JAN WOUTERS

ICRA

International Collegium of Rehabilitative Audiology

2nd to 5th June 2003

Højstrupgaard Conference Centre

Helsingør/Elsinore, Denmark

9th Meeting

ICRA meeting - Denmark, June 2-5, 2003

Programme

Monday, June 2

13.00	***Welcome and practical remarks*** (organizers / president)
13.15	***Report from the I.H.A.T.S. Working Group:*** Søren Westermann (chair), Claus Elberling, Wouter Dreschler, Stig Arlinger, Carl Ludvigsen. **Progress report of a new ICRA CD including environmental noise** 13:15 **Experiences with existing ICRA 1 CD** Carl Ludvigsen 13:25 **New ICRA 2 CD-set** Søren Westermann 13:45 **Background theory and recording techniques** Søren Laugesen 14:05 **Practical issues, choice of recording technique** Anders Jessen 14:20 **Sound demonstration** Søren Laugesen, Anders Jessen 14:30 **Completion of project, timelines & conclusions** Søren Westermann
	Chair: Birger Kollmeier
15.00	***Real-life noises and their masking effect on speech*** Wouter A. Dreschler, Saskia Koster, Jan Koopman Academic Medical Center, Amsterdam, The Netherlands

	Background and rationale: The goal of this study was to investigate the masking effects of different types of noise on speech intelligibility and understand these effects from spectral and temporal noise characteristics. A second goal was to test the applicability of a just-follow-conversation (JFC) test as a quick method to measure many conditions within a limited measurement time. Methods: To achieve this, a large database of real-life background noises was collected. The noises in this database were analysed on spectral and temporal behaviour. The results of these noise analyses indicated that the speech signal is best distinguishable from the noises on basis of its temporal behaviour. A number of noises were selected to represent the different characteristics of the noises, based on the results of the noise analyses. The hypothesis of this study was that the speech intelligibility in noise would decrease when the noise spectrum resembled the speech spectrum. Furthermore, it was expected that speech intelligibility would increase when the noise contained stronger fluctuations. To test these hypotheses, a group of representative noises was selected for speech intelligibility tests. The threshold of 50% sentence intelligibility was determined for 12 noises with a SRT-test. A JFC-test was conducted on 43 noises, the twelve of the first test included. To determine the importance of the different noise characteristics for speech intelligibility, the results of the speech intelligibility tests where correlated with the results of the different noise analyses. Results: These comparisons indicated that the energy of the noises below 1kHz are more important for the ability to follow a conversation than the energy above 1kHz for both the normal-hearing and hearing-impaired subjects. Speech intelligibility decreased when the noise contained more energy in the frequency range below 1kHz. Furthermore, the normal-hearing subjects could take advantage of modulations in the noise, whereas the hearing-impaired subjects could not. For the JFC-test a relatively high test-retest correlation was found, but the relationship with the SRT-results (the golden standard) were poor in some conditions. The consequences for the applicability of the JFC-test will be discussed.
15.20	***Coffee***
15.40	***A method to measure the effect of noise reduction algorithms using simultaneous speech and noise*** Björn Hagerman, Åke Olofsson Unit of Technical and Clinical Audiology, Department of Clinical Neuroscience, Karolinska Institutet Most hearing impairments reduce the ability to understand speech in the presence of background noise. Therefore, there is a great need to enhance the signal-to-noise ratio (S/N) in the hearing aid. It is, however, difficult to estimate the improvement in technical terms. No standardised methods are offered. Our approach is to present speech and noise simultaneously and

	make two measurements, one of them with the noise phase reversed. Taking the sum of the corresponding two output signals, or the difference, the output speech or the output noise can be extracted. Thus the gain can be calculated for each of them, although they are present at the same time and influence the signal processing of the hearing aid in a normal way. Eight different hearing aids were tested with various speech and noise signals and S/Ns. Noise reduction up to 4 dB was measured with noise reduction algorithms (NRAs) activated. The NRAs in the hearing aids measured were more efficient at positive S/N and almost not useful at negative S/N at the particular levels used in the experiment. Fast compression can also influence the S/N.
16.00	***Modeling room acoustic effects on speech reception and perception.*** Arthur Boothroyd A model is proposed that allows the prediction of speech reception at various locations in a room. Data on room dimensions, talker directionality, background noise, and reverberation time are used to derive a Speech Audibility Index. This metric is the percentage of the useful speech signal whose level exceeds that of the interfering noise. The useful speech signal is defined as a logarithmic combination of the direct speech signal and the early components of reverberation (early reflections). The interfering noise is defined as a logarithmic combination of background noise and the late components of reverberation. As in Articulation Index theory, it is assumed that useful speech information is uniformly distributed over a range of 30 dB. Probability theory is then used to predict phoneme recognition as a function of Speech Audibility Index. Proficiency factors (j- and k-factors) are added in order to predict word recognition in isolation and in sentence context. The effects of sensorineural hearing loss are incorporated into these predictions, using corrections based on empirical data. This model is incorporated into a software simulation to assist audiologists in understanding, demonstrating and resolving the listening difficulties faced by users of cochlear implants and hearing aids in acoustically hostile environments.
16.20	***SLEIPNER – a tool for hearing aid analysis using real life signals.*** Claus Elberling Oticon Research Centre The increased complexity of modern hearing aids has made it necessary to explore new ways to evaluate the characteristics of the individual hearing aid with environmental signals like e.g. speech, noise and music. We have proposed a specific evaluation method based on environmental sounds, with the hope that these sounds may better describe how specific signal processing algorithms relate to the perceptual domain. The method uses short-term RMS values of the input and output signals to describe the

