FP6–004171 HEARCOM

Hearing in the Communication Society

INTEGRATED PROJECT

Information Society Technologies

D-2-2: Procedures for the tests included in the auditory profile in four languages

Contractual Date of Delivery:	30 June 2006 (+ 45 days)
Actual Date of Submission:	10 August 2006
Editor:	Wouter A. Dreschler
Sub-Project/Work-Package:	SP1, WP2
Version:	v2.2, final
Total number of pages:	32

Dissemination Level		
PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

Project co-funded by the European Commission within the Sixth Framework Programme (2002-2006)

Deliverable D-2-2

VERSION DETAILS	
Version:	2.2 (final)
Date:	August 10th, 2006
Status:	Final

CONTRIBUTOR(S) to DELIVERABLE	
Partner	**Name**
NL-AMC	Wouter A. Dreschler
NL-AMC	Thamar van Esch
NL-VUMC	Johannes Lyzenga
DE-HZO	Kirsten Wagener
SE-LINK	Birgitta Larsby
UK-ISVR	Mark Lutman
NL-AMC	Joyce Vliegen

DOCUMENT HISTORY			
Version	**Date**	**Responsible**	**Description**
1.0	July 15th, 2006	Thamar van Esch Joyce Vliegen Wouter A Dreschler	
2.0	July 20th,2006	Thamar van Esch Joyce Vliegen Wouter A Dreschler	Appendices added
2.1/2.2	August 10th, 2006	Wouter A Dreschler	Modifications based on the comments of the reviewers

DELIVERABLE REVIEW			
Version	**Date**	**Reviewed by**	**Conclusion***
1.0		S. Arlinger	Accept with some modifications
1.0	August 2nd 2006	T. Houtgast	Accept with some modifications

* e.g. Accept, Develop, Modify, Rework, Update

Table of Contents

List of Tables

Acknowledgement

Supported by grants from the European Union FP6, Project 004171 HEARCOM. The information in this document is provided as is and no guarantee or warranty is given that the information is fit for any particular purpose. The user thereof uses the information at its sole risk and liability.

Pre-Amble

This deliverable concerns the test procedures for the validation of the auditory profile that has been defined in deliverable D2.1, by a multi-centre experimental approach. The auditory profile was designed in order to enable consistent characterization of an individual's auditory impairment across Europe. The auditory profile can be used to determine the individual hearing deficiencies in communication and can help to determine the benefit by assistive devices. The auditory profile should include all necessary measures to describe the details of, and differences between, different hearing impairments.

The auditory profile is relevant for the work in SP2 (Adverse Conditions), because its outcome values will define the auditory demands for the acoustical conditions required in case of hearing impairment. The work is relevant for SP3 (Rehabilitation) and SP4 (Assistive Technology), because the auditory profile indicates the deficits that need to be compensated, either by signal processing (SP3) or by alternative strategies (SP4). Finally, the implementation of these tests in OMA will have a great impact on the dissemination of the test procedures and will stimulate a broad clinical acceptance of this innovative approach to auditory testing.

1 Executive Summary

The aim of the auditory profile is that it should be used as a diagnostic tool in a broad population of subjects with complaints about their performance in (auditory) communication tasks. It will be a diagnostic profile that can be assessed in a (specialized) hearing centre or clinic. The end user of the auditory profile is the professional interested in the characteristics of the hearing of a particular client/patient.

The exact parameters to be used in further testing will be investigated in the multi-centre field trial. For this trial these have been described in detail in the test protocol for the multi-centre field trial. Later, they will be part of the final definition of the auditory profile and they can be fixed in the OMA programs (e.g. for clinical use) or can be left open for a more flexible application (e.g. for research purposes).

The study has been approved by the medical ethical committee of the Academic Medical Centre in Amsterdam (reference: MEC 05/127 # 05.17.0934, dated August 3rd 2005). Other centres have applied for additional approval by their local medical ethical committees. (Update: the Linköping ethical committee has approved the study, reference: M83-06).

2 Introduction

The HEARCOM (Hearing in the Communication Society) project aims at full participation in the modern communication society by reducing the limitations in auditory communication. Two of the focus areas of HEARCOM are on the identification and characterization of auditory communication limitations and on the development of standardized testing and evaluation procedures for hearing-impaired persons. In this context, an auditory profile has been defined.

2.1 Goals of the definition of an auditory profile

The aim of the auditory profile is that it should be used as a diagnostic tool in a broad population of subjects with complaints about their performance in (auditory) communication tasks. It will be a diagnostic profile that can be assessed in a (specialized) hearing centre or clinic. The end user of the auditory profile is the professional interested in the characteristics of the hearing of a particular client/patient.

