The HEAD Graduate School
First Summer Workshop

June 9 – 10, 2008

Vårdnäs Stiftsgård, Rimforsa, Sweden

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The HEAD Graduate School First Summer Workshop

The first HEAD Graduate School Summer Workshop was held at Vårdnäs Stiftsgård, Rimforsa, Sweden, June 9 – 10, 2008. The workshop was open to scientists with an interest in the field of hearing and deafness. Representatives from user organizations and from the hearing aid industry were also present.

HEAD Graduate School

Founded in the spring of 2008, the HEAD Graduate School promotes interdisciplinary research training in the field of hearing impairment and deafness. It is run in collaboration between the universities of Linköping and Örebro within the framework of the Swedish Institute for Disability Research (SIDR) and is funded by the Swedish Research Council.

For further information about the HEAD Graduate School and its activities please visit www.ihv.se/head.

Planning Committee

The workshop was organized by Mary Rudner, Josefine Andin, Mathias Hällgren, Björn Lidestam, and Vendela Westin.

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Abbreviations

AI = Ahlséns Research Institute
CMIV = Center for Medical Image Science and Visualization
DCAL = Deafness Cognition and Language Research Centre
HRF = The Swedish Association of Hard of Hearing People
IBL = Department of Behavioural Sciences and Learning
IKE = Department of Clinical and Experimental Medicine
IMH = Department of Medical and Health Sciences
SHMS = School of Health and Medical Sciences
SIDR = The Swedish Institute for Disability Research

Programme

DAY 1

09.30 AM	**Registration** – tea, coffee and sandwich
10.00 AM	County Governor of Östergötland, Björn Eriksson
10.10 AM	**Welcome and introduction,** Mary Rudner, SIDR, Department of Behavioural Sciences and Learning (IBL), Linköping University (LiU)

Why a graduate school?

10.30 AM	**The graduate school experience**, Maria Engström, Center for Medical Image Science and Visualization (CMIV), Department of Medical and Health Sciences (IMH), LiU
11.00 AM	**The employable HEAD doctor**, Thomas Lunner, SIDR, Department of Clinical and Experimental Medicine (IKE), LiU, Oticon Research Centre, Eriksholm, Denmark
11.30 AM	**HEAD graduate school in an international perspective**, Ruth Campbell, Deafness Cognition and Language Research Centre (DCAL), University College London (UCL)
12.00 AM	**Lunch**
01.00 PM	**Group discussions** – What can the HEAD graduate school offer me?

HEAD research from signal to intervention

01.30 PM	**Introduction**, Jerker Rönnberg, SIDR, IBL, LiU
02.00 PM	**Signal**, Stig Arlinger, IKE, LiU
02.30 PM	**Ear**, Claes Möller, SIDR, School of Health and Medical Sciences (SHMS), Örebro University (ÖU)
03.00 PM	**Tea, coffee and fruit**
03.30 PM	**Brain**, Ruth Campbell, DCAL, UCL
04.00 PM	**Mind**, Björn Lyxell, SIDR, IBL, LiU
04.30 PM	**Dialogue**, Birgitta Sahlén, Department of Logopedics, Phoniatrics and Audiology, Lund University

05.00 PM **Intervention**, Gerhard Andersson & Vendela Westin, SIDR, IBL, LiU

06.00 PM **Dinner**

07.30 PM **Social activity**

DAY 2

Oral sessions

09.00 AM ***Session 1***, Chair, Mathias Hällgren, SIDR, IKE, LiU

Hearing and cognition in speech recognition in noise
Mathias Hällgren & Birgitta Larsby, SIDR, IKE, LiU

Assessing the perceived effort required for aided speech perception in noise
Catharina K Foo, IBL, LiU

High sound levels from music, effects on hearing and prevention
Kim Kähäri, SIDR, SHMS, ÖU

Disturbing sounds in hearing aid users' daily soundscape
Åsa Skagerstrand, SIDR, SHMS, ÖU

How visually specified is speech?
Björn Lidestam, IBL, LiU

10.40 AM **Tea, coffee and fruit**

11.00 AM ***Session 2***, Chair, Josefine Andin, SIDR, IBL, LiU

Benefits for hearing impaired persons who use assistive listening devices at work
Sif Bjarnason, SIDR, SHMS, ÖU

Phonological development in children with otitis proneness
Helena Stålnacke, SIDR, SHMS, ÖU.