	dynamics of the insertion gain. Frequency specific information can be extracted while the hearing aid is driven by a real broad band signal. The evaluation method is implemented in an executable program, SLEIPNER. This provides a series of practical tools including calibration, analysis frequency and bandwidth, short-term rms definitions, short-term rms distribution functions, flexible display options and data filing of the analysis results. The SLEIPNER-program and a related report which describes the most important details of the program and the basic considerations are offered to those who may wish to use it for hearing aid evaluation and research.
16.40	***Simplistic Evaluation Flow Chart for Measurement of Digital Hearing Aids*** Wayne J. Staab, Ph.D., Michael Valente, Ph.D., Christopher Schweitzer, Ph.D., and Kris Frye The measurement of digital hearing aids to determine if the suggested 'intent' of the signal processing algorithm by the manufacturer is being met is not being done clinically. Part of the problem is that the methods used by manufacturers in support of their algorithm is often not available to clinicians. The other problem is that few clinicians know how to proceed with any attempts at digital hearing aid measurement. This paper offers a simplistic Evaluation Flow Chart that can be provided by manufacturers and used by clinicians, using existing hearing aid test equipment, to help determine if the digital hearing aid is performing as expected.
- 17.00	
19.00	***Dinner at Hojstrupgaard***
	Social evening in private bar at Hojstrupgaard

Tuesday, June 3

- 9.00	***Breakfast***
	Chair: Wouter Dreschler
9.00	***The Speech, Spatial, and Qualities of Hearing Scale (SSQ)*** Stuart Gatehouse[1] and William Noble[2] [1]MRC Institute of Hearing Research, Glasgow, Scotland [2]University of New England, Armidale, NSW, Australia The Speech, Spatial and Qualities of Hearing Scale (SSQ) is designed to measure a range of hearing disabilities across several domains. Particular attention is given to hearing speech in a variety of competing contexts, and to the directional, distance, and movement components of spatial hearing. In addition, the abilities both to segregate sounds and to attend to simultaneous speech streams are assessed, reflecting the reality of hearing in the everyday world. Qualities of hearing experience include ease of listening, and the naturalness, clarity, and identifiability of different speakers, different musical pieces and instruments, and different everyday sounds. An application of the SSQ to 153 new clinic clients prior to hearing aid fitting showed greatest difficulty was with simultaneous speech streams, ease of listening, listening in groups and in noise, and judging distance and movement. There was less difficulty in identifying different sounds. SSQ ratings were compared with an independent measure of handicaps covering distress and related emotional effects, as well as restrictions on life. After controlling for differences in hearing level, it was found that identification, attention and effort problems, as well as spatial hearing problems, feature prominently in the disability-handicap relationship, along with certain features of speech hearing. The results implicate aspects of temporal and spatial dynamics of hearing disability in the experience of handicap. The SSQ shows promise as an instrument for evaluating interventions of various kinds, particularly (but not exclusively) those that implicate binaural function.
9.20	***Interaural asymmetry of hearing loss, SSQ disabilities, and handicap*** William Noble[1] and Stuart Gatehouse[2] [1]University of New England, Armidale, NSW, Australia [2]MRC Institute of Hearing Research, Glasgow, Scotland A series of comparative analyses is presented between a group with relatively similar degrees of hearing loss in each ear (N=103: symmetry group) and one with dissimilar losses (N=50: asymmetry group). Asymmetry was defined as an interaural difference of more than 10 dB in hearing levels averaged over 0.5, 1, 2 and 4 kHz. Comparison was focused

	on self-rated disabilities as reflected in responses on the Speech, Spatial and Qualities of Hearing Scale (SSQ). The connections between SSQ ratings and a global self-rating of handicap were also observed. The inter-relations among SSQ items for the two groups were analysed to determine how the SSQ behaves when applied to groups in whom binaural hearing is more (asymmetry) versus less compromised. As expected, spatial hearing is severely disabled in the group with asymmetry; this group is generally more disabled than the symmetry group across all SSQ domains. In the linkages with handicap, spatial hearing, especially in dynamic settings, was strongly represented in the asymmetry group while all aspects of hearing were moderately to strongly represented in the symmetry group. Item intercorrelations showed that speech hearing is a relatively autonomous function for the symmetry group, whereas it is enmeshed with segregation, clarity and naturalness factors for the asymmetry group. Spatial functions were more independent of others in the asymmetry group. The SSQ shows promise in assessment of outcomes in the case of bilateral versus unilateral amplification and/or implantation.
9.40	***Coffee***
10.00	***Report from Aural Rehabilitation Group:*** Holistic Approach (living with CI) Kathy Pichora-Fuller (chair) Lillemor Hallberg, Louise Hickson, Dai Stephens ***ICRA Working Group on Rehabilitation Programs*** Kathy Pichora-Fuller The Working Group on Rehabilitation Programs will report on the 2001 Eriksholm Consensus paper on AR programs for older adults and recommendations for future research directions. The summary has been prepared by Jurgen Kiessling and will be presented by Kathy Pichora-Fuller on behalf of the group. Other ICRA members at the 2003 meeting, including those who participated in the Eriksholm Workshop as well as those who did not, will participate in a panel discussion to explore examples of current programs that exemplify desired properties consistent with the Eriksholm consensus. These programs will touch on topics such as the value of longitudinal studies, the importance of public health and health promotion approaches for AR, the challenge of developing programs that meet individual and population needs, as well as other topics. The purpose of the discussion will be to establish vital connections between the research issues of concern to the ICRA AR Working Group and the other ICRA working groups.

