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ABSTRACTS

Robert W Keith, University of Cincinnati, Ohio, USA

MASTER CLASS I - Auditory Processing Disorders – A USA Perspective

The history of auditory processing disorders (APD) in the United States has been filled with controversy. Only recently has there evolved some semblance of accord on definitions, approaches to assessment, management approaches and therapy outcomes. In spite of these agreements there remain many areas of debate and segments of the audiology community have yet to agree on certain basic principles related to this disorder. This presentation will trace the evolution of APD in the USA from the early 1980s until the present time. Areas of apparent consensus and discord will be presented, along with comments on the future direction of APD in the USA.

Ray Meddis, Department of Psychology, University of Essex

MASTER CLASS II – Getting a computer to 'hear' like someone with a hearing impairment: using this knowledge to benefit client and clinician

Computer models of hearing are new and relatively unfamiliar. This master class will explain in relatively simple terms what a 'hearing dummy' is and how it works. The hearing dummy is based on the idea that hearing can be understood in terms of a cascade of processes in the extreme auditory periphery (stapes, basilar membrane vibration, inner hair cell (IHC) receptor potential, release of transmitter into the IHC/ auditory nerve (AN) synaptic cleft, and AN action potentials. Each of these stages can be simulated by a computer program so that a chain of these programs can represent peripheral aspects of hearing. These models can now be used to represent normal hearing. Alternatively, they can be tuned to simulate impaired hearing to represent the deficits of a particular patient. The hearing dummy can be tested just like a normal patient using the same testing procedures to check that the simulation is accurate. This talk will give practical, live demonstrations of a model in operation.

David Moore, MRC Institute of Hearing Research, Nottingham
Melanie Ferguson, MRC Institute of Hearing Research, Nottingham

MASTER CLASS III – Auditory Processing Disorder – The IHR Perspective

People with reported hearing difficulties but normal audiograms may be referred with suspected APD. BSA and ASHA definitions attribute APD to a range of poor 'auditory processing' (AP) skills in the absence of a general cognitive deficit. We research APD using a 'population approach' that examines large samples of randomly chosen children. The aim is to identify those with poor AP, measured on a range of tone and tone-in-noise psychoacoustic tests, and to correlate AP with their speech-in-noise, cognitive and communication abilities. Recently, we have completed sampling all these abilities in 1638 children aged 6-11 years at four UK sites – the IHR Multi-centre study of AP (IMAP). Temporal and frequency resolution in those (90%) with 1 & 4 kHz thresholds ≤ 20 dB HL were normally distributed, but with long tails on the poor performance side. Weak correlations ($r \approx 0.3$) were found between the AP measures, suggesting generalised AP problems are rare. However, among their non-AP abilities, those with poor temporal resolution (> mean + 1.5 s.d.; n = 94) had poor nonword reading only, whereas those with poor frequency

resolution (< mean - 1.5 s.d.; n = 87) had poor speech-in-noise, nonverbal IQ and communication, indicative of reported hearing difficulties that have been associated with APD. It therefore appears that frequency resolution may be a sensitive, single measure test of APD, but further analysis is required to link this to other measures. APD management has not yet been addressed experimentally. Current advice from the BSA Special Interest Group is to provide a high quality listening environment, encourage directed listening and consider amplification. Auditory training is also recommended. We are currently starting a study of auditory training with some of those children who performed poorly on the AP tests in the IMAP.

Louise Hickson, University of Queensland, Australia

Master Class IV - A Group Communication Education Programme for Adults ACE (Active Communication Education):

ACE is a group rehabilitation program for adults with acquired hearing impairment and their significant others (Hickson, Worrall, & Scarinci, 2007). The aim is for adults with hearing impairment to become more effective communicators by empowering them to develop strategies to cope better in everyday life. The ACE was developed out of a program of research conducted in the Communication Disability Centre at The University of Queensland and it has been extensively evaluated (Hickson, Worrall, & Scarinci, 2006, 2007). ACE is informative and fun - and the evidence shows that it does make a positive difference to the lives of older people with hearing impairment. In this interactive master class, participants will learn some of the practical skills necessary to run the ACE program (i.e., how to facilitate effective interactions in groups and how to develop communication problem solving processes in group members).