Insomnia and hearing impairment
Sarah Granberg, SIDR, SHMS, ÖU

12.00 AM **Lunch**

01.00 PM	***Session 3***, Chair, Vendela Westin, SIDR, IBL, LiU
	Arithmetic and phonological processes in deaf native signers and hearing non-signers Josefine Andin, SIDR, IBL, LiU
	Modality specific differences in working memory for sign and speech Mary Rudner, SIDR, IBL, LiU
	Deafblindness from a bio-psycho-social approach Kerstin Möller, SIDR, SHMS, ÖU
02.00 PM	**Panel discussion:** Full speed aHEAD! – goals for the graduate school.
	Chair: Björn Lidestam, IBL, LiU Åsa Skagerstrand, SIDR, SHMS, ÖU Claes Möller, SIDR, SHMS, ÖU Thomas Lunner, SIDR, IKE, LiU, Eriksholm Jan-Peter Strömgren, HRF
03.00 PM	**Tea, coffee and cake**
04.00 PM	**Closing remarks,** Mary Rudner, SIDR, IBL, LiU

Abstracts

Day 1: HEAD research from signal to intervention

01.30 PM

The challenges of cognitive hearing science

Jerker Rönnberg, SIDR, IBL, Linköping University

*C*ognitive *He*aring *S*cience (CHS) is a new cross-disciplinary area of vital importance to the general *He*aring *a*nd *D*eafness (HEAD) area. It addresses different hearing impairment syndromes and deafness, b) emphasizes the interaction between different kinds of signal processing and cognitive capacity, and (c) relates cognitive capacities to successes/failures of communication, aging and social life. A recent cognitive model for Ease of Language Understanding (ELU) will be briefly introduced. The ELU-model attempts to incorporate and conceptually bind together findings from neural, behavioural and communicative/social levels of description/explanation. Some examples of empirical tests of model predictions/assumptions will be presented, future challenges to the CHS area will be delineated, and suggestions for future research will be pointed out.

02.00 PM

The acoustic signal

Stig Arlinger, IKE, Linköping University

The ear is the receiver of a large variety of acoustic input signals, sounds, of varying complexity, human speech perhaps being the most important signal for the human listener. Sound is defined as vibrations in an elastic medium; for human listeners air is the normal medium. The magnitude of the acoustic signal is recorded in terms of sound pressure variations and expressed as sound pressure level in dB SPL. Frequency is the other basic quantity that defines the acoustic signal. The spectrum describes the frequency composition of the signal. The time course or wave-form of the signal is correlated to the spectrum. Sound pressure level can be measured using different frequency weightings related to the frequency dependent sensitivity of the human ear. Different time-weightings are also used in the sound level meter, again with a relation human hearing.

02.30 PM

The ear

Claes Möller, SIDR, SHMS, Örebro University

This lecture will focus on anatomy and physiology of the inner ear. The cochlea with 2.5 turns is approximately 35mm long. It has three “stairs”, scala vestibuli, media and tympani. The organ of Corti is located in Scala media. One important feature of the ear is its capability to tranform mechanic energy into electric. The cochlea has “geographical representation where sound with short waves (high frequencies) primarily will elicit a response at the base of the cochlea, while lower frequencies will elicit responses closer to the apex. Since the different cells in the cochlea is dependent on metabolites to function, the scalas have different fluids (peri and endolymph). The sound vawe is transported via the middle ear, and the inner ear acts as a frequency generator. The organ of Corti contains many different types of cells the most important are one row of Inner hairs cells (IHC= 3500) and 3 rows of Outer hair cells (OHC= 1500). The top of the hair cells are called stereo-cilias which are movable. The stereocilias are connected with each other by an intricate system called tip links. When the sound wave moves the fundament of the scala media (basilar membrane), the stereo-cilias moves which results in shortening and elongations of the hair cells. This will cause openings of different ion channels and a “ depolarisation where release of chemicals will cause a small electric current. The hair cells are connected to nerve fibers via ganglion spirale (50.000). This will continue with the eight nerve where the nerve fibers also have geographical representation of different frequencies. These nerve fibers contains both afferent (leading in to the brain) and efferent nerve fibers. The interaction of the outer and inner hair cells, and the afferent and efferent nerve fibers are intricate and not yet fully understood. A hearing loss may be caused by many different etiologies and thus affect different parts of the inner ear. Some disorders causes primarily slow destroyment of supporting cells, which will give “starvation” of the hair cells and a slow progressive hearing loss. Other disorders such as after loud noise might give an immediate degeneration of some outer and inner hair cells , which will release toxic agents such as free radicals which will further destroy still living hair cells. Most causes of hearing loss are genetic (60-70%) sometimes in combination with environmental factors. The genes will not produce certain proteins needed for hearing activities.