	Individuals with Hearing Loss in Changing Contexts: Technology in the Person-Context Fit Kathy Pichora-Fuller Abstract not yet received ***Living with Cochlea implants: experiences from 17 adult patients in Sweden*** Lillemor R-M Hallberg & Anders Ringdahl *Abstract* The aim of this grounded theory study was to gain a deeper understanding of what it means to profoundly deaf adults to undergo a cochlea implantation (CI) and their experience of living with it daily. The aim of grounded theory is theorizing, that is constructing from data an explanatory scheme that systematically integrates various concepts and their relationships. The study group consisted of ten women and seven men (29-78 yrs; mean = 56.5 yrs), who have had their CI for between 1 and 12 years (mean = 4.1 yrs). Open taped interviews were carried out and analyzed. The core category, coming back to life, defines a psychological process basic to existence, elucidating the existential value of hearing, including perceived harmony in life and becoming a part of the living world as important dimensions. This core concept is related to four additional emerging categories in a temporal order. Preventing disappointment concerns the decision to undergo the operation governed by the conception of having nothing to lose combined with low expectations of successful outcomes. Waiting in silence relates to experiences during the post-operative period such as sensations from the head and uncertainty about the outcome of surgery. The "switch-on" was experienced as a significant revelation and the emotionally loaded starting point for their coming back to life. Relearning the brain concerns the lengthy audiovisual learning process, finally resulting in that "a car sounds like a car". Strengthening of self-worth concerns psychosocial outcomes of CI, in terms of less dependency and increased social participation. Cochlear implants provide a substantial improvement of the quality of life, as identified in the emerging generic process of coming back to life, fundamental for psychological existence.
12.00	***Lunch***
13.00	**IOI-symposium:** ***Introduction*** Bill Noble (chair): 13.10

The IOI-HA as a routine quality service indicator in Scotland

Stuart Gatehouse,
MRC Institute of Hearing Research (Scottish Section),
Glasgow Royal Infirmary, North Glasgow University Hospitals NHS Trust,
Glasgow, Scotland

As part of a review of Audiology Services in Scotland, in addition to aspects of structure and process, eventual measures of outcome in the disability and handicap domain were required. The project specifications indicated a short questionnaire which could be self-completed, and distributed and returned by mail independent of the host clinic services. The IOI-HA conformed to the required specifications and was used in five major audiology centres in Scotland as part of the service review. The availability of reference data from elsewhere in Europe and North America provided a benchmark against which the Scottish services could be compared.

The returns showed significant variations between service delivery centres in Scotland and inferior overall levels of outcome to reference data from overseas. The IOI-HA has proved to be sufficiently robust and sensitive to document service standards at least in this context.

13.30

The IOI applied in cases of cochlear implants and CI/hearing aid combinations

Ringdahl A*, Holmes AE** and Hallberg L*, Nilsson J*, & Colburn M**
*SWEDEN, **USA,

Background information for this study will be presented to ICRA by Alice Holmes and co-writers (see abstract). The data from IOI are from following groups: Patients with cochleae implants (n=95), candidates for implantation (n=20), patients with a post-lingual PTA (0.5, 1.0 and 2.0 kHz) of ≥ 80 dB HL in the best ear (n=61). These data will be analyzed with reference to the Health Utilities Index, the Psychological General Well Being Scale and the Glasgow Benefit Hearing Inventory, and data from other investigations of IOI.

13.50

IOI-BAHA - the application of IOI-HA to bone anchored hearing aids.

Dafydd Stephens
Welsh Hearing Institute,
University Hospital of Wales

Our currently work on IOI-BAHA comprises the 7 IOI-HA questions plus two extra ones which are specific to this group,

covering ear discharge and comfort. The last relates primarily to problems with headband BC aids.

14.10

Evaluation of a training program for hearing strategies using IOI-AI and IOI-SO

Sophia E. Kramer, Hella Allessie
VU University Medical Center, Amsterdam

A recently developed video-training program for the rehabilitation of hearing impaired elderly adults was evaluated. The program deals with hearing strategies and speech reading and is designed for both hearing impaired individuals and their significant others (SO). Subjects who visited the clinic for hearing aid fitting were randomly assigned to a training group (hearing aid fitting + video-training program) or a control group (hearing aid fitting). The training group consisted of 25 hearing impaired older adults + 23 significant others. The control group comprised 28 hearing impaired subjects+21 significant others. Effectiveness of the program was determined via various self-report outcome instruments addressing psychosocial functioning and handicap. The IOI-AI and IOI-SO were included. The training program was found to be an effective tool for improving certain aspects of psychosocial functioning. IOI data demonstrated favourable attitudes towards the training. For certain IOI items, SO scores differed significantly from scores of the hearing impaired participant.