Sue Hill, Department of Health

Abstract not available at time of printing.

Torsten Dau,
Centre for Applied Hearing Research,University of Denmark

Signal Analysis in the human auditory system

How does a physical event that is characterized by acoustical waves entering our outer ear produce an auditory sensation? A major aim of hearing research is to establish a functional relationship between the basic physical attributes of a stimulus, such as the intensity or the spectral content, and their associated percepts. It is the combination of sensory psychoacoustics, electrophysiology (e.g. acoustically evoked potentials) and neuroimaging (e.g. magnetic resonance imaging) that nowadays allows for a deeper understanding of the relationship between our (acoustic) environment, its internal representation, and (auditory) sensation. The general principles of sensory information processing and object representation can often be characterized by an input-output function of the system (or a sub-system) using specifically designed stimuli. This talk considers three main stages of signal transformation in the human auditory system that represent fundamental processes of frequency analysis, time analysis, and fundamental processes of frequency analysis, time analysis, and pattern recognition. While the research mainly deals with fundamental principles of neural modelling and strategies of auditory signal processing and perception, many findings can be useful for technical and clinical applications, such as improved man-machine communication by employing auditory-model-based processing techniques, or new processing strategies in digital hearing aids and cochlear implants.

Louise Hickson, University of Queensland, Australia

The Importance of Measuring Outcomes in Audiological Rehabilitation

Knowledge translation emphasises the use of research-generated knowledge, although it is not limited to that. Knowledge should also be generated from the clinical context and this is where outcomes measurement is directly relevant. A rehabilitation intervention that has proven efficacy in a research setting may or may not be successful in a clinical setting. It is argued here that the measurement of outcomes should be core business for audiologists working in rehabilitation. This paper will discuss why outcomes should be measured, what measures can be used, when they should be administered, who they

should be used with, and how the data obtained from such measures can be interpreted and used to generate knowledge. Measurement is not one-dimensional and there are many different outcomes that can and should be measured depending on what it is the client, clinician or funding agency wants to know about the service. Some measures provide valuable information about the individual client and help the clinician understand what aspects need to be improved for that person. Some measures allow for merging of data across individuals so that results from one clinic can be compared to those of another. Some, such as the International Outcome Inventory (Cox et al, 2000), allow comparisons across countries. Both theoretical and practical aspects of outcomes measurement in rehabilitative audiology will be described.

Ray Meddis, Dept. of Psychology, University of Essex, Colchester

Beyond the audiogram: identifying and modelling patterns of hearing deficit

Ideally, the choice of a hearing aid and its tuning parameters should be based on a detailed assessment of a patient's hearing. In clinical practice, very little data is collected and considerable emphasis is placed on the audiogram alone. If we were to collect more data, how should we best spend the limited available clinical time? What would be the best tests? Would the additional knowledge make any difference to the hearing aid prescription? To address these questions, we have been subjecting a number of hearing impaired listeners to a wide range of tests. The tests have been devised to be easy to administer under automatic computer control and easy for the patient to use. The principal finding is that there is an unexpected variation among patients in the patterns of impairment that are revealed by the tests. These patterns are, in themselves, suggestive of the corrections that might be required in a suitable hearing aid. However, the data are currently being used to help develop computer models of the patients' hearing with a view to creating 'hearing dummies' to be used in the absence of the patient to find the best hearing aid strategy and the optimum settings. This talk will review the tests used, show some of the patterns of deficit revealed by the tests and show how a 'hearing dummy' can replicate these hearing deficits.

Kelly Tremblay, University of Washington, Seattle

Auditory Training – From the Laboratory to the Clinic

We typically think of hearing as it relates to the ear, but sound travels along many nerve fibres and through many brain structures before reaching the auditory centres of the cortex. Along these pathways, the content of the signal (i.e., frequency, intensity, and timing information) is coded by highly organized neural systems and these codes contribute to our perception of speech and music.