The auditory profile should be used to characterize the individual's auditory impairment profile in a uniform way within Europe. The auditory profile can be used to determine the individual's hearing deficiency in communication and can help to determine the benefit from assistive devices. The auditory profile should include all necessary measures to describe all major details and differences between different hearing impairments. On the other hand, the auditory profile should minimize redundancy between measures.

2.2 Areas of interest

The components of the auditory profile should be relevant for auditory communication performance. Usually most emphasis is given to speech perception, but the scope of the auditory profile is clearly broader: the profile should also be related to signal recognition, sound quality, spatial hearing, listening comfort, listening effort, and adequate processing of daily sounds. A limited set of tests will never be able to cover all aspects in detail, but the aim is that the auditory profile is broad enough to cover at least the main parameters in these areas.

More specifically, the partners selected the following eight fields for testing:

1. Audibility
2. Loudness perception

3. Frequency-time resolution
4. Speech perception in noise
5. Spatial hearing
6. Subjective judgments and communication
7. Listening effort
8. Cognitive abilities

In each of these fields we made an inventory of the available tests and we decided in a consensus meeting which tests should be included in the auditory profile.

2.3 Tests included in the auditory profile

In deliverable D-2-1 it was agreed to partition the tests in three different categories: 'Standard' (I: used for each patient), 'Advanced' (II: HearCom inventory), and 'Specialized' (III: II plus additional measurements). It was decided that the auditory profile consists of the tests in categories I and II. Tests in category III are useful additional measurements, but they will not be implemented in the context of HEARCOM.

Recently, pilot experiments have been finished to solve some remaining uncertainties, for instance about the combined F-T test to be used and the final choice for the test on cognitive abilities. Also, the JND-azimuth test (the minimal audible angle: MAA) became available.

The test of Larsby and Arlinger was chosen as the most appropriate F-T test on the basis of phase-I testing. In the HearCom meeting in Gladbeck (March 2006) it was decided that the lexical decision making test was part of the advanced tests (category II) and the textual SRT-test (TRT) was considered to be a specialized test (category III).

The preliminary auditory profile now contains the following tests (category I and II):

I: Standard	II: Advanced
1. Audibility	
Audiogram (AC+BC)	
2. Loudness	
Acalos at 0,5 and 3 kHz	Acalos at other frequencies
3. Frequency-time resolution	
	Combined F-T test (Larsby and Arlinger)
4. Speech perception	
Speech in quiet and noise (SRT or OlSa)	
5. Spatial hearing	
Intelligibility level difference (ILD)	Binaural intelligibility level difference (BILD)
	Minimal audible angle (MAA)
6. Subjective judgement, communication and listening effort	
	Gothenburg profile
7. Listening effort	
Effort scaling for speech in noise	
8. Cognitive abilities	
	Lexical decision making

Table 1: List of tests included in the auditory profile.

It should be stressed that the auditory profile described above is primarily focussed on the diagnosis of auditory functioning. For the purpose of auditory rehabilitation, some extra tests may be needed in order to select, fit, and evaluate hearing aids. For the subjective judgments, specific questionnaires have been developed to evaluate the benefit of hearing aids, e.g. the Glasgow Hearing Aid Benefit Profile (GHABP). These aspects will be considered in the work related to auditory rehabilitation (WP 6).

2.4 Implementation of the tests

All tests have been implemented on a common software platform in Oldenburg (called OMA, Oldenburg Measurement Applications), see deliverable D-2-1b.

3 Implementation of the language-specific tests in four languages.

Whereas previously the tests were only available in English, the tests on OMA are now available in four languages: English, German, Dutch and Swedish. This applies to all speech and language tests and the subjective judgement test: SRT (speech-reception Threshold), OlSa (Oldeburger sentence test), ILD[1] (Intelligibility Level Difference), BILD (Binaural Intelligibility Level Difference), Lexical decision making test, Effort scaling for speech in noise and the Gothenburg profile.

3.1 Non-speech tests

For the non-speech tests (tests on audibility, loudness, frequency-time resolution, and spatial resolution) there is only need for a translation of the instructions and the interface for the test leader. During the multi-centre study the interface for the test leader will only be available in English due to time constraints. This was judged to be an acceptable situation given that the test leaders will be members of the HearCom community.

3.2 Speech tests

3.2.1 Speech perception

For speech testing in noise two types of speech material were available: everyday sentences with an open structure (Plomp-type sentences) and artificially composed sentences (OlSa-type sentences[2]).