14.30

Outcomes of Active Communication Education for older people: Comparing the IOI-AI with other measures

Louise Hickson, Linda Worrall, and Nerina Donaldson
Communication Disability in Ageing Research Unit,
The University of Queensland, Australia

Active Communication Education (ACE) is an interactive group program for older people with hearing impairment living in the community. The program is facilitated by an audiologist or speech pathologist and runs for two hours per week over five weeks. The aims of the ACE are to improve the communicative function of older people with hearing impairment, reduce the participation restriction that they experience, and improve their quality of life. A range of measures is being used to evaluate different outcomes of the program. Firstly, we are comparing pre-post intervention scores on the Hearing Handicap Questionnaire (HHQ; Gatehouse and Noble, personal communication), the Self-Assessment of Communication (SAC; Schow & Nerbonne, 1982), the Quantified Denver Scale of Communicative Function (QDSCF; Alpiner et al., 1974;Tuley et al., 1990), Ryff Psychological Well-

	being Scale (Ryff, 1989), and the Short Form-36 (SF-36; Ware & Sherbourne, 1992). Although some participants showed significant improvements post-intervention on these measures, little difference was evident between participants' mean scores pre and post. Secondly, a modified version of the Client Oriented Scale of Improvement (COSI; Dillon, James, & Ginis, 1997) and the International Outcome Inventory – Alternative Interventions (IOI-AI; Noble, 2002) are being administered and more positive findings have been obtained with these measures. Finally, participants' qualitative responses to the program have been recorded. In this presentation, data from the first phase of a large scale study of the efficacy of communication training will be presented with particular emphasis on our experience with this range of outcome measures.
14.50	***Coffee***

15.10	***Round Table discussion of the Self-Report Working Group.***

Notes by Bill Noble (chair) for Round Table Discussion
Self-Report Working Group

The following are understood also to be members of the Working Group (bracket indicates unable to attend this meeting):

Stig Arlinger
(Robyn Cox)
Stuart Gatehouse
Louise Getty
Lillemor Hallberg
Louise Hickson
Kathy Pichora-Fuller
Anders Ringdahl
Dai Stephens

Everyone else at the ICRA meeting is of course welcome to attend and join in discussion of the issues raised at the Round Table.

Four headings were flagged earlier:

1. The IOI-HA. Guidelines for its application so as to promote optimum comparability of outcome data across contexts of application.

2. Guidelines for translation of IOI into further languages.

3. Proposals for further development and use of the IOI, including application of the IOI-SO and the IOI-non-HA interventions.

4. Future directions for the Self-report Working Group.

It is not the intention of these notes to limit discussion to those issues. The following notes are intended simply as a starting point. Please set out your own ideas and circulate them in advance of the meeting, or bring with you to the meeting

1. Applying the IOI

The IOI is designed as a post-intervention assessment tool. In its original form the intervention is assumed to be a personally-worn hearing aid. A first guideline would be with respect to the length of time, post-fitting, that the IOI should be applied. It would be advisable, given what is known about acclimatization, and the perturbations in reported handicap levels — perhaps reflecting changes in use pattern — to wait at least three months after fitting has been finalised before applying the IOI.

Sample size. The IOI-HA has been applied to date in three large population samples in The Netherlands, USA and Wales. Two factors have fairly consistently emerged, one covering overall benefit (items 1, 2, 4 and 7), the other covering residual effects (3, 5 and 6). It can be expected that meaningful results will be observed in small samples (N ≥20) if they are relatively homogeneous in terms of age, diagnosis, severity of loss, ear asymmetry and fitting profile. It will be beneficial to any appraisal of outcomes using the IOI (or any other measure) to distinguish clients along those lines in assessing both factors of the inventory, in which case users should attempt to accumulate at least 20 people per cell from among the applicable cells proposed in Table 1. (Note, this guideline is not prescribing that every cell be addressed, merely, that clients can be assigned to a cell as an aid to making comparisons among subsets. There may be scope for adding type of amplification device.)

The rationale for the IOI is to enable ready comparison among different forms of service provision, and the data presented by Gatehouse at the IOI Symposium indicate the potential of the inventory for this purpose. In order that such comparison be effective it is necessary that the samples compared are akin to each other on other critical variables, such as those identified above, thereby allowing the effect of type or site of intervention to be evaluated.

2. Translating the IOI

The procedure described by Cox, Stephens and Kramer (Cox, Stephens, & Kramer, 2002) should be followed, involving native speakers of the target language who are proficient in written English and have a good knowledge of the disciplinary area. Independent checking of meaning should be employed. The procedure of "back-translation" is unnecessary; more important is to ensure that the original meanings of the items and the scoring categories are carried over intelligibly to the target language. The existing translations in Dutch and Welsh can serve as models, insofar as the response patterns in those languages seem very comparable.

Table 1. Factors usefully distinguished in appraising outcomes of a hearing aid intervention (some cells may not be clinically meaningful).

		one aid				two aids			
		mild/mod		sev/prof		mild/mod		sev/prof	
		sym	asym	sym	asym	sym	asym	sym	asym
sensory	20-50								
	51-70								
	71-90								
conductive	20-50								
	51-70								
	71-90								

3. Potential further development of the IOI, and use of its variants

We will have had opportunity to appraise the effectiveness of the IOI in further application (bone-anchored aids, implants), and the application of its variants (IOI-SO, IOI-AI), from papers contributed to the IOI Symposium. No brilliant thoughts under this heading occur to me at the time of writing the present notes, so we should wait and see what ideas emerge from exposure to the reports of these studies.

4. Future directions for the Working Group

Two areas may be worth developing: one is tinnitus, the other is disabilities and handicaps experienced by children with impaired hearing.
The problem of tinnitus has long been recognised and numerous surveys have been conducted giving rise to a hugely variable array of data (see Table 2, from Preece, Tyler and Noble (in press). The variability is due to the nature of questions that people have been asked, as regards the frequency, duration and annoyingness of tinnitus. It would be worthwhile determining on what sorts of questions are worth asking in terms of experienced disability and handicap, as against reliance on questions that ask merely for incidence or duration of tinnitus experience. Some existing scales address the disabilities/handicaps domains (Hallam, Jakes, & Hinchcliffe, 1988; Kuk, Tyler, Russell, & Jordan, 1990), but there is scope for a short version of these suitable for use at a population level.
Children with hearing impairment have been the subject of intensive investigation in terms of performance testing, but have been ignored in terms

of their experience of disabilities and handicaps. The nature of their experiences will doubtless vary in ways predictable from observations in adults, but there will be features critically influenced by age of onset and family circumstances.

