Manchester Centre for Audiology and Deafness

Manchester Centre for Audiology and Deafness (ManCAD) – Clinical Audiology Papers conference

ManCAD – CAPers

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Capers
skip or dance about in a lively or playful way.
"the participants were capering about the room"

Welcome to ManCAD Caper's – ManCAD's inaugural clinical audiology research conference.

This conference is first and foremost a meeting to honour our colleague and friend Dave Moore, Professor of Auditory Neuroscience, who will be retiring later this year. However, it is also an opportunity for ManCAD to establish itself as the host of a biennial clinical auditory research conference that will bridge the gap between research and practice.

We are hosting this conference for Dave because he has spent much of his career in the UK, and latterly as a ManCAD colleague. He was fundamental in establishing the Hearing Health research theme within the NIHR Manchester Biomedical Research Centre (BRC). You will hear a lot more about Dave's long career and scientific achievements over the coming couple of days so for now, we say, "*Thank you Dave for all you've given to the field of hearing research, best of luck, and here's a toast to your ongoing drive for discoveries that continue to benefit people with hearing difficulties."*

As for ManCAD CAPers, we have put together a *lively and playful* programme that combines invited presentations that highlight some of Dave's work along with submitted papers and posters from clinical audiological researchers. The excellence of the programme speaks for itself. Topics you'll learn about include the role of the olivocochlear system in sound localization, listening difficulties in children, accessible hearing care, use of big data sets in audiology, and alternative approaches to hearing assessment, to name but a few.

We are thrilled to have truly international attendees. At the time of writing, we have attendees from 17 countries, 13 NHS trusts and 26 universities, some of whom are clinical audiologists, some are researchers, some academics and some are students.

We couldn't have hosted this conference without sponsorship from our industry colleagues, Interacoustics, Sonova, Specsavers and WSAudiology, along with support from the Hearing Health theme of the BRC and Kevin's NIHR Senior Investigator Award. Thank you. We also like thank all of our ManCAD colleagues for stepping in to help out over the past few weeks. Special thanks go to *Lucy Ferrie* and *Wendy Lamb* the conference coordinators, and to Cath Wright, Research Programme Manager.

The conference itself will take place in the Whitworth art gallery, adjacent to the University of Manchester. The previous time we used this venue was for the ManCAD centenary celebrations (1919-2019) that some of you attended. The evening poster session will happen at a local not-for-profit arts centre in the centre of Manchester (HOME Manchester). Do make time to explore both venues. Take a walk in Whitworth Park or visit the galleries during lunch and check out the films, theatre and art exhibition at HOME Manchester before the poster session.

We are excited and privileged to have you here in Manchester. We hope you not only enjoy the next two days of clinical audiological research but that you also have time to visit some of Manchester's sights, restaurants and breweries.

Wishing you a lively and playful time!

Gaby and *Kevin*

General information

Conference location: Grand Hall, Whitworth Art Gallery, Oxford Rd, Manchester, M15 6ER

- Accessibility information: https://www.whitworth.manchester.ac.uk/visit/access/
- Getting there: https://www.whitworth.manchester.ac.uk/visit/planyourvisit/gettinghere/
- There will be a coat rack outside the conference room.
- Suitcases can be left in the Grand Hall at your own risk.

Poster session location: HOME Manchester, 2 Tony Wilson Pl, Manchester, M15 4FN

- Accessibility information: https://homemcr.org/facilities-and-access/access-information/
- Getting there: https://homemcr.org/visit/getting-here/
- There will be a buffet dinner at the poster session.
- On arrival we will provide you with a token for one drink.
- Additional drinks must be purchased by you!

For podium presenters:

- We would prefer that you present using our laptop to simplify set up logistics
- Please upload your presentation at the start of the day or during a break
- We will have a memory stick/thumb drive available for you to use
- A pointer will be available

For poster presenters:

- Posters can be up to A0 size (landscape or portrait).
- Please bring your posters with you to the poster session.
- Poster boards will be available for you to put up your poster from 6:45pm onwards.
- Mount your poster on the appropriately numbered board. These numbers are shown in the program.
- We will provide pins/velcro.
- Please take down your poster at the end of the evening.

General questions:

- During the conference, if you have conference-related questions ask Gaby Saunders, Lucy Ferrie, or Wendy Lamb.
- If you have questions about Manchester, ask anyone wearing a ManCAD badge.

If you are a FAMOUS trial site, don't forget to collect two FAMOUS polo shirts from registration (one for you and one for a work colleague).

Monday 16th September 2024

Whitworth Art Gallery Oxford Rd, Manchester M15 6ER

8.00-8.45: Registration/tea/coffee

8.45- 9.00: **Welcome** *Gaby Saunders*

9.00-9.30: **Of ferrets and children and other binaural creatures – reflections on Dave's career and life** Lisa Hunter (invited)

9.30-9.50: **A tribute to Dave** *Mel Ferguson* (invited)

9.50-10.20: **Olivocochlear efferents and their role in sound localization: the Nottingham Experiments** *Charlie Liberman* (invited)

10.20-10.40: Submitted paper

- **Descending cortical loops for auditory plasticity** *Victoria Bajo*

10.40-11.00: Coffee break

11.00-11.30: **Data drives discovery: Hearing research using UK biobank** *Kevin J Munro* (invited)

11.30-12.30: Submitted papers

- **Development and validation of a novel computational approach to online hearing screening and audiogram estimation** *Charlotte Vercammen*
- **"The song remains the same": creating novel narrowband audiometric stimuli from familiar melodies** *Michael Stone*
- **Systematic differences across testing centre and visit in UK Biobank speech-in-noise thresholds** *Michael Akeroyd*

12.30-13.45: Lunch

13.45-14.30: **A brief biography of Dave** – **What I've learned along the way, by himself**

14.30-15.00: **A brief joint biography of Dave, DIN and me** *Cas Smits* (invited)

15.00-15.20: Tea break

15.20-16.20: Submitted papers

- **Relationships between subjective and objective measures of listening difficulty: insights from an online speech-in-noise study** I*an Wiggins*
- **Is heart rate associated with listening motivation during real-world speech communication for adult hearing aid users?** *Klaudia Edinger Andersson*
- **The just-follow conversation task: A viable measure of conversational listening ability** *Bill Whitmer*