The lecture will rapidly cover basic parts of anatomy and physiology, in order to discuss some new findings in understanding why a person with hearing loss both have problems with quantity and quality. It is therefore highly recommended to take a few minutes of cognition in order to understand perception.

03.30 PM

Neural bases of hearing and deafness: A quick and dirty overview

Ruth Campbell, DCAL, University College London

This talk will be a short tutorial on the cortical bases for hearing and speech processing in relation to deafness. It will touch on the cortical bases for (silent) speechreading focussing on deaf people, and on cortical plasticity of the deaf brain in relation to the development of language and cognition.

04.00 PM

Cognitive psychology and hearing-impairment: Are they related?

Björn Lyxell, SIDR, IBL, Linköping University

The importance of cognitive processes in listening and communication in hearing-impaired individuals is not a new finding. This was recognized already as early as in the beginning of the sixties (e.g. Davis, 1964, Pichora-Fuller, 2007). However, the role played by cognitive processes in communication has to a large part remained unresolved until recently. This presentation will highlight some recent trends in the area of cognition and hearing-impairment. Specifically, we will focus on the role played by cognitive psychology in cognitive development (e.g. children with CI, older adults' cognitive decline), listening in challenging situations (e.g. noise) and how the individual's cognitive capacity interacts with different kinds of hearing devices.

04.30 PM

Deaf adolescents with CI in conversation with hearing peers - working memory and requests for clarification

Birgitta Sahlén, Dept. of Logopedics, Phoniatrics and Audiology, Lund University

Conversational skills in children and teenagers with CI are studied. Our focus has mainly been on requests for clarification of information in referential communication tasks. A range of analyses have been made: number of words, turns, time to solve task, number of questions and types of questions. Results from the dialogues shows that conversational pairs including a child with CI and a hearing peer use more turns, more time to solve the task, more questions but less words and more requests for confirmation of new information than pairs with two hearing children, that use more requests for elaboration (open questions).The same pattern emerges for individuals with CI compared to matched hearing children. We have also explored how speech recognition, working memory and, speech/language skills are related to conversational skills in children with CI.

Significant correlations were found between speech recognition cognitive and linguistic measures and number and type of questions in referential communication made by the children with CI. Children with better WM seemed to behave differently in conversation than children with poorer WM.

Generally the children with CI seem to be active and competent conversational partners, but they use more time and more questions in referential communication than hearing peers, especially of a type that helps them to avoid communication breakdowns. Interestingly the children with CI used very few open questions, where they had no control of the answer. This kind of task (referential communication) might be less demanding than more open conversations, since it is well-structured, the environment is calm, they know their conversational partner well, factors that have important clinical and pedagogical implications.

05.00 PM

Cognitive behavioral treatment of tinnitus distress: An overview

Vendela Westin, SIDR, IBL, Linköping University

Gerhard Andersson, IBL, Linköping University

Tinnitus is an auditory perception that can be described as the experience of sound, in the ear or in the head, in the absence of external acoustic stimulation. Since direct treatment of tinnitus, with few rare exceptions, cannot abolish the symptom several treatments have been developed which target the distress that may accompany tinnitus. Certain forms of psychological distress, such as depression, anxiety, sleep disturbance and difficulty concentrating have consistently been found to be related to tinnitus distress. One treatment that focuses on management of tinnitus distress and associated problems is cognitive behavior therapy (CBT). Non systematic reviews and two independent meta-analyses support the use of CBT for reducing tinnitus distress.