Even though we are typically born with the capacity to code this acoustic information, our brain "changes" as a function of age, auditory deprivation (hearing loss), and auditory stimulation (e.g., hearing aids, cochlear implants). Sometimes described as being "plastic", the brain reorganizes itself throughout our lifespan, according to the auditory input that it receives. In this respect, when someone experiences age-related hearing loss, the way sound is processed within the ear is altered, and so are the biological codes in the central auditory system. For this reason, we are interested in understanding how the brain is affected by aging and hearing loss, and how people can take advantage of the brain's plasticity. One example is auditory training exercises. The presumed rationale behind these training programs is that listening exercises improve place and timing codes in the brain, as well as teaches people to focus and attend to important acoustic cues.

Bernhard Seeber, MRC Institute of Hearing Research, Nottingham

Localisation with bilateral cochlear implants in reverberant environments

Cochlear implants (CIs) often restore speech understanding in quiet, but most patients complain that the presence of reverberation or noise makes understanding of speech more difficult or even impossible. In normal hearing, a spatial separation between target and noise source helps speech understanding. The ability to localise the target is closely linked to it and often similarly impaired by the presence of noise.

We will review the ability of patients with bilateral CIs to localise single sound sources which can be remarkably good. We will report on a study that investigated the effect of reflections on localisation ability. In normal hearing, the precedence effect allows for unimpaired localisation of the leading sound source

despite the presence of later arriving reflections. Our results with bilateral CI-listeners show two main outcomes: (1) About half of the tested patients showed no precedence effect; instead a single sound source was localised in-between the leading and the lagging source; (2) A few patients showed the precedence effect even for temporally overlapping stimuli. This is remarkable for two reasons: (1) It requires access to binaural information of the lead despite a strong waveform interaction with the lag; (2) Fine temporal cues are not encoded in the electric pulses in current CIs but this information is crucial for the precedence effect in normal hearing. The results suggest that CI-listeners instead used different information.

Ellen Gerritts
Academisch Ziekenhuis, Maastricht, The Netherlands

Learning through Listening: Do Children with auditory processing disorders benefit from FM-systems?

The Phonak Edulink is an ear-level wireless FM system that has been developed to enhance the signal-to-noise ratio. The present study investigated whether the EduLink facilitated lexical access and phonological processing in noise of children with Auditory Processing Disorders. Children with Specific Language Impairment (SLI), children with dyslexia and age-matched controls participated in a auditory repetition priming task with lexical decision. Word and non-word primes and targets were presented in noise. Dependent variables were reaction times and correct decisions. All children were tested twice: prior and after 6 months use of the Edulink. The results show that lexical decision times of children with SLI using EduLink were relatively faster than those of SLI children without EduLink. However, there also was a large individual variation in reaction times within the SLI group. Children with SLI and dyslexia wearing EduLink were more accurate in their lexical decisions than SLI and control children not using EduLink.

Heather Fortnum, University of Nottingham

Translational Hearing Research

Translational research is currently a hot topic, not least within hearing research. The Department of Health, through the National Institute of Health Research, recently acknowledged the importance of deafness and hearing problems by including it as a priority area in the awards of funding for Biomedical Research Units. These Units have been established specifically to drive innovation in the prevention, diagnosis and treatment of ill-health and to translate advances in medical research into benefits for patients. The National Biomedical Research Unit in Hearing has been established in Nottingham as a partnership between the University of Nottingham, the Medical Research Council Institute of Hearing Research and Nottingham University Hospitals Trust.

This focus group will explore translational research in all areas of hearing and balance science. Through small group discussion and facilitated feedback we will address issues at all levels of the research process from design, through implementation, to dissemination and clinical provision. The underlying theme for the workshop will be:

“Bench to bedside and back again” –
how basic scientists and clinical researchers can add value to each others work.

Those attending should come along prepared to discuss:

What is translational research?
What can translational research do for me?
What is the added value of translation?
What are the priority issues for translational research in hearing?

Sygal Amitay, MRC Institute of Hearing Research, Nottingham

Can Training Aid Hearing?