19.00-22.00: **Poster session and dinner** at HOME Manchester 2 Tony Wilson Pl, Manchester M15 4FN

Tuesday 17th September 2024

8.30-9.00: Registration/tea/coffee

9.00-9.30: **Understanding listening difficulties in children: a multifaceted approach** *Astrid Van Wieringen* (invited)

9.30-10.10: Submitted papers

- **What are the barriers to consistent infant hearing aid use? A parent survey using the Theoretical Domains Framework** *Ciara Kelly*
- **Paediatric mild-to-moderate hearing loss across the UK** *Hannah Stewart*

10.10-10.30: Coffee break

10.30-11.00: **A collaborative journey in accessible hearing care innovation** *De Wet Swanepoel* (invited)

11.00-11.45*:* **Learning from experience: The role of mentors** *Jan-Willem Wasmann* (invited)

11.45-13.15: Lunch

13.15-14.15: Submitted papers

- **Real benefits from real-ear measurements?** *Tytti Willberg*
- **Chirp speech: A novel approach for studying disordered speech processing in children** *Lauren Petley*
- **Effects of second language exposure on speech perception measures** *Lena Wong*

14.15-14.45: **Adult hearing screening: Uptake of an internet-delivered hearing assessment** *Piers Dawes* (invited)

14.45-15.05: Tea break

15.05-16.05: Submitted papers

- **Separating the causes of listening difficulties** *Harvey Dillon*
- **Does immune history influence cochlear implant outcomes in children?** *Kate Hough*
- **Evaluation of the paediatric audiology pathway alignment (PAPA) triage for paediatric audiology referrals in Ireland** *Adrian Davis*

16.05-16.15: **Conference close** *Gaby Saunders*

Posters

1. **That looks noisy: evaluation and preference of an Image-Based Questionnaire (IBQ) for assessing hearing** *Emanuele Perugia, Samuel Couth,* Gabrielle Saunders
2. **New methods of behavioural hearing testing in young children with social and communication disorders** *Josephine Marriage, Keiran Joseph*
3. **Using digital measures of cognition and audition to screen for cognitive decline in a Spanish-speaking population**. *Esteban Sebastian Lelo de Larrea-Mancera, Yvonne Flores-Medina, Aaron Seitz, Ruth Alcalá-Lozano*
4. **Better, worse, or both ears? What's the best hearing-aid fitting?** *Oliver Zobay, Graham Naylor, Gabrielle Saunders, Lauren Dillard*
5. **Do people with cognitive impairment benefit from cochlear implants? A scoping review.** *Hannah Cross, Piers Dawes, Rebecca Millman, Iracema Leroi, Christiane Völter*
6. **Developing a speech perception testing protocol for the COACH trial** *Catherine Killan, Terry Nunn, Tracey Twomey, Trish Hepburn, Caroline Rick, Imogen Gould, Garry Meakin, Alan Montgomery, Douglas Hartley, Padraig Kitterick*
7. **An automated digits-in-noise hearing test using automatic speech recognition and text-to-speech: A proof-of-concept study** *Mohsen Fatehifar, Kevin Munro, Michael Stone, David Wond, Timothy Cootes, Josef, Schlittenlacher*
8. **Understanding cultural variations in stigma related to hearing loss and hearing aid use** *Suhani Pattanshetti, Gabrielle Saunders, Charlotte Vercammen, Samuel Couth*
9. **Diagnosing listening difficulties in children: A tri-level approach to explore the relationship between auditory processing, speech processing, language processing, and cognitive abilities in typically developing children as a first step** *Xuehan Zhou, Harvey Dillon, Kelly Burgoyne, Dani Tomlin, Antje Heinrich*
10. **Speech used in broadcast is more difficult to comprehend and more effortful for older people who wear hearing aids than for older people with "normal hearing"** *Rebecca Millman, Lorenza Curetti, Ben Shirley, Lauren Ward, Alan Archer-Boyd, Matthew Paradis, Michael Stone*
11. **Hearing loss and Parkinson's Disease, are they related? A UK Biobank analysis** *Megan Readman, Yang Wang, Fang Wan, Ian Fairman, Sally A. Linkenauger, Trevor J. Crawford, Chris J Plack*
12. **Exploring the impact of tactile defensiveness in those with cognitive needs during audiology appointments: perspectives from audiologists and carers on behalf of patients** Georgia Cook
13. **A study protocol to assess the effects of cancer treatments on speech perception in noise, cognition, and hearing-related quality of life** *Tytti Willberg, Akseli Tommila, Outi Alanko, Iiris Nieminen, Heikki Irjala, Maria Sundvall*
14. ***Self-reported hearing handicap for older adults: Ques*tionnaire evaluation and relation to common audiological measures** *Stefanie Goicke, Christian, Brandt, Larry Humes, Tobias Neher*
15. **Can we measure the social and emotional well-being of adults with hearing loss?** *Jack Holman, Paulina Hagyariova*
16. **Does the method matter? Quantitative and qualitative perspectives in the self-adjustment of hearing-aid gain** *Janin Benecke, William Whitmer*

18. **Towards international priorities for hearing research** *Antje Heinrich, Christian Sumner, Robert MacKinnon, Frederick Gallun*
19. **The UK National Eye Health and Hearing Study (UKNEHS)** *Carolina Leal, Rupert Bourne, Adrian Davis, Michael Akeroyd, Jameel Muzzaffar*

Abstracts: Monday 16th September 2024

Of ferrets and children and other binaural creatures – Reflections on Dave's career and life. *Lisa Hunter*

A tribute to Dave, *Melanie Ferguson*

Olivocochlear efferents and their role in sound localization: the Nottingham Experiments. *Charles Liberman*

The cochlea receives feedback from two neuronal pathways originating in the superior olivary complex, the lateral olivocochlear (LOC) neurons projecting to unmyelinated terminals of auditory nerve fibers and the medial olivocochlear (MOC) neurons projecting to outer hair cells. Although these feedback systems are universal features of the mammalian cochlea, their functional roles remain incompletely understood.
In 2006, we published a lesion study in mice suggesting the idea that a major role of the LOC system was to balance excitability of the auditory nerves from the two ears to maintain accurate coding of the interaural intensity differences needed for high-frequency sound localization. Knowing of the Moore lab's extensive work on sound localization in ferrets, I asked Dave if he wanted to collaborate on a lesion study probing whether the OC system was needed for the localization re-learning their ferrets demonstrated after monaural ear plugging. He readily agreed, and we worked together at the MRC for the next several years, culminating in a 2011 publication supporting the motivating hypothesis.
This talk will recount the trials, tribulations and successes of the Nottingham Experiments and update the results in the context of subsequent work on the olivocochlear system.