[1] The acronym ILD is commonly used for two related phenomena. ILD as Interaural Level Difference refers to the level cue that is present in binaural experiments. In the context of this study we use ILD for speech as the Intelligibility Level Difference, that is defined as the benefit for speech intelligibility due to binaural effects.

[2] This is an abbreviation of the Oldenburger Satz-test, the term that is commonly used within the HEARCOM Consortium. However, the original version of this type of speech material has been designed by Hagerman.

- The Plomp-type sentences have been developed for each of the four languages included in the study. A sample is given in Appendix A.

- The OlSa-type sentences have been developed within subproject SP1/WP1 and all have a fixed structure as described in deliverable D-1-3. The Dutch version is called Matrix test, because the stimuli are generated from a matrix containing ten names, ten verbs, ten numerals, ten adjectives, and ten objects, see Appendix B.

3.2.2 ILD and BILD tests

Some aspects of spatial hearing will be tested with speech stimuli. For this purpose, the test material described in section 3.2.1 will be used. It is strongly recommended that the same type of speech material will be used for speech-in-noise testing and ILD and BILD tests.

3.2.3 Subjective judgment and communication

The Gothenburg Profile was selected to be used in the auditory profile. The original questions in Swedish have been translated into German, English, and Dutch. The translations are presented in Appendix C.

3.2.4 Listening effort

Listening effort will be tested with running speech stimuli.

3.2.5 Cognitive abilities

For the lexical decision test as developed in Swedish, equivalent versions have been developed for the other three languages. A sample of the words used for this test has been listed in Appendix D.

4 Inclusion of subjects

75 Hearing-impaired subjects will be invited to participate in this study on a voluntary basis (15 for each of the participating centres). They are selected from the clinical population according to the following inclusion criteria:

- Age between 18 and 75 years.
- Average hearing loss (PTA) at the better ear between 20 and 50 dB and at the poorer ear between 20 and 70 dB. The average is taken from the pure tone audiogram thresholds at 500, 1000, 2000, and 4000 Hz.
- Maximum difference in PTA between the two ears of 30 dB
- No language problems.
- Active and alert and able to perform the tests.
- Willing to spend two visits for testing (about 2 hours per visit).
- No complaints of tinnitus.

Each *ear* will be categorized in one of the following four audiometric configurations:

- Mild flat hearing loss:
    - PTA ≤ 50 dB
    - Difference between thresholds at 0.5 and 4 kHz ≤ 30 dB
- Severe flat hearing loss
    - PTA > 50 dB
    - Difference between thresholds at 0.5 and 4 kHz ≤ 30 dB
- Mild sloping hearing loss
    - PTA ≤ 50 dB
    - Difference between thresholds at 0.5 and 4 kHz > 30 dB
- Severe sloping hearing loss
    - PTA > 50 dB

- Difference between thresholds at 0.5 and 4 kHz > 30 dB

We aim at including at least 5 *ears* in each of the four categories for each participating centre. Moreover, we defined the following targets regarding the inclusion of *ears* with conductive hearing losses:

- At least 15 *ears* with a pure perceptive hearing loss (air bone gaps at 0.5 and 1 kHz ≤ 15 dB)
- At least 5 *ears* with a conductive or combined hearing loss (air bone gaps at 0.5 and 1 kHz > 15 dB)

Concerning *subjects* with asymmetrical hearing losses, we propose the following for each centre:

- At least 8 *subjects* with a symmetrical hearing loss (difference in PTA between left and right ear ≤ 10 dB)
- At least 3 *subjects* with a asymmetrical hearing loss (difference in PTA between left and right ear > 10 dB)

In addition, 25 normal-hearing subjects (all pure-tone audiogram thresholds better than 20 dB), aged between 18 and 50 years (no presbyacusis), will be included.

All subjects have to sign an informed-consent form. The subjects will receive a financial reimbursement for their travelling expenses.

5 Experimental methods

All tests will be conducted by headphones. Except for the spatial hearing tests, all measurements will be performed monaurally at both ears separately. Moreover, we decided to conduct measurements at two frequencies, i.e. 500 and 3000, Hz where applicable and at equal loudness levels (see below). Because the auditory profile is a diagnostic profile, all tests will be conducted without hearing aids.

5.1 Test descriptions

5.1.1 Audibility

Pure-tone thresholds will be measured using a standard audiometer. Air-conduction thresholds are measured at 250, 500, 1000, 2000, 3000, 4000, 6000, and 8000 Hz and bone-conduction thresholds at 250, 500, 1000, and 3000 Hz with adequate masking of the contra-lateral ear.