My aim is to present an overview of the treatment components and research results of cognitive behavior therapy for tinnitus distress.

Day 2: Session 1

09.00 AM

Hearing and cognition in speech recognition in noise

Mathias Hällgren, SIDR, IKE, Linköping University

Birgitta Larsby, SIDR, IKE, Linköping University

In our society we are continuously influenced by unwanted sounds. This makes it more difficult and strenuous to understand and process spoken information. Disturbing sounds in our environment differ in nature, but often the sources are other persons speaking. Then the sound interferes with the spoken message not only due to its physical properties but also because it conveys a meaningful message which can be hard to ignore. The purpose of the present investigations is to study how our ability to recognize speech is affected by environmental sounds with different physical properties and degrees of cognitive involvement.

In a series of experiments we have studied cognitive aspects of speech comprehension in noise. Subjects with moderate bilateral sensorineural hearing impairments, aged 45-86 years, participated in the studies. Speech recognition was assessed by Hagerman's speech test and by the Hearing in Noise Test (HINT).

Exposure to noise with different more or less speech-like characteristics produce different effects on the outcome of the speech recognition tests which will be further discussed in relation to age, cognitive ability and signal-to-noise ratios.

Thanks are due to The Swedish Council for Working Life and Social Research (FAS) and to the EU-project HEARCOM.

09.20 AM

Speech recognition in noise and perceived effort

Catharina Foo, IBL, Linköping University

Mary Rudner, SIDR, IBL, Linköping University

Thomas Lunner, SIDR, IKE, Linköping University, Oticon A/S

Jerker Rönnberg, SIDR, IBL, Linköping University

Speech recognition in noise is an effortful process requiring explicit cognitive processing. It may be influenced by noise modulation and signal processing when hearing is aided. The relationship may be understood in terms of the working memory model for Ease of language Understanding. According to ELU, subjects with good explicit cognitive capacity will be better listeners and previous work suggests they find listening less effortful.

This study focuses on objective listening performance, subjective effort of aided speech recognition in noise, and cognitive capacity. 30 experienced hearing aid users participated.

Speech recognition was tested using the Hagerman sentences presented in three fixed speech to noise ratios, using modulated and unmodulated noise. The subjects used both fast and slow compression release hearing aid settings.

Effort was rated using a visual analogue scale and cognitive capacity was measured using the reading span test. ANOVAs and correlations were computed.

Preliminary findings show that effort ratings involved in aided speech recognition covary with noise level and performance but that these effects are reduced by noise modulation. Further, perceived effort at low SNR may be related to cognitive capacity. These findings extend previous work on perceived effort and cognitive capacity and provide further evidence that type of noise is an important factor in this relationship.

09.40 AM

High sound levels from music, effects on hearing and prevention

Kim Kähäri, SIDR, SHMS, Örebro University

High sound levels and musical industry go hand in hand and the effects on the musicians hearing have not been unnoticed. Several studies have shown on a high prevalence of hearing disorders among musicians especially tinnitus, hyperacusis and distortion disorders when compared to non musicians.

The fear for future negative hearing development or a ready developed hearing disorder is in a musician a trauma that influences not only the work and to function as a fully adequate musician but the whole life. This fact is severe for the individual, a heavy cost for the society and calls for preventive work. The EU Noise directive 2003/10/EG regarding “Health and safety among employees when exposed to noise” has since 2005 been applied by the Swedish Work Environment Authority in AFS 2005:16 “Noise”. According to this regulation, Swedish guidelines to support work environment management in the musical business should be formed. This has now been done and this presentation will address the relationship between high sound levels from music, and the effects on hearing. The presentation will also include some preventive examples of management of a noisy musical work environment.