Descending cortical loops for auditory plasticity. *Victoria Bajo*

The ability to modify the neural activity evoked by sensory experience is the basis of learning. Descending projections from cortical areas are among the most prominent pathways in any sensory system, suggesting their role in modulating subcortical processing. In this talk, I will provide details and examples about how corticofugal connections contribute to auditory perception and multisensory integration. One of the main neural loops connects the primary auditory areas with the core auditory thalamus. Removing layer VI pyramidal neurons that project to the ventral division of the medial geniculate body affects pitch perception that is essential to identify auditory objects by impairing the ability of ferrets to discriminate mistuning tones. Another descending loop connects the auditory cortex with the inferior colliculus in the midbrain. Silencing optogenetically ArchT-expressing neurons in adult ferrets, we show that within-trial activity in the auditory cortex is required for training-dependent recovery in sound-localization accuracy following monaural deprivation. This learning-induced auditory plasticity requires the functional integrity of the cortico-collicular pathway. The selective elimination of the large coticocollicular pyramidal cells in layer V impairs the ability of animals to adapt to changes in the binaural cue values produced by unilateral ear occlusion. Beyond their role in unisensory processing, descending cortical loops mediate communication between primary sensory cortical areas. In mice, whiskers stimulation causes suppression of sound-evoked activity in the primary auditory cortex. This suppression is implemented through a descending circuit that links the primary somatosensory cortex, via the auditory midbrain, with thalamic neurons that project to primary auditory cortex. Those same neural circuits responsible for auditory plasticity in the adult brain are likely to be involved in the generation of tinnitus, a phantom auditory perception. Using optogenetic methods for manipulating brain activity, I am exploring the changes that occur within the auditory cortex when tinnitus is experienced to find out whether those changes can be reversed to alleviate this condition in a clinical context.

Data drives discovery: Hearing research using UK biobank. *Kevin J Munro*

UK Biobank is arguably the most detailed, long-term prospective health research study in the world. Since 2006, UK Biobank has collected an unprecedented amount of biological and medical data on half a million people, aged between 40 and 69 years old. Hearing was assessed using self-report along with an objective measure involving recognition of spoken digits in background noise. A collaboration of hearing researchers in Manchester, Nottingham, Cincinnati and elsewhere was the first to use UK Biobank to investigate prevalence of hearing loss and its association with cognition, environmental and genetic factors e.g., cigarette smoking, alcohol consumption, diet and prenatal development. Key findings include:

- Older people have declining cognitive ability associated with reduced ability to recognise digits-in-noise.
- Subjective reports of hearing difficulty are more common than suggested by recognition of digits-in-noise.
- Addressing modifiable risks could improve hearing health across the lifespan.

Development and validation of a novel computational approach to online hearing screening and audiogram estimation. *Charlotte Vercammen*

The Covid-19 pandemic fuelled the need for a self-administered hearing test that reliably screens for hearing loss and offers frequency-specific information to inform further hearing rehabilitation, without an in-person visit. Yet, pure tones in quiet assessments are prone to uncertainties and usage errors when performed remotely, as a self-test, and/or using uncalibrated equipment. Therefore, we aimed to develop and validate a hearing test that leverages individuals' self-reported hearing abilities, probabilistic effects of age, inter-frequency and inter-aural relationships in human audiograms to obtain reliable hearing screening results and estimate a full, bilateral audiogram from a small number of self-administered pure-tone threshold measurements. For the development, we relied on data of 251 participants with known gold standard clinical audiograms. Additional data was collected prospectively in an at-home, online experiment: self-administered pure-tones in quiet hearing assessments, responses to questions about self-perceived hearing abilities, individuals' age decades, and type of hardware used for data collection. An algorithm was developed to compute a test result, relying on average correction for hardware used, multiple regression, Bayesian and binary classification. For the validation of the algorithm, we prospectively collected data of 156 participants, who performed the newly developed hearing test and took part in gold standard audiometric assessment. We will present sensitivity, specificity, positive and negative predictive values as primary outcome metrics for the screening performance of the hearing test. In addition, we will discuss errors between estimated and gold standard clinical audiograms as well as test efficiency.

"The song remains the same": creating novel narrowband audiometric stimuli from familiar melodies. *Michael Stone*

Measuring audiometric thresholds can be difficult in some patient populations, such as children where attention spans are short. The past decade has seen multiple attempts to replace the conventional pure tone or narrow-band warble signals with familiar theme tunes that have been narrow-band-filtered and use these as the signals-of-interest. While the auditory system can extract the melody from narrowband signals, the decrease in intensity of instrument harmonics with increasing frequency, combined with the increasing intensity of the accompanying percussion means that signals centred at high frequency bear little familial resemblance to the signals at lower frequencies. Additionally, the percussion generates large temporal fluctuations, making the calibration of level rather difficult. Using signal processing to transform the signals into the "cepstral" domain, we can extract the pitch

contour, generate harmonics spanning a wide range of frequencies, and combine these with the temporal envelope of the melody region before filtering to the desired centre frequency and bandwidth. The dynamics of the resulting often highly modulated signal are brought progressively under control with sequential stages of slow, fast, and limiting dynamic range compression. Alongside demonstrating examples of these new signals and the pitfalls in their generation, we will present hearing threshold data from healthy adults, and from children, to show how such signals can be used as an alternative for collecting absolute thresholds.