5.1.2 Loudness

Loudness perception will be measured using Acalos (adaptive categorical loudness scaling). Measurements will be performed using 1/3-octave bands of so/called ´low-noise noise´ at 500 and 3000 Hz, and using the broadband speech-shaped ICRA1 noise (depending on the gender of the speaker in the speech tests (see below), a male- or female-weighted version of this noise will be used).

From these measurements most comfortable loudness levels will be derived (MCL-low, level in dB SPL at 20 categorical loudness units, clu). For all subjects, all following tests will be conducted at equal loudness levels: the MCL-low level that will be called MCL in further descriptions.

5.1.3 Frequency-time resolution

The F-T test of Larsby and Arlinger will be used to measure spectral, temporal, and combined spectro-temporal resolution. Masked thresholds of tone pulses in four different noises are measured: octave-band stationary noise, noise with spectral gaps (around signal frequency), noise with temporal gaps (coinciding with the signals) and noise with both spectral and temporal gaps. Thresholds are estimated using a Békésy tracking procedure.

Measurements will be conducted at both ears separately, at 500 and 3000 Hz. The masking noise will be fixed at MCL-level (as being derived from

Acalos using 1/3 octave band noises at 500 and 3000 Hz), and signal level will be varied.

5.1.4 Speech perception

Speech perception can be measured using Plomp- or OlSatype tests. Because of the learning effect in OlSa-type tests, Plomp-type tests are preferred for experiments in which only a limited number of measurements is required. However, centers are free to choose which type of test they use, e.g. based on availability of tests and lists in the local language.

Measurements will be recorded:

- In quiet, diotically
- In stationary noise (ICRA-1, male- or female-weighted version, same gender as the speaker), monaurally at both ears
- In fluctuating noise (ICRA-5_250 or ICRA-4_250, same gender as the speaker), monaurally at both ears

The noise level will be fixed at MCL-level (with a maximum of 85 dB SPL), varying the speech level. Outcome measure is the speech recognition threshold (SRT): the signal to noise ratio (SNR) for 50% correct, except for the quiet condition where the outcome measure is the speech level for 50% correct.

5.1.5 Spatial hearing

Three tests will be conducted involving spatial hearing: intelligibility level difference test (ILD), binaural intelligibility level difference test (BILD) and the minimal audible angle test (MAA). As these tests are all conducted via headphones, virtual stimuli are used. Stimuli are filtered with generic Head-Related Transfer Functions (HRTFs) from different directions. For the ILD and BILD test this means that the speech signal is always filtered with the HRTF of straight ahead (0^o) and the noise is filtered either with the HRTF of 0^o or with the HRTF of 90^o. These two signals are added and presented dichotically, except for the monaural BILD conditions.

In the ILD and BILD tests, the noise level will be fixed at MCL-level (as being derived from Acalos using speech shaped noise, with a maximum of 85 dB SPL) and the speech level will be varied. Centers can choose which type of test they use, e.g. based on availability of tests and lists in the local language.

ILD test

For this test, speech recognition thresholds will be measured in three conditions with noise (ICRA-1, male- or female-weighted version, depending on the gender of the speaker):

- S_0N_0: speech and noise both coming from the front (0°)
- S_0N_{90}: speech coming from the front (0°) and noise coming from the right side (90°)
- S_0N_{-90}: speech coming from the front (0°) and noise coming from the left side (-90°)

The ILD represents the SRT difference between the S_0N_0 and the S_0N_{90} or S_0N_{-90} measurement.

5.1.5.1 BILD test

To estimate the BILD, two additional, monaural, measurements have to be conducted:

- S_0N_{90}: speech coming from the front (0°) and noise coming from the right side (90°) with the right ear blocked (so both signals are presented monaurally to the left ear)
- S_0N_{-90}: speech coming from the front (0°) and noise coming from the left side (-90°) with the left ear blocked (both signals presented monaurally to the right ear)

The BILD represents the SRT difference between the monaural and binaural S_0N_{90} and S_0N_{-90} measurements.

5.1.5.2 MAA test

To test sound localisation ability, a virtual headphone version of the minimal audible angle (MAA) test will be used. This test measures the just noticeable difference (JND) in horizontal sound direction.

In this test, two stimuli are presented consecutively from different directions, symmetrically spaced on different sides of the straight-ahead direction. The order of the sounds (left first or right first) is randomised. The task for the listener is to indicate the order of the two sounds. If the two sounds are perceived from different angles the result is the impression of a moving sound. Was the sound going from left to right or from right to left?