The potential of auditory training to remediate and rehabilitate a variety of language and hearing problems has largely gone untapped, despite evidence that it can significantly improve outcome on a broad range of

measures, both perceptual and cognitive. While clinicians report success in applying training in aid of language and hearing skills in various clinical populations, scientists tend to take the more cautious approach of attempting to understand the mechanisms before promoting application. The search for understanding the mechanisms underlying learning and the rules by which training on simple stimuli can transfer to better performance on more complex tasks is ongoing. In my talk I will explain what perceptual learning is and how we have been studying it over the last few years. I will present some interesting and surprising results and discuss the implications for taking this work from the laboratory and into the clinic.

Sygal Amitay, MRC Institute of Hearing Research, Nottingham

Focus Group – II Auditory Training

In the Focus Group we will discuss how clinical and basic research can mutually benefit from collaboration, and the dangers and advantages of taking cutting-edge research into the field before the mechanisms are fully understood.

Rosalyn Davies
National Hospital for Neurology & Neurosurgery, London

Treating Visual Vertigo – an advance in vestibular rehabilitation?

The idea that visual perception of the environment may trigger vestibular sensations has existed for some time, with Erasmus Darwin describing the effects of presbyopia on balance as far back as 1794. Visual vertigo was classified by Thomas Brandt (1991) into universally-experienced physiological syndromes such as height vertigo, or the effects of circular vection; and into pathological syndromes e.g. when there is a disorder of co-axial vision, or an eye movement disorder degrading the visual image. More recently, interest has swung to understanding the syndrome faced by a proportion of patients with a vestibular disorder (Cohen, 2004) whereby "vertigo" is triggered by characteristic visual surroundings e.g. the movement of large visual scenes i.e. in crowds, on public transport or riding escalators. That movement of large visual scenes can induce postural sway was established by Nashner and Berthoz ,1978, amongst others; and measurement of the visually induced illusion of self-motion known as "vection" was described by Carpenter in 1988.

These concepts have been introduced into the domain of vestibular rehabilitation with the introduction of optokinetic stimulation (OKS) as an intervention to desensitise patients to the effects of visual motion (Pavlou et al, 2004). This presentation will describe the outcome of our current randomised clinical trial of a home video of OKS, used daily over eight weeks by a group of 60 patients with peripheral vestibular deficits (Pavlou, Coelho and Davies). The trial compares the benefits of weekly, physiotherapy-supervised sessions of OKS using an optokinetic ball (Group 1) with a video delivering OKS (Group 2); and also asks if the once weekly physiotherapy supervision improved the benefits compared with a single physiotherapy session (Group 3). Outcome measures include both objective measures of sway as well as validated questionnaire measures of vertigo and its associated symptomatology.

David Moore, MRC – Institute of Hearing Research, Nottingham

Auditory Processing Disorder – Opening Comments

Although the label APD has been around for at least 30 years, and the disorder has been formally defined by professional societies on both sides of the Atlantic, most clinicians are unclear how to deal with APD, and most researchers think the 'disorder' is too poorly specified to be suitable for scientific study. However, there is a huge appetite among the carers and professionals dealing with children who have poor listening skills for improved diagnosis and management. This symposium brings together three perspectives on the way forward in understanding this complex problem. For me, the key elements to progress are (i) that the understanding should be based on proper scientific principles, (ii) that there needs to be a disconnect between current practice and research – in other words, a fresh start, and (iii) most challenging of all, that evidence of progress should be sufficiently robust to trigger a new international consensus.

Robert Keith, University of Cincinnati, Ohio, USA
Auditory Processing Disorders: The Cincinnati Research Experience

The University of Cincinnati has long held a reputation for research in the area of auditory processing disorders (APD). Recently research into this disorder has increased, especially at the Cincinnati Children's Hospital Medical Center where a nucleus of investigators is involved in the study of APD from a range of perspectives. This presentation will summarize some of the projects being conducted that includes revision of the SCAN auditory test battery, investigation of other new behavioural tests of APD, the study of APD using sophisticated imaging techniques such as fMRI and MEG, and the effectiveness of a proposed treatment program. The presentation will provide a thumbnail sketch of one center's attempts to understand this complex disorder.