Systematic differences across testing centre and visit in UK Biobank speech-in-noise thresholds. *Michael Akeroyd*

The UK Biobank is a large-scale biomedical cohort study that was designed to enable detailed studies of the determinants of diseases of middle and old age. It contains in-depth genetic, phenotypic, and health information from approximately half a million UK volunteer participants aged between 40 and 69 years old at time of recruitment between 2006 and 2010. An adaptive digit-triplet test ("DTT") of speech in noise was included in 2009, and since then, the test has been administered at least 450,000 times in 4 phases ("visits") in, at most, 10 testing centres. As part of a wider project studying the psychometrics of the speech recognition threshold (SRT) data, we noticed a systematic upwards shift in SRT values from the first two phases ("Baseline" and "Repeat" visits) to the 3rd and 4th ("First Imaging" and "Second Imaging" visits). Here we analyse the magnitude of these differences, consider potential explanations, and propose correction factors to apply to the DTT data that effectively remove these differences and so can be applied before the data are used in other analyses. METHOD After various exclusions due to incomplete or entirely incorrect tracks, 456,358 tracks remained for analysis. We quantified the dependence of SRT on age by fitting an exponential function in which the rate of change of SRT with age did not vary across the centre or visit, but the overall value, coded as a constant in our exponential equation, could do. RESULTS We found that there are substantial and systematic differences in SRTs, by as much as two decibels, across testing centres and visits. The data fell into three groups, namely all the Baseline and Repeat visits at English testing centres; the Baseline visits at the Welsh centres; and both of the Imaging visits. There is also an effect of the volume the test was presented at. The values of the constant varied considerably across these, from -7.0 to -3.8 dB. We propose correction tables designed to adjust the data to give a common value for the constant of -5.0 dB across centre, visit and volume. DISCUSSION The concerns are primarily with the data from the earlier Baseline and Repeat visits; the ongoing First and Second Imaging visits appear to be far less susceptible. Due to the many years since the data was collected, we cannot be sure of the causes, but we believe that the two most plausible are across-centre differences in ambient noise and distortion in the digital-to-analog converters. In conclusion, (1) we recommend that the most rigorous approach to using the Biobank DTT data is to adjust for centres, visits and audio volumes before the data are used, which essentially adjust all the data to an exponential dependence on age with the rate of change being 1.4 dB by 5.2% per year; (2) we caution against interpreting any of the Biobank data as representative of what the SRTs of the UK population would be in in acoustically-controlled situations.

A brief joint biography of Dave, DIN and me. *Cas Smits*

In this presentation, I will provide an overview of studies on the digits-in-noise (DIN) test that Dave and I have worked on together (and sometimes separately) over the past two decades. I will discuss the key findings of these studies. The digits-in-noise test uses three-digit sequences (triplets) in noise to determine the signal-to-noise ratio (SNR) at which a listener can correctly recognize 50% of the triplets, using an adaptive procedure. This SNR is known as the speech recognition threshold (SRT). I will discuss studies that investigated the effect

of interrupted noise and antiphasic presentation on DIN SRTs. Following this, I will demonstrate how we have utilized the antiphasic presentation mode to enhance the sensitivity of the DIN test to unilateral hearing losses and conductive hearing losses. Another study examined the adaptive procedure used and explored methods to identify unreliable DIN test results. Additionally, I will discuss how the DIN test has been used to show that extended high frequencies significantly impact the intelligibility of the digits. Finally, the presentation will demonstrate a method for fully automatic generation of DIN tests in multiple languages.

Relationships between subjective and objective measures of listening difficulty: insights from an online speech-in-noise study. *Ian Wiggins*

In hearing research and clinical practice, difficulties individuals experience when listening to speech in noise are characterised and measured in a multitude of ways (objective versus subjective measures, accuracy versus effort, etc.). The relationships between these different measures are not always clear, which can hamper the ability to interpret findings and draw comparisons across studies. We conducted an online speech-in-noise study with the aim of elucidating the relationships between various objective and subjective measures of listening difficulty. Methods A total of 67 participants (42 identified by self-report as having normal hearing, 25 with some degree of hearing loss) completed an online sentence recognition task in which BKB sentences were presented in speech-shaped noise at signal-to-noise ratios (SNRs) of -8, -4, 0, +4, +8, and +20 dB. Participants were instructed to listen to each sentence and then repeat aloud what they heard. Responses were recorded through participants' webcams and later independently scored by two researchers. The outcome measures that we considered were: 1) objective intelligibility (percentage of keywords correctly repeated); 2) verbal response time (extracted from the audio recordings); 3) subjective intelligibility; 4) subjective listening effort; and 5) subjective tendency to give up listening (due to the task seeming overwhelmingly difficult). All subjective measures were collected using 10-point visual analogue scales administered at the end of a block of 16 sentences presented at the same SNR. Results We found that objective intelligibility, subjective intelligibility, and subjective listening effort showed the clearest between-group differences (NH vs. HL). Objective measures were more strongly influenced by age than were subjective measures, with performance tending to decline with increasing age. When moving from highly favourable to more adverse SNRs, subjective listening effort was the first measure to be affected, followed by subjective intelligibility, objective intelligibility, subjective tendency to give up listening, and, finally, verbal response time. Participants, especially those with normal hearing, consistently underestimated their own performance (i.e., subjectively rated intelligibility was lower than indicated by the percentage of correctly repeated keywords). Subjective listening effort, subjective intelligibility, and objective intelligibility (the latter at adverse SNRs in particular) were the most influential features for predicting individual EAS scores, a self-reported measure of daily-life listening effort. Conclusion Taken together, our findings can help offer perspective when interpreting the results of studies in which only one, or a subset, of these outcome measures were collected, as well as guiding the selection of sensitive outcome measures for future studies.