References

Cox, R. M., Stephens, D., & Kramer, S. E. (2002). Translations of the International Outcome Inventory for Hearing Aids (IOI-HA). International Journal of Audiology, 41(1), 3-26.

Hallam, R. S., Jakes, S. C., & Hinchcliffe, R. (1988). Cognitive variables in tinnitus annoyance. British Journal of Clinical Psychology, 27, 213-222.

Kuk, F. K., Tyler, R. S., Russell, D., & Jordan, H. (1990). The psychometric properties of a tinnitus handicap questionnaire. Ear & Hearing, 11(6), 434-445.

Preece, J. P., Tyler, R. S., & Noble, W. (in press). Tinnitus in the elderly. Geriatrics and Aging.

Table 2. Prevalence of Tinnitus for Various Age Groups
Ages are in years and percentages are rounded to the nearest whole number.

Hinchcliffe[10]		Leske[8]		Coles[11]		Axelsson[12]		Brown[9]		Davis[1]		Sanchez[13]		Nondahl[4]	
Age	%	Age	%	Age	%	Age	%	Age	%	Age	%	Age	%	Age	%
18–24	21	18–24	27	17–30	4	20–29	8	18–44	2	17–30	10				
25–34	27	25–34	27												
35–44	24	35–44	31	31–40	5	30–39	6			31–40	9				
45–54	27	45–54	33	41–50	8	40–49	9			41–50	11			48-59	7
55–64	39	55–64	38	51–60	12	50–59	19	45–64	5	51–60	15			60-69	10
65–74	37	65–74	45	61–70	16	60–69	20	65–74	9	61–70	19	70–74	5	70-79	9
		75–79	41	71–80	14	70–79	21	>75	8	71–80	18	75–79	7	80-92	6
										>80	18	80–84	9		
												>84	9		

Axelsson A, Ringdahl A. Tinnitus: A study of its prevalence and characteristics. British Journal of Audiology 1989; 23: 53-62.
Brown, SC. Older Americans and tinnitus: A demographic study and chartbook. In: Johnson RC, Hotto SA, Editors. GRI Monograph Series A, #2 Washington: Gallaudet University.
Coles RRA. Epidemiology of tinnitus: Prevalence. Journal of Laryngology and Otology 1984; Suppl. 9: 7-15.
Davis, A. Hearing in Adults. London: Whurr, 1994.
Hinchcliffe R. Prevalence of the commoner ear, nose and throat conditions in the adult rural population of Great Britain. British Journal of Preventive Medicine 1961; 15: 128-140.
Leske MC. Prevalence estimates of communicative disorders in the U.S.: Language, learning and vestibular disorders. ASHA. 1981; 23: 229-237.
Nondahl DM, Cruickshanks KJ, Wiley TL, Klein R, Klein BEK, Tweed TS. Prevalence and 5-year incidence of tinnitus among older adults: The epidemiology of hearing loss study. Journal of the American Academy of Audiology 2002; 13: 323-331.
Sanchez L, Boyd C, Davis AC. Prevalence and problems of tinnitus in the elderly. In: Hazell J. Editor, Proceedings of the Sixth International Tinnitus Seminar. Cambridge: The Tinnitus and Hyperacusis Centre; 1999: 58-63.

- 17.00

19.00 ***Dinner at Hojstrupgaard***

Social evening in private bar at Hojstrupgaard

Wednesday, June 4

- 9.00 ***Breakfast***

Chair: Stig Arlinger

9.00 ***Beyond Segmental Intelligibility – Celebrating the Complexity of the Auditory World***

Stuart Gatehouse,
MRC Institute of Hearing Research (Scottish Section)

We hear sounds around us all the time, deriving from multiple sound sources at multiple locations occurring at varying points in time. When we hear a sound which has salience, we shift our attention, eyes and head towards the source, and we listen carefully. We comprehend the sound, and often participate in communication, principally in the form of dialogue. The auditory systems, and deficits in its function, are integral to the cascade between hearing, listening, comprehending and communicating. Traditional audiological research pays little attention to the complexities of human communication. In elderly listeners with SNHL, for the perception of the segmental intelligibility of a single talker in a background of steady-state noise presented monaurally over headphones, individuals' measures of the audibility of the speech-signal (perhaps augmented by measures of frequency and temporal resolution) exert a high degree of predictive leverage. In contrast, for listeners in real rooms with a variety of reverberation characteristics, containing multiple sound sources (some of which are talkers and some of which are non-speech) which listeners are required to locate, attend to, and switch attention between, then such measures are much less predictive. Despite the fact that the vast majority of SNHL is primarily cochlear in origin, the interaction between sensory and cognitive aspects of hearing must exert a material influence on the extent to which listeners function in real environments on perceptually relevant tasks, and hence on disability and on the benefits of intervention. Performance measures in the laboratory or clinic usually test segmental intelligibility of a single voice, whose spatial position and spectral/temporal characteristics are static and predictable, in a single noise (usually steady state or at best speech-like babble), which is again static and predictable. In the self-report domain we access a richer set of communication environments, though still predominantly ignoring the three-dimensional and temporally dynamic aspects of the auditory world. This communication reports from a series of experiments which represent the start of a research program to investigate auditory abilities, disabilities and the benefits of hearing aids in more complex acoustical environments whilst undertaking perceptually relevant tasks.

