.

The cross-over between the two disciplines is expected to lie in the transfer-of-knowledge regarding the application of computer-led screening in health care, taking in to account potential requirements for a group of users with special needs (Computer Sciences), and a rich expertise on speech, language and hearing screening techniques (Humanities/LHCA).

[300 words]

Deliverables
Enumerate intended project results: papers, research proposals or otherwise. (max 200 words)

Our project is expected to generate a variety of deliverables presenting the outcomes of both fundamental and applied research through more traditional forms of academic dissemination (research article and poster presentation) as well as in an online format targeting a broad audience (kennislink.nl). Other expected results are the result of development activities: (i) an optimized version of the speech audiometric test materials, (ii) a software tool that can be used in audiometric screening contexts, and

(iii) a database of speech reception data of young children that can be used for further (PhD-) research and for building norm-references against which the outcomes of children with a hearing impairment are to be interpreted. The results of this project are further expected to provide the necessary input to write up a full proposal for an NWO- or ZonMW-funded PhD position. A detailed overview of the expected project results, the person(s) by whom they will be realised and the proposed date of the realisation are given in Table 1 below.

[166 words]

Expected results	Realised by	Date (MM-YYYY)
a optimized version of speech audiometric test materials (words and sentences)	SA1	12-2016
a speech audiometric software tool that can be used in multi-disciplinary language and hearing assessments in young children	SA2	12-2016
a database of speech reception data of young children to be used for further analyses	SA1	03-2017
Research proposal for a PhD project (clinical linguistics)	Coene, Klein (with Goverts, VUmc)	06-2017
Joint research article regarding the development of pediatric computer-led speech audiometric testing in an *Open Access* peer-reviewed journal	Coene, Klein, Goverts, SAs	08-2017
Presentation of intermediate project results and the Workshop on Language, Hearing & Cognition within the FP7 Marie Curie ITN project "Hearing Minds" [coordinator: FGW]	SAs (supervised by Coene, Klein)	05-2017
Outreach to broad audience by means of thematic presentation at *www.KennisLink.nl*	SAs (supervised by Coene, Klein)	08-2017

Table 1. Expected project results realized by the 2 SAs and their supervisors

Planning
Provide a breakdown of the project into phases with tentative timing (max 150 words)

September 2016 – December 2016. An inventory will be made of the factors that may affect the assessment of speech understanding by means of computer-led tasks in young children, both from the perspective of linguistics and computer sciences, giving attention to picture pointing reliability and the attractiveness of the task procedure for toddlers. The optimized test materials will be implemented in a newly developed software tool.

January 2017 - March 2017. Reference data will be gathered at *KinderRijk* and further analysed.

April - June 2017. The SAs will present the project results during a workshop organized within the context of a FP7 Industry-Academy-Partnerships-and-Pathways project (Hearing Minds). The supervisors will write a research proposal for a PhD-project (joint work with dr.S.T.Goverts, LHCA VUmc) and will start drafting the research paper.

July 2017- August 2017. The research paper finalized and submitted, and the project results will be presented to a broad audience (KennisLink).

[150 words]

References

[1] Feuth, E. (2015). Een talig gebalanceerde kinderzinnentest voor Nederlandssprekende kinderen. Masterscriptie Vrije Universiteit Amsterdam.

[2] de Groot, F. (2015). Spraakaudiometrie voor Nederlandstalige jonge kinderen: een frasentest. Masterscriptie Vrije Universiteit Amsterdam.

[3] Raven, A. (2016). Een onderzoek naar spraakperceptiefouten van normaalhorende kleuters uit groep 1 bij de Woorverstaan Jonge Kleuters-taak. BA scriptie Communicatie-en Informatiewetenschappen Vrije Universiteit Amsterdam.

[4] Schlichting, Spelberg, (2010). *Handleiding Schlichting Test voor Taalproductie – II*. Bohn Stafleu van Loghum, Houten. ISBN: 97890 313 7449

[5] Zink, Lejaegere, (2002). *N-CDIs Lijsten voor Communicatieve Ontwikkeling – Korte vormen*. Acco Leuven / Leusden. ISBN: 90 334 5287 1. NUR: 896

Please respect the word count limits: proposals that exceed the stated limits will not be eligible.

*Send completed proposals to: akademiestudent.fsw@vu.nl, **before 10 June 2016 at 12.00pm**. An independent committee will evaluate the proposals; subsequent notification of the committee decision will be given on 1 July.*