Is heart rate associated with listening motivation during real-world speech communication for adult hearing aid users? *Klaudia Edinger Andersson*

The real-life listening experiences of hearing aid (HA) users are shaped by the sound environments they encounter and their listening intents. They can be captured through ecological momentary assessments (EMAs) complemented with acoustic data collected by the HAs. In addition, physiological signals can be gathered using wearables (e.g., wristbands). Physiological signals can potentially serve as proxies for listening effort. The framework for understanding effortful listening (FUEL) postulates a relationship between

listening effort and acoustic factors (such as sound pressure level, SPL, and signal-to-noise ratio, SNR) as well as listening motivation. Laboratory studies have shown that individuals are willing to exert more listening effort, driven by motivation, when acoustic conditions become more challenging. The extent to which these putative relationships manifest in everyday sound environments remains to be explored, however. In our previous research, we found associations between self-reported EMA scores reflecting listening experiences across different intents, SPLs, and SNRs, as well as heart rate. Specifically, higher SPL and lower SNR were strongly associated with poorer EMA ratings during speech listening compared to passive listening. Moreover, elevated heart rate correlated more strongly with perceived environmental noisiness during speech listening than during passive listening. Building on these findings, the current study explored associations between EMA scores reflecting listening motivation and heart rate across different listening intents, SPLs, and SNRs, with a particular focus on speech communication situations. In this observational trial study, 25 adults with symmetrical mild-to-moderate hearing loss were fitted with HAs. During a 2-week trial period, they were asked to document their daily listening experiences, intents, and motivation using a smartphone app, while ambient SPLs and SNRs were logged by their HAs. Continuous heart rate data were collected using wristbands worn by the participants. Data analyses are currently ongoing. Preliminary results indicate that participants rated speech communication as most important for being able to hear well. Further, stronger motivation appears to be associated with higher heart rate in speech communication situations. The effects of SPL and SNR appear to influence EMA scores in situations involving focused listening. By investigating the interplay of SPL, SNR, heart rate, and listening intent in the daily lives of HA users, our study aims to provide insights into optimizing hearing aid benefit in real-world listening scenarios.

The just-follow conversation task: A viable measure of conversational listening ability. *Bill Whitmer*

Listening to a conversation demands comprehension, attention and prediction. To better understand the impact of these demands, as well as how hearing aids might alleviate them, a conversational listening test should be realistic, repeatable and relatable (i.e., have interpretable units). A test that potentially satisfies these needs is the just-follow conversation (JFC) task. In the JFC task, a listener adjusts the signal level to where they can understand, with effort, the gist of what is being said in a background of noise. Here, we use the JFC to probe if there is a difference between focused listening to dialogues vs. monologues, and how well we can distribute our attention across multiple talkers. We further explore the psychometric properties of the JFC as a perceptual measure of attentive and aided listening. Fifty-four participants sat in the centre of a circular loudspeaker array and adjusted the level of one monologue, one dialogue or two monologues presented in the front hemifield to where they could just follow the speech. On each trial, participants made four adjustments. Signals were presented in an Ambisonics café background and in uncorrelated same-spectrum noise, both at a fixed long-term average level of 67.3 dB(A). Bilateral hearing-aid users adjusted each speech type in each background both aided and unaided. Non-users, who also mostly had a hearing loss, repeated each condition to evaluate reliability. Results showed a general increase in JFC SNR for dialogues and two monologues relative to one monologue. Individual JFC SNRs were correlated with speech subscale scores on the SSQ12 as well as individual pure-tone threshold averages. No significant differences were found between unaided and aided conditions for the hearing-aid users. JFC reliability was comparable to more objective speech understanding measures, but it may not be suitable to capture perceived conversational benefits for more subtle changes in hearing-aid processing.

Abstracts: Tuesday17th September 2024

Understanding listening difficulties in children: a multifaceted approach. *Astrid Van Wieringen*

Many children experience listening difficulties despite normal hearing sensitivity. Parents, teachers, and other caregivers often grope in the dark concerning the causes of these listening difficulties. Depending on the professional/clinician a diagnosis is made and a care path chosen. This may not be the right diagnosis and care path. The ECLiPS questionnaire, an acronym for Evaluation of Children's Listening and Processing Skills, has proven to be a powerful questionnaire to capture the multifaceted nature of listening difficulties. It was developed by Barry and More (2013) and contains 5 subscales (1) speech & auditory processing, 2) environmental & auditory sensitivity, 3) language, literacy and laterality, 4) memory & attention, and 5) pragmatic and social skills). Caregivers are asked to rate how much they agree with 37 statements on a 5-point scale. The composite scores and the scores on the subscales offer a picture of how the child is performing in real life. The Dutch-Flemish version of the questionnaire was verified to be a psychometrically valid qualitative measure to assess listening and processing skills (Denys et al., 2024). Research indicates that language and attention are important domains to consider in addition to auditory tasks. However, it is still necessary to translate knowledge of the ECLiPS into clinical protocols. Our presentation will focus on what we have learned from Dave Moore and colleagues to address listening difficulties holistically, which has led to the funding of the applied biomedical research project CLINIC. We will discuss how the ECLiPS data from a population sample and from children with developmental disabilities will help determine profiles of children with listening difficulties in the first phase of our project, and how results of a systematic review are leading to a selection of behavioral measures for the longitudinal, 2nd phase of the project. These behavioral measures, complemented by neural measures, will be administered to children with recognized developmental disabilities, to capture different important processes for listening in a holistic way to understand deficits in functioning and to define targeted care paths. References Denys S, Barry J, Moore DR, Verhaert N, van Wieringen A. A Multi-Sample Comparison and Rasch Analysis of the Evaluation of Children's Listening and Processing Skills Questionnaire. Ear Hear. 2024 Jun 3. doi: 10.1097/AUD.0000000000001509. Epub ahead of print. PMID: 388257399

What are the barriers to consistent infant hearing aid use? A parent survey using the Theoretical Domains Framework. *Ciara Kelly*