After a training session, 3 measurements will be recorded using:

- Broadband white noise
- Low-pass noise, filtered at 1500 Hz
- High-pass noise, filtered at 3000 Hz

To investigate to which extent subjects are able to use interaural level differences and interaural time differences as cues for sound localization, high- and low-pass stimuli are used. The measurement using broadband white noise will give extra information about the interaction between these two different cues. Measurements will be performed at MCL-level: MCL at 500 Hz for low-pass noise, MCL at 3000 Hz for high-pass noise, and MCL measured with ICRA1 noise for broadband speech-shaped noise. For subjects with asymmetric hearing loss, MCL-level at the better ear will be used.

5.1.6 Subjective judgments and communication

Subjects will be asked to fill in an online questionnaire: the Gothenburg Profile (see Appendix C). The Gothenburg Profile measures experienced hearing disability and handicap. It consists of 20 items divided into two subscales. The first subscale measures 'experienced disability in hearing speech' and 'sound localization'. The second subscale targets the 'experienced handicap in social settings' and the 'personal reactions to the experienced handicap'.

5.1.7 Listening effort

Subjects will be asked to indicate their experienced effort on a scale while listening binaurally to speech material (fairy tales) in four different conditions: in ICRA-1 noise at S/N = 0 dB, in ICRA-1 noise at S/N = 10 dB, in ICRA-5 noise at S/N = 0 dB, and in ICRA-5 noise at S/N = 10 dB with the noise level fixed at MCL level (with a maximum of 85 dB SPL) in all conditions. A male- or female-weighted version of the ICRA-1 noise will be used, depending on the gender of the speaker.

5.1.8 Cognitive abilities

A measure of cognitive abilities will be retrieved using the Lexical decision-making test, which estimates the lexical access of subjects. The task is to discriminate words from non-words: during the test, items are selected at random from lists of real words and non-words. Test items are presented as text on a computer screen and subjects have to indicate the nature of the presented items (word or non-word) by pressing the corresponding button. Response times and correct scores are recorded.

5.2 Time schedule and test order

The schedule below shows an estimate of the time needed for all measurements. Pure tone audiometry is not included because the audiogram usually is available prior to the study. As can be seen, total measurement time is one and a half hour. Since subjects will get breaks in between tests, one session will take approximately 2 hours. Total sound exposure for one session will be approximately 80 dB (depending on the subject's hearing thresholds) over a period of, more or less, 45 minutes.

Test	Measurement time (min)
Acalos	10
Effort scaling	5
Speech perception	15
ILD test	9
BILD test	6
Gothenburg Profile	5
F-T test	15
MAA test	20
Lexical decision making test	5
Total	90

Table 2: Estimate of the measurement time per test.

The complete test set will be conducted in test and retest in two sessions of about 2 hours on separate days[3]. The test and retest measurements should be recorded within 3 weeks.

Because the protocol consists of tests of different kinds, a fixed test order can be used. The order to be used is the one specified in the schedule. A session should start with the loudness scaling measurement (Acalos), because the outcomes of this test are used in the following tests. Furthermore, all speech tests (Effort scaling, Speech perception, ILD test, and BILD test) are grouped together. After the speech tests, subjects will have a break and fill in the questionnaire (Gothenburg Profile). Subjects continue with the psychophysical tests (F-T test and MAA test), and finish with the Lexical decision making test.

[3] Given the relatively high importance of spatial hearing for the degree of handicap and the innovative character of the spatial tests in this test battery, the tests on spatial hearing take a relatively high amount of the total testing time. In the final version of the auditory profile binaural aspects can probably be tested with a limited set of spatial hearing tests.

6 Extensions of the test battery

If desirable, it is possible to add the following extensions to the protocol (category III tests):

- Loudness scaling measurement (Acalos) at 1000 Hz
- Spectral and temporal resolution measurement (F-T test) at 1000 Hz
- Speech testing with the spectra of speech and noise shaped to the individual audiogram in order to compensate for effects of audibility
- Textual SRT (TRT test) for measuring cognitive abilities

7 Dissemination and Exploitation

For the dissemination of the results of the work of WP2, the target groups are:

- Audiologists and ENT-physicians
- Hearing aid acousticians
- Hearing aid industry

For the health professionals HEARCOM will deliver diagnostic tools and a well standardized battery of tests that composes the auditory profile.

Given the fact that all tests have been implemented on the same software platform (Oldenburg Measurements Applications, OMA), there is a large potential to market the complete set of HearCom tests to the target groups described above.

8 Conclusions

The auditory profile is a central piece of work in the HearCom project. It is relevant for the work in SP2 (Adverse Conditions), because its outcome values will define the auditory demands for the acoustical conditions required in case of hearing impairment. The work is relevant for SP3 (Rehabilitation) and SP4 (Assistive Technology), because the auditory profile indicates the deficits that need to be compensated, either by signal processing (SP3) or by alternative strategies (SP4). Finally, the implementation of these tests in OMA will have a great impact on the dissemination of the test procedures and will stimulate a broad clinical acceptance of this innovative approach to auditory testing.