They include:

1) The development of a self report scale, the Speech hearing, Spatial hearing and Qualities of hearing (SSQ) which attempts to tap into elements of disability including selective attention, switching attention, appreciation of distance and movement, and aspects of identification and sound source segregation. The data show systematic relationships with impairment and likely difficulty of the circumstances. Strikingly, they show the highest correlations with an independent measure of hearing handicap for items which tap into switching and sustaining attention, and aspects of distance and movement (that is the perceptionaly, spatially and temporally dynamic aspects of listening) rather than the traditional disability items. The correlations survive partialling with age, hearing level and auditory lifestyle and are not evident in elderly listeners without sensorineural hearing loss.

2) A performance measure of selective attention based upon a combined speech and music task confirms that the rank ordering of reports on the SSQ with measured ability to sustain attention. Thus listeners report of attentional abilities appear to reflect a processing capability rather than some external intervening influence.

3) Repeat administration of the SSQ after experience of (predominately) linear amplification shows both systematic benefits and disadvantages on individual SSQ items.

4) A combined test of localisation and speech identification ability in noise for wide-band and low-past speech stimuli in diffuse noise background and noise backgrounds where the noise has a single perceived location (equivalent to noise with low and high interaural correlation) demonstrate significant effects of both binaural hearing and auditory attention on speech intelligibility, even in a relatively simple segmental task.

The results provide an initial framework to justify the potential importance of auditory abilities that are achieved beyond the level of the cochlear in both attentional and spatially and temporarily dynamic aspects to the problems that hearing impaired people experience in everyday listening and the extent as to which the provision of amplification might elevate those disabilities. They point to some potential pitfalls in amplification strategies which might compromise real world listening ability. A challenge for the future is to gain an understanding based on evidence in both self-report and performance domains of the effects of sensorineural hearing loss and the benefits of differing amplification rationales.

9.20 ***The "Oldenburger Satztest" - a prototype for an internationally comparable sentence test?***

Birger Kollmeier
University of Oldenburg,
AG Medizinische Physik, Fachbereich Physik

Abstract not yet received

9.40 ***Hearing aid accessories for adults: the remote FM microphone.***

Arthur Boothroyd

Twelve adults with mild to severe hearing loss, aged 52 to 85, were fit with behind-the-ear FM hearing aids and used them for a minimum of two weeks. A single session of counseling, instruction and demonstration was provided before the trial period. Phoneme recognition was measured before and after the trial period at several speech levels under 3 conditions: aided in quiet, aided in spectrally matched noise, and FM-assisted in noise. Perceived benefit was assessed by questionnaire at the end of the trial period. Under controlled conditions, FM-assisted phoneme recognition in noise equaled aided phoneme recognition in quiet. Both were very well predicted by the average pure-tone threshold at 2000 and 4000 Hz. Articulation Index (AI) fell by roughly 1 percentage point per dB of loss over 4 dB. Aided phoneme recognition in noise was quite well predicted by the same average threshold. AI in noise at a signal-to-noise ratio of 0 dB was roughly one third of that in quiet. Average self-assessed benefit was highest for one talker, at a distance, in quiet or in noise, and lowest for multiple talkers and one close talker in quiet. Older subjects and subjects with poorer aided recognition in noise tended to express lower perceived benefit. All subjects expressed some or considerable perceived benefit overall but many reported that the system was ineffective in reducing background noise. This last finding was attributed to use of an "equal gain" criterion in adjusting relative gains via the hearing aid and FM microphones. No subject expressed an intention to acquire an FM system. It was concluded that the expected benefits of a remote FM microphone in reducing the negative effects of distance and noise, for a single talker, can be demonstrated under both laboratory and field conditions but considerable counseling, instruction and coaching, together with individual adjustment of relative gains via FM and hearing aid microphones, will be required to ensure optimal use of and benefit from FM microphones, as hearing aid accessories, by adults with hearing loss.

10.00 ***Coffee***

10.20 H.Luts &

Frequency-specific threshold measurements for hearing aid fitting in young children

Jan Wouters

Following our general neonatal hearing screening program in Flanders (6M inhabitants), we are working on auditory steady state response audiometry in babies from age of 1 month up, as a help for fitting hearing aids

10.40

Hard evidence for different sound fields (anaechoic test rooms) generated with a HATS (Head And Torso Simulator)

Ludwig Moser
Bayerische Julius-Maximilians-Universität

Multi speaker test fields gain in popularity to evaluate bilaterally fitted heads with a hearing problem. The bilateral devices could be modern hearing aids or implants. In the later case those test rooms are a means to generate evidence for bilateral fittings vs. unilateral. Patients tested in various test rooms in different labs show results with a large variance. A HATS as a manekin is at least an object to minimize intra generated variance. Results of at least three different test rooms in different European countries will be presented and I hope we will have a good discussion.

11.00

Simplex optimization of three hearing-aid algorithms

Wouter A. Dreschler and Bas A. M. Franck
Academic Medical Center, Amsterdam, The Netherlands

Background and rationale: Several strategies have been proposed to fine-tune hearing aids. Especially, prescription rules have been developed to estimate the most suitable frequency response for the hearing-impaired individual. In this study, we investigated a different optimization approach that should be able to fine-tune multiple parameters or algorithms simultaneously: the Simplex procedure.