10.00 AM

Disturbing sounds in the hearing aid users daily soundscape

Åsa Skagerstrand, SIDR, SHMS, Örebro University

The soundscape of today becomes noisier compared to previous times. The society and our way of living have higher demands on our possibility to achieve acoustic information. These two statements put together might indicate a problem for some persons and especially those who have a hearing impairment and use hearing aids. A well-known problem, both from research and clinical experience, is the user's negative reaction to high-level sounds as well as the increased amount of sounds when using hearing aids. In order to improve the rehabilitation given by audiologists this thesis focuses on the negatively perceived, disturbing, sounds for the hearing aid user. Initially a field study were made to achieve information of what sounds that hearing aid users find negative and disturbing in their daily soundscape. Those sounds were then acoustically analyzed for spectral and temporal patterns. The on-going part of the thesis focuses on how this kind of sounds are perceived, psychoacoustical, and how different types of signal processing deal with the same sound. The presentation at the HEAD workshop will give information from the initial studies of negative parts of the hearing aid user's daily soundscape, and some preliminary result of the on-going psychoacoustical study.

10.20 AM

Perception of vowel duration by ear and eye

Björn Lidestam, IBL, Linköping University

Much is known about how the acoustic speech signal and the auditory perception of speech works. Much less is known about the optical properties of the speech signal and their relation to visual perception of speech. Vowel duration may constitute prosodic cues, and can also be a semantic feature. This experiment explored A, V, and AV perception of vowel duration. The purpose was to explore JNDs; to compare performance across modalities; to compare perception of vowel duration as a function of visual distinctiveness, and to compare error bias. 90 normal¬hearing participants perceived stimulus pairs differing with regard to duration of the vowel /a/. Duration differences varied in twelve steps (33–396 msec). Modality was between groups. Responses were given as key presses, to indicate whether the first or the last stimulus in each pair was perceived to be longer. Performance and RT were measured. Some preliminary results suggest as follows. (a) Accuracy is lower for V than A and AV perception. (b) Visual distinctiveness from consonant context affects performance in both V and AV perception. (c) Whether the first or the last stimulus in the pair was perceived to be longer, when the difference was minimal, was affected by modality. (d) JNDs were not possible to establish.

Day 2: Session 2

11.00 AM

Benefits for hearing impaired persons who use assistive listening devices at work

Sif Bjarnason, SIDR, SHMS, Örebro University

The aim of this phd-study is to investigate the use of assistive listening devices, ALD´s, by persons with hearing aids on the Swedish labour market. The central assumption is that both technical and various social mechanisms affect the use of ALD´s in communication. Empirical data suggest that persons with partial hearing loss may benefit largely from ALD´s in challenging listening situations. While hearing aids are intended for general purpose use, ALDs are used in specific situations less studied in disability research.

Some results from a study (in progress) of 71 permanently employed hearing aid users will be presented at the workshop. This group obtained ALD´s from the Swedish Social Insurance Agency during 2005 and 2006. They answered a questionnaire about the usefulness from different kinds of technical solutions, in relation to specified hearing situations at work.

Finally, a future interview study with some persons from the sample will be discussed briefly. Theories about *redistribution* and *social recognition* may be fruitful for the understanding of processes leading to a successful use of ALD´s in communication.

11.20 AM

Phonological development in children prone to otitis media

Helena Stålnacke, SIDR, SHMS, Örebro University

Jan van Doorn, Umeå University

Peter Czigler, Örebro University

A child's communicative development, cognitive development, and academic achievements are directly linked to his/her language development. Therefore, it is important to identify each individual child who is at risk for delayed language development. Children with hearing loss constitute a high-risk group for delayed language development. One of the etiological factors of hearing loss is acute otitis media, causing fluctuating conductive hearing loss (0-40 dBHL). Although the research, conducted on otitis prone children's language development, can be characterised as extensive and intensive, the relationship between the fluctuating hearing loss and speech development still needs to be established. One way to illuminate this relationship is to focus on children's early phonological development in a longitudinal perspective. This is the aim of the present project.

The subjects are 26 otitis prone and 21 non otitis prone children. The investigation includes the children's phonological production, phoneme discrimination ability, and phonological awareness. The phonological production and perception data reveals a child's ability to discriminate, store and reproduce appropriate acoustic contrasts between speech sounds. A child's phonological awareness has been recognised to have importance for a child learning to read and write during primary school years.

Parts of the results from the investigation will be presented at the workshop.