Appendix A: a sample of Plomp-type sentences

Dutch

We kunnen weer even vooruit.
Dit is geen avond voor toespraken.
Over zijn toekomst blijft hij vaag.
Het toestel is nooit gevonden.
Ze voelde zich veruit de sterkste.
Het vliegveld werd sterk uitgebreid.
Ze kruist haar armen voor haar borst.
Daar hoeft niemand aan te twijfelen.
Het boek is pas een maand op de markt.
Het was een ongekend warme dag.
Ik werk al heel lang met kinderen.
De familie wacht op zijn komst.
Het schip werd in beslag genomen.

English

The CLOWN had a FUNNY FACE.
The CAR ENGINE's RUNNING.
SHE CUT with her KNIFE.
CHILDREN LIKE STRAWBERRIES.
The HOUSE had NINE ROOMS.
THEY're BUYING some BREAD.
The GREEN TOMATOES are SMALL.
HE PLAYED with his TRAIN.
The POSTMAN SHUT the GATE.
THEY're LOOKING AT the CLOCK.
The BAG BUMPS on the GROUND.
The BOY DID a HANDSTAND.

German

Mein Dackel pariert aufs Wort.
In Eurer Wohnung waren Diebe.
Steigt Dein Drachen sehr hoch?
Der Bart muss jetzt ab.
Hast Du schon gefrühstückt?
Das Fass ist uüerglaufen.
Der Durst war kaum zu löschen.
Der Brief geht gleich ab.
Alle Augen blicken zum Himmel.
Dichte Baumkronen verdeckten den Himmel.

Swedish

Klänningen i skyltfönstret är vit
Affärsmannen körde för fort
Servitrisen tappar besticken
Månen lyste på de sex männen
I diskhon låg tjugo gafflar
Flickan stod länge i duschen
Han tappade en sko
Åtta tallrikar föll från hyllan
Fem filmer recenserades
En spegelram målades grön

Appendix B: OlSa-type sentences

Dutch

Name	Verb	Number	Adjective	Noun
Anneke	wint	drie	grote	dozen.
Monique	geeft	negen	nieuwe	schoenen.
Sarah	kiest	acht	vuile	boeken.
Christien	koopt	vier	kleine	munten.
Heleen	tekent	twee	mooie	stenen.
Jan	vroeg	vijf	goede	ringen.
Pieter	vond	tien	zware	boten.
Mark	telde	twaalf	dure	messen.
Willem	maakte	achttien	oranje	bloemen.
Tom	had	zes	groene	fietsen.

English

Name	Verb	Number	Adjective	Noun
Peter	got	three	large	desks.
Kathy	sees	nine	small	chairs.
Lucy	bought	five	old	shoes.
Alan	gives	eight	dark	toys.
Rachel	sold	four	thin	spoons.
Barry	likes	six	green	mugs.
Steven	has	two	cheap	ships.
Thomas	kept	ten	pink	rings.
Hannah	wins	twelve	red	tins.
Nina	wants	some	big	beds.

German

Name	Verb	Number	Adjective	Noun
Peter	bekommt	drei	große	Blumen.
Kerstin	sieht	neun	kleine	Tassen.
Tanja	kauft	sieben	alte	Autos.
Ulrich	gibt	acht	nasse	Bilder.
Britta	schenkt	vier	schwere	Dosen.
Wolfgang	verleiht	fünf	grüne	Sessel.
Stefan	hat	zwei	teure	Messer.
Thomas	gewann	achtzehn	schöne	Schuhe.
Doris	nahm	zwölf	rote	Steine.
Nina	malt	elf	weiße	Ringe.

Swedish

Name	Verb	Number	Adjective	Noun
Karin	gav	två	gamla	knappar.
Britta	höll	tre	hela	bollar.
Märta	ser	fyra	stora	vantar.
Peter	köpte	sex	nya	pennor.
Svante	lånar	sju	vackra	korgar.
Jonas	ägde	åtta	mörka	skålar.
Else	flyttar	nio	ljusa	mössor.
Anna	visar	elva	fina	dukar.
Bosse	har	tolv	lätta	ringar.
Gustav	tog	arton	svarta	lådor.