Brian Day
Sobell Dept of Motor Neuroscience and Movement Disorders, UCL Institute of Neurology, Queen Square, London,

Navigation and remote control via the peripheral vestibular system

Vestibular information contributes to a number of brain functions. These include balance, gaze, navigation, self-motion perception, voluntary movement, and spatial orientation. There is a major obstacle to isolating and studying the vestibular contribution to these brain functions in man. Any imposed movement that is used to stimulate the vestibular organs under natural conditions necessarily excites many sensory systems. This makes it difficult to extract the vestibular component of an evoked response. A way around this is to bypass the process of mechanical activation of the vestibular organs and perturb the vestibular system in isolation by stimulating behind the ears with small direct electrical currents. It turns out that this galvanic vestibular stimulation (GVS) technique has the same frequency-modulating effect on the vestibular afferents as natural movement, and is interpreted by the brain as such. The signal arising from the semicircular canal afferents is equivalent to a rotation of the head about a head-fixed axis in the mid-sagittal plane and inclined about 18 deg to Reid's plane. This 'virtual' head rotation signal produces automatic behavioural effects that depend upon posture and context. In a blindfolded subject standing with head upright, GVS evokes a balance response that causes the subject to sway appreciably in a direction that depends upon stimulus polarity and head yaw position. In a subject walking with the head facing the ground the same stimulus induces involuntary turns to the left or the right depending upon stimulus polarity and magnitude. Thus, subjects can be steered remotely along complex routes.

Doris-Eva Bamiou
National Hospital for Neurology & Neurosurgery, London

APD in Adults

Disordered auditory processing (APD) may affect a significant proportion of adults, and this proportion may increase with age. APD may be present since childhood, may become acquired after stroke or other neurological disease, or may be age related. Diagnosis relies on thorough audiological testing as well as additional assessments such as psychometry and imaging. The management may include a range of strategies as well as auditory training. This presentation will discuss some diagnostic issues as well as specific management issues for APD in adults.

Deborah Hall, MRC Institute of Hearing Research, Nottingham

Tinnitus Research plans at Nottingham

People suffering from tinnitus are to benefit from an injection of up to £4m from the National Institute for Health Research to fund ground-breaking new treatments in Nottingham. A unique collaboration between the MRC Institute of Hearing Research, the Nottingham University Hospitals NHS Trust and the University has created a new National Biomedical Research Unit in Hearing.

Counselling and cognitive therapies can help people cope with their tinnitus by reducing its psychological impact, while sound therapies can prove helpful in distracting the person from listening to their tinnitus by providing background sound. Yet none of these treatments strive to change the tinnitus sensation itself. Our research will explore a new approach to management which aims to 'correct' the abnormal patterns of activity in the central auditory system that are thought to underlie tinnitus, thus altering the subjective qualities of the sensation (namely its loudness and its pitch). One of the main goals of the new Unit will be to provide an evidence-base for this form of acoustic rehabilitation. In this talk, I will explain the

physiological mechanisms that motivate this treatment approach, review some of the preliminary support for its efficacy, and summarise key issues for future research.

Melanie Ferguson, MRC Institute of Hearing Research, Nottingham

APD in children: towards a test battery to diagnose APD for everyday clinical use

This talk will focus on results from a recently completed multi-centre study of auditory processing (IMAP). This novel and major population study aims to result in a scientifically validated test battery to diagnose auditory processing disorder (APD) in primary school-aged children. Data were collected from 1600 children aged 6-11 years old, over a 14 month period in Nottingham, Exeter, Cardiff and Glasgow. The one-hour test battery included tests of auditory processing tasks (spectral and temporal resolution), speech intelligibility (VCV words in noise), tests of cognition (non-verbal IQ, memory, literacy) and attention (auditory and visual). Preliminary analyses show that children with poor auditory processing have significantly poorer cognitive, speech intelligibility, listening and communication abilities than children with normal auditory processing. Furthermore, different response patterns to auditory stimuli suggest a provisional working hypothesis of two types of auditory processing deficit – sensory and attentional – where those with a sensory deficit have poorer cognitive performance across the board and those with an attentional deficit have poorer communication and reading abilities.