11.40 AM

Hearing impairment and insomnia

Sarah Granberg, SIDR, SHMS, Örebro University

Primary insomnia has been a target for investigation during several years, focusing on different aspects such as precipitating and perpetuating factors and treatment. Primary insomnia is a sleep disorder, where a person experiences difficulties falling asleep or experiences numerous or early awakenings. Thus, primary insomnia is known to have a major impact on the daily life. This condition is not a secondary effect of medication or other medical conditions. Stressful life events or stressful life in general (for instance the psychosocial work environment) have been identified as a clear link to the development of primary insomnia.

Recent research has shown that insomnia is common, particularly among women, in individuals with hearing impairment. The reason for this is not yet fully explored. Therefore, this study aims to identify risk factors for primary insomnia in individuals with hearing impairment. A questionnaire has been developed focusing on different aspects, such as the person's work situation, health, hearing impairment and social life. The questionnaire will be distributed to a group consisting of 80 persons with hearing impairment and coexisting primary insomnia, recruited from different Audiological clinics. The questionnaire will also be handed out to a matched control group. This is an ongoing study and therefore no results are yet available.

Day 2: Session 3

01.00 PM

Arithmetic and phonological processes in deaf signers and hearing non-signers

Josefine Andin, SIDR, IBL, Linköping University

In hearing people most arithmetic operations are language dependent. Different arithmetical processes engage different neurocognitive components; multiplication is associated with activation in the left frontal lobe, while subtraction is also associated with activation in the right parietal lobe. In sign language, evidence points towards an overall greater involvement of the right parietal lobe. However, it is not known how this right hemisphere shift is related to arithmetic operations. In this cognitive study, we sought to investigate a combination of arithmetic and phonological aspects of sign language.

To obtain a base for comparing signers to hearing non-signers using the same set up we constructed a computerised test battery with six conditions, including a phonological task (same handshape for signers and rhyme for hearing subjects), subtraction, multiplication, letter order, digit order and a baseline control task. So far 11 deaf signers and 4 hearing non-signers have been tested. Preliminary results showed a strong correlation between accuracy on the phonological and the subtraction task in both groups. Furthermore, there seems to be a groups difference on the performance on the multiplication task, which might be explained by a closer connection between phonology and multiplication in hearing persons. To further investigate these processes a fMRI study on deaf signers and hearing non-signers is planned.

01.20 PM

Modality specific differences in working memory for sign and speech

Mary Rudner, SIDR, IBL, Linköping University

The working memory model for Ease of Language Understanding (ELU) predicts that processing differences between language modalities emerge when cognitive demands are explicit. Previous behavioural and neurocognitive work has shown that cognitive processing differences may be related to the different spatial and temporal processing demands involved in sign language and speech. In a set of working memory experiments with participants who were Deaf Signers (DS), Hearing Signers (HS) or Hearing Nonsigners (HN), we manipulated level of explicit processing required as well as temporal and spatial demands. Easily nameable pictures were used as stimuli to avoid confounds relating to sensory modality. When explicit processing demands were low, performance was largely similar for DS, HS and HN. However, when explicit and temporal processing demands were high, DS did not perform as well as HN. This effect was compounded by oral education. These findings suggest that temporal organization is not as prominent in working memory for sign language as it is in working memory for speech. A general effect of semantic similarity was also found. These findings are discussed in relation to the ELU model.

01.40 PM

Deafblindness from a bio-psycho-social approach

Kerstin Möller, SIDR, SHMS, Örebro University

Deafblindness signify impairment in both visual and hearing function, which means that views that are visible and sounds that are audible for human beings in general are not seen and heard. International Classification of Functioning, Disability and Health (WHO 2001) are used as a framework to explore mechanisms related to deafblindness. The Ecological approach (Gibson 1966) and Disability as a laminated system (Bhaskar & Danermark 2006) are used in order describe and explain these mechanisms. The conclusions that can be drawn are: *Participation restrictions* for people with deafblindness are far-reaching and are embedded in a complex process of interaction between the person with deafblindness and the environment. It is extremely important to understand the role of *participation restrictions* in deafblindness. Primary activity limitation is to not see and hear enough for comprehension. Hence, not taking part in the visible and audible world is primary participation restriction. Performing activities without basic information includes risk. One important aspect of deafblindness is *exposure*.