Consistent hearing aid use protects against spoken language delays in 0–3-year-olds with hearing loss; however, use is at its lowest and most variable during this critical period for language development. The few existing interventions to increase use lack effectiveness and focus on a narrow subset of determinants of infant hearing use (namely, knowledge and skills). To ensure future intervention efforts address the full range of factors influencing parents consistently implementing their child's hearing aid use during infancy and toddlerhood, a theoretically informed understanding of the determinants of infant hearing is needed. We aimed to address this gap in understanding by investigating parent-reported barriers to hearing aid use in children under 3 years of age using the Theoretical Domains Framework (TDF; which limits the risk of omitting important behavioural determinants) and exploring whether specific TDF domains are associated with parent-reported infant hearing aid use. Method: 56 parents of 0–36-month-old hearing aid users (Mean = 18 months) were recruited across the United Kingdom via relevant professionals and organisations. Parents completed an anonymous 55-item online survey developed by the research team to measure parent-reported barriers to infant hearing aid use. Survey development was based on the TDF, involved the use of established guidelines, and incorporated stakeholder

feedback (i.e., parents of infant hearing aid users and professionals who support these families). Results: Parents reported a wide range of barriers across the TDF domains, which were associated with parent-reported hearing aid use and more pronounced in parents of lower hearing aid users. The most strongly reported domains across participants were 'emotion' (e.g., feelings of worry when implementing their child's hearing aid use), 'beliefs about capabilities' (e.g., belief in their ability to implement their child's hearing aid use consistently), and 'environmental context and resources' (e.g., child removing their hearing aids). The 'knowledge' and 'skills' domains were perceived by parents to be the least impactful and amongst the weakest correlates of parent-reported hearing aid use. Conclusions: Parents report a wider range of barriers to infant hearing aid use than existing investigations suggest and current interventions address. Consequently, interventions that focus on a narrow subset of domains, especially knowledge and skills, are less likely to be effective and well-received by parents. Future interventions would benefit from: (i) targeting a wider range of TDF domains in their design; and (ii) implementing the present TDF survey to identify and target family-specific barriers to infant hearing aid use, which would allow for tailored intervention approaches that better suit specific needs. Recommendations for theory-driven intervention development are discussed alongside implications for practice.

Paediatric mild-to-moderate hearing loss across the UK. H*annah Stewart*

Successful communication is critical for children's education and social development (Misurelli et al., 2020). Education settings are extremely noisy environments, but the noise is rich with information (Shield & Dockrell, 2008; Crukley, Scollie & Parsa, 2011). Hearing impaired children are consistently shown to be dramatically disadvantaged academically relative to their normal hearing peers (National Deaf Children's Society, 2019). This difference is evident from the first year of primary school and continues through to adulthood. Mild-to-moderate hearing loss (MMHL) is a neglected diagnostic group, despite covering 57% of deaf children in the UK (Consortium for Research in Deaf Education, 2021). Currently, there are no NICE guidelines regarding the assessment or management of paediatric MMHL. Furthermore, there is no clear evidence regarding what interventions are optimal for children with MMHL (e.g., clinical trial NCT03771287 – Stewart et al., 2022). The funding and care routes for these children and their families vary across the UK with health professionals working in parallel or in collaboration with teachers of the deaf. Objective To discuss routes for enhancing research participation in paediatric MMHL and to identify future research priorities for children with MMHL across the UK. Methods We conducted PPI focus groups with 18 participants including audiologists, teachers of the deaf, researchers, caregivers, and a separate group for 3 children with MMHL. Results Thematic analysis revealed six themes. The individual: whereby children with MMHL need to be seen holistically to help empower them from a young age. The listening environment: children need to be assessed out in their everyday listening environment to see what help they need and to assess whether interventions are working. The lack of standardisation is huge across all four nations in the services and support available to the children and their families, but also in the auditory technology available. Funding: some areas have resulted to drastic measures (e.g., crowd funding) to ensure children receive appropriate auditory technology. Screening: is needed throughout school for both hearing and listening. Awareness of the condition: is low not only among lay audiences but also among professionals working in paediatric deafness. Conclusion This study demonstrates the impact of the limited knowledge regarding paediatric MMHL and where understanding is high, there is a lack of implementation.

A collaborative journey in accessible hearing care innovation. *De Wet Swanepoel*

This presentation will explore the milestones and innovative advancements in accessible hearing care achieved through our collaborative journey with Dr. David Moore. As

collaborators on several projects, our partnership has driven the development and implementation of mobile technologies designed to deliver high-quality hearing care to underserved populations.

Learning from experience: The role of mentors. *Jan-Willem Wasmann*

This presentation explores the qualities of effective mentors from a mentee's perspective, emphasizing both individual and collective approaches. We will discuss how we can learn from each other and consider what the future holds for mentorship. Drawing on experiences from my PhD journey and my work as an audiologist, I will illustrate how various mentors, including Dave's invaluable guidance, have shaped my academic and personal development. Key characteristics of a good mentor will be highlighted. Additionally, we will delve into research projects, comparing insights and outcomes, and discuss Dave's contributions to the Virtual Conference on Computational Audiology (VCCA) and the establishment of the Computational Audiology Network (CAN). This talk aims to underline the impact of effective mentorship on one's career, blending personal anecdotes with research experiences and envisioning future possibilities.

Real benefits from real-ear measurements? *Tytti Willberg*

Real-ear measurements (REM) are the standard for hearing aid (HA) fitting. However, REM are time-consuming and their benefit in HA fitting has been questioned as recent studies have shown that the benefits of REM-based fittings for patient-reported outcome measures (PROMs) are small. The aim of our study was to compare REM-based HA fitting to the current fitting practice for speech perception in noise (SPIN), HA usage, and patient satisfaction. Materials and Methods: This prospective, randomized, single-blinded, multicenter crossover study included 100 first-time hearing users. All participants were fitted with Phonak Marvel HAs and were assigned randomly to receive either an REM-based fitting or to have their HAs fitted according to the current practice (CP), which is based on the manufacturer’s initial fit. At a follow-up visit after an acclimatization period of 2-3 months, the fittings were switched. At the third study visit, after another 2-3-month acclimatization period, the participants were asked to choose which fitting they preferred. At each visit, the usage log information was recorded, and the subjective and objective benefits were assessed using the Finnish matrix sentence test (FMST), Finnish digit triplet test (FDTT), Hearing in real life environments (HERE) questionnaire, and Speech, Spatial, and Qualities (SSQ) questionnaire. Results: Data collection is still ongoing, with 64 participants having completed the third follow-up visit. Based on the current data, the overall HA benefit for SPIN was significant, with an overall mean improvement of 1.6 dB SNR (95% CI: -1.22, -1.96, $p < 0.0001$, paired t-test) in the FMST results from baseline to the first follow-up. For FMST, all comparisons between the two groups and fitting practices resulted in only small differences (< 0.5 dB SNR), of which none were statistically significant. HERE and SSQ showed a significant HA benefit based on the mean overall difference from baseline to the first follow-up visit. For HERE the mean improvement was 36.4 points (95% CI: 25.96, 46.77, $p < 0.0001$, paired t-test), and for SSQ 80.9 points (95% CI: 102.48, 59.29, $p < 0.0001$, paired t-test). Similar to the SPIN results, none of the comparisons between the groups or fitting practices showed any statistically significant differences. Most participants chose to keep the fitting programmed to their HAs at the third study visit, as they had not noticed any significant differences between the two fittings. The poster will present the latest data available at the time of the presentation. Conclusion: Based on both objective and subjective measures, the overall benefit of using REM to fit first-time HA users was small. However, more detailed analyses are needed to assess whether REM-based fitting could benefit certain audiogram configurations or patient populations.