Methods: To direct the Simplex towards the optimal setting we use a paired-comparison paradigm to compare differently processed sentences in noise on aspects of speech intelligibility or listening comfort. Three different experiments were conducted.
In our first study the reliability of the Simplex procedure is investigated, using three experimental signal processing algorithms and judged on listening comfort. The purpose of the second study is to evaluate the perceptual effects of advanced processing of three state-of-the-art hearing aid algorithms. We also investigated the optimal combinations of these algorithms with respect to speech intelligibility, i.e. the speech reception threshold (SRT).

Results: The results from study I indicate that hearing-impaired subjects need larger differences between algorithms settings than normal hearing subjects in order to be perceptually distinguishable. The reliability depends on hearing capacity, initial value (starting point), step size, algorithm, and noise type. Defining a minimum step size might enhance the reliability of the Simplex procedure. The results from study II indicate that the applicability of the Simplex procedure is limited for the test hearing aid. The major factor that influences the reliability negatively is the difficulty to perceive differences between the algorithm settings. Besides, it appeared that the reliability depends on noise type, hearing loss, hearing loss slope, age, and algorithm. The best Simplex winner does not always yield the best SRT. The explanation could be that the hearing-impaired subjects do not only weigh the speech intelligibility of the fragments, but also the listening comfort. The algorithm syllabic compression is preferred for fluctuating speech noise, especially for subjects with flat or negative hearing loss slopes. The noise reduction scheme is preferred much for most subjects. Most subjects prefer some speech enhancing. Finally, the optimal combination depends on the subject. This underlines the importance of individual fine-tuning of the test hearing aid, i.e. the Simplex strategy.

Chair: Dai Stephens

11.20

An assessment of costs and benefits of hearing aids for adults in Sweden

Stig Arlinger, Ulf Rosenhall, Arne Leijon and Bengt Brorsson

In Sweden, an estimated 560 000 adults have hearing impairments severe enough to require a hearing aid. Approximately 270 000 adults have hearing aids, of whom more than 50% use the devices regularly.

This report presents findings from a systematic and critical review of the scientific literature on the costs, risks, and benefits of using hearing aids to treat hearing loss.

The literature search focused on answering four questions:

- How common is hearing impairment in the adult population, and what is the distribution among age groups and between men and women?
- At what level of hearing impairment can hearing aids be of sufficient benefit to motivate testing and prescribing these devices?
- What is known about the value of the various technical features in modern hearing aids?
- What are the costs for testing and acquiring hearing aids in Sweden?

	Results: • An estimated 1.2 million people in Sweden aged 18 years and older have mild hearing impairment, 495 000 have moderate hearing impairment, and 120 000 have severe or very severe hearing impairments. • Hearing aids mainly benefit those with moderate to severe hearing impairment. • Several studies show the advantages of non-linear hearing aids in regard to sound quality and benefits in daily life, according to users, but no significant differences have been demonstrated in speech testing in a laboratory setting. • There is no evidence that hearing aids with digital amplification are superior to modern hearing aids using analog amplification. Hearing aids usually use an omnidirectional microphone, but they can also be equipped with a directional microphone. Some users notice the difference, and use a directional-microphone device in noisy environments while they often prefer omnidirectional microphones in quieter environments. • Acoustic and hearing physiology factors suggest that two hearing aids may be superior to one in people with hearing loss in both ears. However, no clinical trials have shown that two hearing aids are superior to one hearing aid in the user's daily life situation.
	• Approximately 560 000 adults are estimated to have sufficiently significant hearing loss to derive benefit from a hearing device. Approximately 270 000 people have hearing aids. Slightly more than half of this group report that they use their hearing aid "often" or "always". • An estimated 58 000 people aged 18 years and older received hearing aids in Sweden during 2002. Of this total, 39 000 received a hearing aid in one ear and 19 000 received hearing aids in both ears. This yields an average cost of approximately 10 000 SEK per person receiving hearing aids.
11.40	***A cross-cultural study on the benefits of cochlear implants*** Ringdahl A*, Hallberg LR-M*, Holmes AE** *Sweden, **USA Cultural and societal factors can influence the psychosocial impact of severe to profound hearing loss and subsequent treatments. The purpose of this study was to compare the perceived psychosocial and speech perception benefits of cochlear implants for post-lingual hearing impaired adults in Sweden and the USA. Hallberg and Ringdahl (2002) completed a qualitative study on 17 Swedish post-lingual, adult cochlear implant patients that formed the basis for the research program to be discussed. Analysis of in-depth interviews in this

	qualitative study revealed that the core benefit reported by these patients involved psychological and existential dimensions rather than just speech perception and communication alone. Two groups of cochlear implant (CI) users, one from the Sweden and one from the USA were compared to each other and to a Swedish control group. The control group consisted of Swedish patients who qualified audiologically for a cochlear implant but had not had the surgery. Several outcome measures were used to evaluate the psychosocial and quality of life benefits of the procedure. All adult post-lingual cochlear implant patients at Sahlgrenska University Hospital in Göteborg and at County Hospital in Borås SWEDEN and at the University of Florida Shands Teaching Hospital in Gainesville, FL USA were given by post the following self-assessment instruments in their native language: the Health Utilities Index, the Psychological General Well Being Scale and the Glasgow Benefit Inventory. Hearing tests used were best-aided threshold, aided PB word score, and aided sentence score in quiet and in noise. In addition, these subjects were compared to a control group of Swedish hearing aid users who were sent the same instruments. Multi-variant analyses are being used to ascertain if age, age of onset of hearing loss, age at implantation, length of implant/hearing aid use, type processor and program, speech perception, nationality, social-economic factors and expenditures for the audiologic rehabilitation program can be used as outcome predictors for the various outcome measures. Significant predictors are then be used as co-variants in the comparison study between the implanted subjects and the control group. Comparisons among the groups in terms of quality of life, psychological well being and perceived and measured speech perception benefit will be discussed. In addition, the importance of cross-culture studies and the difficulties in methodology encountered in this investigation will be discussed.