Appendix C: Gothenburg Profile

Dutch

Subschaal 1: Ervaren beperkingen

Spraakverstaan

1. Kunt u horen wat er gezegd wordt als u thuis met één persoon een gesprek voert?
2. Kunt u horen wat iedereen zegt als u thuis met meerdere mensen een gesprek voert?
3. Kunt u op bijeenkomsten de spreker verstaan, als u op een gunstige plek zit?
4. Kunt u de nieuwslezer op de tv bij de normale volumestand verstaan?
5. Kunt u de nieuwslezer op de radio bij de normale volumestand verstaan?

Lokalisatie

6. Kunt u in het verkeer horen uit welke richting alle geluiden komen?
7. Draait u uw hoofd de verkeerde kant op als iemand u aanspreekt?
8. Wordt u verrast door auto's omdat ze al dichterbij zijn dan u dacht te horen?
9. Kunt u het horen als iemand achter u een deur opent?
10. Kunt u horen of het water dat opstaat al kookt?

Subschaal 2: Ervaren handicap, relatie met anderen

Hoe hoorproblemen sociale contacten beïnvloeden

11. Ervaart u uw hoorproblemen als een obstakel in uw sociale leven?
12. Vermijdt u groepen omdat het te vermoeiend is om te volgen wat er gezegd wordt?
13. Heeft u de indruk dat veel mensen u negeren vanwege uw hoorproblemen?
14. Heeft u het gevoel dat andere mensen het lastig vinden om met u te praten?
15. Voelt u zich buitengesloten door uw hoorproblemen?

Gedrag en reacties

16. Bent u terughoudend om nieuwe mensen te leren kennen vanwege uw hoorproblemen?
17. Houdt u zich stil in groepsgesprekken omdat u bang bent iets verkeerds te zeggen?
18. Wordt u in uw zelfvertrouwen aangetast omdat u een hoorprobleem heeft?
19. Heeft u het gevoel dat u tekort schiet door uw slechte gehoor?
20. Voelt u zich verdrietig of boos als u niet aan een gesprek kunt deelnemen?

Respons alternatieven zijn: Nooit, Zelden, Regelmatig, Vaak en Altijd.

English

The Gothenburg Profile consists of the following questions:

Subscale 1: Speech intelligibility and localization.

1. How often does it occur that you cannot hear conversation when speaking to one person at home?
2. How often does it occur that you cannot hear conversation in a group at home?
3. How often does it occur that you cannot hear the speaker at a meeting, if you are well positioned?
4. How often does it occur that you cannot hear the newsreader on the TV, when the volume is not turned up?
5. How often does it occur that you cannot hear the newsreader on the radio?
6. How often does it occur that you cannot localize different sound of traffic?
7. How often does it occur that you turn your head to the wrong direction when someone is calling out to you?
8. How often does it occur that you are surprised because cars have come closer to you than you thought?
9. How often does it occur that you cannot hear when someone is opening a door behind you?
10. How often does it occur that you cannot (only by hearing) decide if the water is boiling in a pan?

Subscale 2: Experienced handicap, relation to others

11. How often do you find hearing problems an obstacle for your social life?
12. How often does it occur that you avoid social gathering because it is too hard to follow a conversation?
13. How often does it occur that you feel that people are ignoring you just because of your hearing difficulties?
14. How often do you feel that people find it hard to talk to you?
15. How often does it occur that you have a feeling of being excluded from things because of your hearing difficulties?
16. How often does it occur that you are reluctant to meet new people due to your hearing difficulties?
17. How often does it occur, if you are sitting quietly in a group of people, that you are afraid of saying something foolish?
18. How often does it occur that your self confidence is affected because you are having hearing difficulties?
19. How often does it occur that your poor hearing makes you feel inadequate?
20. How often does it occur that you feel sad or angry if you cannot join in a conversation?

Response alternatives are: Never, Rarely, Sometimes, Often, and Always.

German

1: Sprachverstehen und Richtungshören

1. Können Sie den Gesprächspartner verstehen, wenn Sie sich zu Hause mit einer Person unterhalten?
2. Können Sie jeden Gesprächspartner verstehen, wenn Sie sich zu Hause mit mehreren Personen unterhalten?
3. Können Sie in einer Versammlung den Sprecher verstehen, wenn Sie einen guten Platz haben?
4. Können Sie den Nachrichtensprecher im Fernsehen verstehen, wenn die Lautstärke normal eingestellt ist?
5. Können Sie den Nachrichtensprecher im Radio verstehen, wenn die Lautstärke normal eingestellt ist?
6. Können Sie verschiedene Geräusche des Straßenverkehrs lokalisieren bzw. einordnen?
7. Wenden Sie den Kopf in die falsche Richtung, wenn Sie jemand anspricht?
8. Werden Sie von Autos überrascht, die Ihnen näher kommen als Sie aufgrund des Hörens vermutet haben?
9. Hören Sie es, wenn jemand hinter Ihnen eine Tür öffnet?;
10. Können Sie durch das Hören allein entscheiden, ob Wasser in einem Topf kocht?