Chirp speech: A novel approach for studying disordered speech processing in children. *Lauren Petley*

Clinical conditions that are marked by deficits in speech comprehension could potentially involve disordered processing at multiple levels of the speech processing hierarchy, from the central auditory nervous system through to cortical language networks. A range of event-related potentials exist that can index neural operations at all of these levels, but differences in the protocols required to measure them make comprehensive testing difficult. Chirp Speech is a novel method that combines natural speech with acoustic chirps to overcome this limitation. Chirps (i.e., brief upward frequency sweeps) have long been recognized to accommodate for the basilar membrane delay in acoustic transduction and thereby increase the detectability of early auditory evoked responses. Chirp Speech leverages this observation through acoustic engineering to optimize speech EEG responses while maintaining intelligibility. Design: A 16-minute story, recorded by an adult male, and a series of chirps were filtered into non-overlapping, interleaved frequency bands that preserved the fundamental frequency of the voice as well as much of the speech energy at higher frequencies. The chirps were then combined with the speech at glottal pulse onsets to produce Chirp Speech. Twenty-nine children (16 typically developing, 13 with listening difficulties), ages 8-17 years old, actively listened to the story and responded to the target word “and” via button press. Audio was delivered diotically at 70 dB SPL, while the EEG data was collected from 52 scalp sites. Averages computed with respect to chirp onsets were used to derive the auditory brainstem response (ABR wave V), the middle latency response (MLR), long-latency auditory evoked potentials (LLAEPs), P300 (a measure of selective attention and working memory updating) and the N400 (a measure of semantic integration). Results: Chirp Speech successfully evoked a spectrum of auditory and cognitive responses ranging from the brainstem to cortical language processing. Post-auricular muscle artifacts and poor target word detection rates posed challenges for the measurement of the MLR and P300, respectively. Group differences in the scalp distribution of the N400 suggest altered semantic integration in children with LiD. Conclusions: Chirp Speech effectively evokes a range of responses along the central auditory hierarchy, as well as responses associated with cognitive operations like selective attention, working memory, and language processing, in a relatively short amount of time. The method is therefore promising for patient populations with auditory deficits that involve contributions from the central nervous system. Caution is warranted due to the risk for contamination by PAM artifacts, which can be mitigated via reduced presentation levels. Application of the method to speech stimuli that are designed to more effectively target cognitive operations like selective attention or other facets of language processing could further enhance the value of this approach.

Effects of second language exposure on speech perception measures. *Lena Wong*

Speakers of a second language have difficulties perceiving speech in noise and their proficiency in the second language could have an impact on their performance in speech intelligibility measures, depending on the complexity of the test stimuli. Due to the simplicity of test stimuli used in Digit in Noise Test (DIN), effects of second language exposure on speech reception thresholds measured might be less affected by language exposure. This study aimed to evaluate the effects of language exposure on speech reception thresholds measured using digits presented in noise. Method: A total of 51 native Mandarin-speaking participants, with Cantonese as their second language (L2), participated. Speech reception thresholds (SRTs) were obtained using sentences on the Cantonese Hearing in Noise Test (CHINT), and using 2-digit, 3-digit, and 5-digit sequences, with forward recall; as well as 3-digit sequences with backward recall on the Cantonese and Mandarin versions of integrated Digit-in-Noise tests (iDIN). Language proficiency was assessed using a modified version of the Language Experience and Proficiency Questionnaire (LEAP-Q), contextualized for non-native Cantonese speakers in Hong Kong. Results: The participants' mean years of Cantonese exposure were 11.64 ± 12.21 (range: 6 months to 50 years). SRTs obtained

using 5-digit sequences on the Mandarin iDIN were significantly better than that obtained using Cantonese iDIN, suggesting that 2- to 3-digit SRTs were not influenced by language exposure in this group of participants. Correlation analyses demonstrated that years of exposure to Cantonese were associated with SRTs measured using all digit sequence on the Cantonese iDIN ($p \leq .016$). Years of Cantonese exposure also correlated with SRTs measured on the CHINT ($p < .001$). Conclusion: Although years of Cantonese exposure as L2 affected 2- to 5-digit SRTs in the Cantonese iDIN, the impact of second language exposure on 2- to 3-digit SRTs seems to be minimal. These results imply that when using 2- or 3-digit sequences to screen hearing, second language exposure may not have a significant impact. However, perception of longer digit sequences and sentence in noise may be affected and speech intelligibility measurement using these test stimuli should be interpreted with caution.

Adult hearing screening: Uptake of an internet-delivered hearing assessment. *Piers Dawes*

Systematic adult hearing screening has potential to reduce the burden of hearing loss and improve quality of life. But there are numerous outstanding questions about adult screening, including reliability and uptake of new screening tests, hearing aid uptake, use and benefit and the cost-effectiveness of screening. We evaluated the uptake of an internet-based hearing test among primary care practices in areas of high socioeconomic deprivation around Manchester. An estimated 70% of adults with hearing loss but who do not use hearing aids took the test. Internet-based hearing testing offers an efficient paradigm for identifying hearing loss.