Adrian Davis,
MRC Hearing & Communication Group, University of Manchester
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Epidemiology of Balance

Balance: Basic Population Statistics and Impact on Life

This lecture aims to provide an understanding of evidence and gaps relating :

- An understanding of the Public Health context of balance problems
- Basic knowledge about the distribution of balance problems in the population, its prevalence and incidence
- The extent to which people are provided with health services for balance problems
- The risk factors for balance problems in the population
- The burden of balance problems, particularly with respect to the effect that it has on basis quality of life indices for individual and families.
- The extent to which risk factors can be used within planning primary prevention or secondary intervention

Gwen Carr, MRC Hearing & Communication Group, Manchester

NHSP Screening Outcomes

The full roll out of the NHS Newborn Hearing Screening Programme in England was completed in Spring 2006 and was followed up with the instigation of the NHSP national Quality Assurance programme in November of that year.

This presentation will review programme outcomes at national and local levels, drawing on data from the eSP national screening management system and the findings of the first cycle of QA visits (122 sites over an 18 month period). The main issues and challenges for services across the care pathway will be highlighted, together with some of the strategies implemented by services to improve service delivery in accordance with NHSP Quality Standards.

Catherine McMahon, MacQuarie University, New South Wales, Australia

The use of auditory evoked potentials in predicting functional outcomes in auditory neuropathy

One of the challenges in managing children with auditory neuropathy within the first few weeks of life is that it is difficult to determine the most appropriate device to fit (hearing aids or cochlear implant/s); a decision that is partly made on the magnitude of hearing loss. Whereas the auditory brainstem response (ABR) is typically used to estimate hearing thresholds for babies with within the first few weeks of life, in babies with auditory neuropathy, there is no correlation between the ABR and hearing thresholds. Further, even once hearing thresholds can be behaviourally measured, a correlation between hearing thresholds and functional outcomes does not consistently exist (Rance et al. 2002). We believe that the variability in functional outcomes is likely to be governed, in part, by the location of the disruption (pre-synaptic or post-synaptic) and the amount of disruption to the processing of timing cues.

In this study, we have used auditory evoked potentials (AEPs) measured in auditory neuropathy subjects fitted with cochlear implants to determine whether AEPs can be used to predict functional outcomes in this population.

References - Rance, G., Cone-Wesson, B., Wunderlich, J. and Dowell, R. (2002). Speech perception and cortical event related potentials in children with auditory neuropathy. *Ear & Hearing*, 23, 239 – 253

David Moore – MRC Institute of Hearing Research, Nottingham

Translational Research at IHR

Translation – taking research from ‘bench to bedside’ and ‘bedside to bench’ – has always been with us, but political pressure has persuaded medical research agencies in many countries to place ever greater emphasis on identifying, and funding, research projects that have relatively clear paths from conception and execution to patient (and economic) benefit. In the UK, the National Institute of Health Research (NIHR) is nearing completion of a dramatic (some would say Draconian) revision of NHS research activities that has transparency, scientific impact and translation at its heart. In terms of public and political recognition, hearing has not been left behind in this revolution but, in common with other specialities, researchers have had difficulty keeping pace with the dizzying speed of change. Translational hearing research has an illustrious record. Most notable, in the UK, was the discovery, by David Kemp, of OAEs, and their subsequent deployment in hearing screening tests around the world. An interesting example, initially developed in the US, has been the cochlear implant (CI). While most of the basic science community initially eschewed CIs, the clinical community doggedly kept on and, now, CI research forms a major component of the annual ARO meeting programme – an example of reverse translation. In Nottingham, we have current translational research programmes in a number of areas, including MRI noise reduction, auditory learning and auditory processing disorder. I will touch on some of these as examples of different models by which translation may improve our health . . . and our wealth.