2: Verhaltens- und Reaktionsweisen und Zwischenmenschliche Beziehungen

11. Empfinden Sie Ihre Hörstörung als eine Beeinträchtigung Ihrer Kontakte zu anderen Menschen?
12. Meiden Sie die Zusammenkunft mit anderen Menschen, weil Sie der Unterhaltung nur schwer folgen können?
13. Haben Sie den Eindruck, dass manche Menschen Sie ignorieren, nur weil Sie schlecht hören?
14. Haben Sie das Gefühl, dass andere Menschen es als schwierig empfinden, sich mit Ihnen zu unterhalten?
15. Fühlen Sie sich wegen Ihrer Hörstörung von Dingen ausgeschlossen?
16. Zögern Sie wegen Ihrer Hörbeeinträchtigung neue Menschen kennenzulernen?
17. Meiden Sie Gruppenunterhaltungen, weil Sie fürchten, unpassend zu antworten?
18. Ist Ihr Selbstvertrauen durch die Hörstörung beeinträchtigt?
19. Fühlen Sie sich wegen Ihrer Hörstörung minderwertig?
20. Sind Sie traurig oder ärgerlich, wenn Sie an einer Unterhaltung nicht teilhaben können?

Antwortmöglichkeiten: Nie, Selten, Manchmal, Oft oder Immer.

Swedish

Göteborgsprofilen består av följande frågor:

1: Att höra tal och varifrån ljud kommer.

1. Händer det ofta att du inte kan höra samtal med en person hemma?
2. Händer det att du inte kan höra vid samtal i grupp, när du är hemma?
3. Händer det att du inte kan höra talaren vid ett möte, även om du sitter på en bra plats?
4. Händer det att du inte kan höra nyhetsuppläsaren på TV när volymen inte är extra uppskruvad?
5. Händer det att du inte kan höra nyhetsuppläsaren på radio?
6. Händer det att du inte kan avgöra varifrån olika ljud kommer i trafiken?
7. Händer det att du vänder huvudet åt fel håll, när någon ropar på dig.
8. Händer det att du blir överraskad av att bilar hunnit komma närmare än du trodde?
9. Händer det att du inte kan höra när någon öppnar en dörr bakom dig?
10. Händer det att du inte kan (enbart med hörseln) avgöra om vattnet kokar i en kastrull?

2: Upplevt handicap, relationer till andra

11. Tycker du att hörselproblem är ett hinder i ditt umgängesliv?
12. Händer det att du undviker samvaro med andra, därför att det är ansträngande att följa med I ett samtal?
13. Händer det att du får en känsla av att andra inte låtsas om dig, bara för att du ha svårt att höra?
14. Får du en känsla av att andra tycker det är ansträngande att prata med dig?
15. Händer det att du får en känsla av att vara utestängd från saker, därför att du har svårt att höra?
16. Händer det att du drar dig för att träffa nya människor på grund av problem med hörseln?
17. Händer det att du sitter tyst i en grupp av rädsla av att höra något tokigt?
18. Händer det att ditt självförtroende påverkas av att du har svårt att höra?
19. Händer det att din dåliga hörsel får dig att känna dig otillräcklig?
20. Händer det att du känner dig ledsen och arg om du inte kan delta i samtal?

Svarsalternativ: Aldrig, Sällan, Ibland, Ofta och Alltid.

Appendix D: Lexical decision words

Dutch

Words	Non - words
BUS	PES
ZIN	HIN
GEEF	GEEM
BEL	ZEL
KOP	GOL
NIEUW	NIEEF
KAAS	JAAS
LACH	RACH
HOOP	MOOP
ZOEK	ZOEG

English

Words	Non - words
FAN	SHU
RUG	KAS
GAP	CAG
KEY	POB
GET	NAR
FUN	DAR
JOB	LIK
SUM	MOL
ASK	HUS
SKY	DUR

German

Words	Non - words
ALS	AHK
AN	AHT
AUCH	ANKT
BACH	APF
BACK	AUL
BAHN	AUT
BAß	BÄCH
BAT	BÄTZ
BEET	BEECH
BEIß	BEH

Swedish

Words	Non - words
HOP	DIL
ARG	NSI
TVÅ	LAR
BOR	AHT
LOD	BIB
VAN	BNE
LUT	NAB
ARV	AIH
PAR	KAT
RIK	NIS