12.00	***Lunch***
13.00	***What became of the Shape and the Good Practice Guidance Sub-Groups?*** Stuart Gatehouse
14.00	***ICRA Business Meeting***
-16.00	
16.45	***Visit to the Louisiana Museum of Art and Culture in Humlebaek***
19.00	***Dinner at Skovmosegård /Søren Westermann***

	Thursday, June 5
-9.00	***Breakfast***
9.00	***Chair: Wayne Staab*** ***What have we learned about multi-microphone noise reduction strategies for a BTE hearing aid?*** Jan Wouters Key words: fixed beamforming, adaptive systems, matching, robustness, algorithms. Abstract Review of our recent results with a fixed beamformer (as an assistive listening device for a BTE), with adaptive algorithm approaches (relative to the AudioZoom)
9.20	***ACALOS - Optimized adaptive procedure for loudness scaling.*** Birger Kollmeier University of Oldenburg AG Medizinische Physik, Fachbereich Physik Abstract not yet received
9.40	***Are we prescribing too much gain for people with mild hearing loss?*** Arne Leijon People with mild hearing loss complain mainly about problems in NOISY sound environments. The most widely spread generic hearing-instrument prescription method, NAL-NL1, has a strong scientific foundation, but the underlying optimization was done only for speech in QUIET. This mismatch may lead to higher prescribed gain than necessary. Other prescriptions that recommend higher gain than NAL-NL1 are probably even worse in noise. A series of experiments by my PhD student Karolina Smeds have indicated that users prefer less gain, i.e. less loudness of amplified sound, than the NAL-NL1 prescribes. (Some of these data were presented at the previous ICRA meeting.) Although the NAL-NL1 is intended to restore normal or less than normal loudness, hearing-impaired subjects listening to NAL-NL1-amplified sound rated the sound as louder than corresponding ratings by unaided normal-hearing persons. This indicates that the underlying loudness calculation method may also be wrong. A recently published study by Shanks et al (2002) showed that users with mild hearing loss obtained lower speech recognition scores with

	increasing presentation levels, at constant signal/noise ratios. Thus, they would have obtained better speech recognition in noise if their hearing instruments had decreased the gain to compensate for the increasing presentation level. Reference: Shanks JE, Wilson RH, Larson V, Williams D. Speech recognition performance of patients with sensorineural hearing loss under unaided and aided conditions using linear and compression hearing aids. Ear and Hearing 2002;23(4):280-290.
10.00	***Coffee***
10.20	***The challenges that Modernising NHS Hearing Aid Services in England has posed in measuring patient outcomes*** Adrian Davis MRC Institute of Hearing Research, Nottingham Abstract not yet received
10.40	*No scheduled events*
11.00	***Summary / Evaluation*** Past and new presidents
12.00	***Lunch***
	Departure

List of participants for
the 9th ICRA Meeting 2003, 2-5 June 2003 held at Højstrupgaard, Elsinore, Denmark

	Fellow:	Spouse	Country	Arrival/Dept
1	Stig Arlinger Dept. of Technical Audiology, University Hospital, Linköping		Sweden	2-5 June
2	Arthur Boothroyd San Diego		USA	1-5 June
3	Wouter A. Dreschler Clinical & Experimental Audiology, AMC, Amsterdam		The Netherlands	1-4 June
4	Claus Elberling Oticon Research Centre, Eriksholm		Denmark	1-5 June
5	Stuart Gatehouse, MRC Institute of Hearing Research, Glasgow,		Scotland - UK	1-5 June
6	Louise Getty School of Speech Pathology and Audiology, University of Montreal		Canada	1-5 June
7	Björn Hagerman Technical Audiology, Danderyd		Sweden	2-5 June
8	Lillemor Hallberg Nordic School of Public Health, Göteborg	Sven Hallberg	Sweden	2-5 June
9	Louise Hickson Dept. of Speech Pathology & Audiology, University of Queensland, Brisbane	Peter Hickson	Australia	2-5 June
10	Alice Holmes Dept. of Communicative Disorders, University of Florida, Gainsville	Geoff O'Meara	USA	2-5 June
11	Birger Kollmeier Medizinische Physik, University of Oldenburg		Germany	2-5 June
12	Sophia Kramer Dept of Audiology, Vrije University Medical Center, Amsterdam		The Netherlands	2-5 June
13	Arne Leijon Speech, Music & Hearing, Royal Institute of Technology, Stockholm		Sweden	2-5 June
14	Carl Ludvigsen Widex A/S		Denmark	1-5 June
15	Ludwig Moser Universitäts-HNO-Klinik, Würzburg		Denmark	2-5 June
16	Bill Noble Head, School of Phychology, University of New England	Michelle Schouten	Australia	1-5 June
17	Kathy Pichora-Fuller Dept. Psychology and Program of Communication, Culture & Information University of Toronto at Mississauga		Canada	1-6 June
18	Anders Ringdal Dept. of Audiology Sahlgrenska Univeristy Hospital, Göteborg		Sweden	1-5 June