Separating the causes of listening difficulties. *Harvey Dillon*

Children and adults can have abnormal difficulty understanding speech in acoustically challenging situations, despite having normal hearing thresholds. In principle, this difficulty can be caused by deficits in any of auditory processing, speech sound identification, cognition, or language, either in isolation or in combination. Identifying the primary cause is complicated. Firstly, tests in any one domain (e.g. auditory processing) inevitably place demands on skills in another domain (e.g. cognition). Secondly, it is possible, if not likely, for an individual to have deficits in more than one of the causal domains. Thirdly, deficits in one domain can lead to deficits in other domains. Even when the domain primarily causing the deficit is identified, identifying the specific deficits within that domain may be challenging. Identification is necessary, however, if remediation therapy that intensively exercises the skill in deficit is to be applied. The talk will show principles for separating the different domains, and data that shows the relationships between abilities in different domains. The principal outcome measure is sentence understanding in noise, measured with either Listening in Spatialized Noise Sentences test (LiSN-S), or the Test of Listening Difficulties – Universal (ToLD-U), the latter realistically simulating listening in a noise reverberant classroom. Sentence understanding in noise is shown to be associated with the following, listed in decreasing strength of relationship: • Use of spatial cues to segregate target speech from competition (measured with LiSN-S spatial advantage measure); • Language ability (measured with AudiCloze test of cloze ability); • Short-term memory (measured with DigiSpan test of digit span); • Speech sound perception in noise (measured with LiSN-U test of nonsense syllables in noise), which in turn is not affected by language ability; • Dichotic perception (measured with DDdT test of dichotic digit perception), which was highly associated with short-term memory and also highly predicted by a diotic test of simultaneously presented digits. All measures monitor consistency of responding as each test progresses, with the aim of detecting any measurements that may have been affected by lapses in attention as testing proceeds. The test battery appears capable of detecting and

differentiating individual reasons for poor speech understanding in noise in individual children or adults.

Does immune history influence cochlear implant outcomes in children? *Kate Hough*

Despite the significant success of cochlear implants, a proportion of people do not achieve the expected hearing benefits. This is detrimental to the person, can lead to non-use of implants, overuse of clinical resource without resolution of the issue and may reduce trust in the device for people who are within clinical criteria. The reasons for underperformance are multifactorial and poorly understood. Better understanding of the mechanisms that give rise to poorer hearing may enable interventions that give more people better hearing outcomes with their implant. This project will generate data to enable us to test the alternate hypothesis that insertion of an electrode array into the cochlea elicits an inflammatory tissue response that varies due to individual differences between people at the time of implantation. Most studies investigating responses to electrode array insertion have been in animals and have not enabled us to determine how the inflammatory response might vary between people, each of whom has their own immune history. We need to understand, and predict, the individual inflammatory response as this could lead to improved clinical management and better outcomes for more people. Our aim is to investigate the relationship between the inflammatory state of macrophages in the ear and hearing outcomes following cochlear implantation. The CHIEF (cochlear implants and inner ear inflammation) study is an observational, cross-sectional, study of children and young people undergoing cochlear implantation. Tissue and fluid samples will be collected from the ear/(s) being implanted during surgery including middle ear mucosa, middle ear fluid (if present) and cochlear fluid. A nasal swab and blood sample will be collected at the time of surgery. In cases where an implant is being removed because of implant failure, the implant and tissue attached will be collected. Following implantation, we will collect routine clinical outcome measures for up to five years. To inform, contribute to, and challenge our biomedical research, we established a patient and public involvement and engagement (PPIE) group for people with lived experience of hearing loss called ALL_EARS@UoS. During CHIEF, we are co-developing a group for young people to ensure young people are engaged in the development and running of the study, our wider research and to share their lived experience of hearing loss.

Evaluation of the paediatric audiology pathway alignment (PAPA) triage for paediatric audiology referrals in Ireland. *Adrian Davis*

There were 5918 children waitlisted nationally in Ireland for hearing assessment and management with Health Services Executive (HSE) audiology services in March 2016. Data from the HSE Business Information Unit (Primary Care) indicated 20% of children were waiting in excess of 12 months for assessment. The primary reasons for this related to the inability to recruit and retain paediatric audiologists and over referral of cases for diagnostic assessments. Records show that typically the audiology service discharged 70-80% (in common with most other services of this kind in Europe). It is well established that hearing loss in children needs to be identified and managed as early as possible in order to ensure appropriate development of their speech, language, educational and social development, which can have lifelong consequences for the child and family. The HSE Integrated Audiology Programme explored alternative options to provide an innovative, efficient and effective triage service to reduce waiting times for assessing children and place them on an appropriate audiology care pathway, termed paediatric audiology pathway alignment (PAPA), provided by an external provider (Northgate Public Services, now NEC). A proof of concept (POC) was conducted to evaluate the clinical appropriateness and viability of PAPA as a triage model; this was overseen by Senior Paediatric Audiologists from the HSE and piloted in Dublin. A proof of concept was implemented to determine the viability of PAPA. Standard objective audiometric techniques (transient otoacoustic emissions +/-

tympanometry) and a validated questionnaire (Milovanovic et al 2016) was used to determine if a child had: • A high probability of satisfactory hearing. • A likely temporary middle ear disorder, requiring ENT management. • High probability of a permanent hearing disorder of a level likely to impact upon speech and language development (> 35 dBHL). Clients were sequentially taken from routine HSE paediatric audiology referrals on waiting list, split by under and over 4 years of age. A randomised balanced design was implemented with 50% having either objective or behavioural assessment first. All assessments were performed by qualified paediatric audiologists, with clinicians blinded to the outcome of the objective / behavioural assessment. Results 594 Children were offered a hearing assessment with an attendance rate of 80% (N=476). The PAPA approach was well tolerated with 89.9% (N=423) tolerating objective assessment. 15 children were identified with a PCHI and all were identified using the PAPA. No child presenting with a mild or unilateral loss was missed by the triage. Conclusions PAPA provides an effective mechanism to screen children waiting for a hearing assessment and allocates them to an appropriate pathway with the potential to fast track their service needs.

POSTERS

1. That looks noisy: evaluation and preference of an Image-Based Questionnaire (IBQ) for assessing hearing. *Emanuele Perugia, Samuel Couth, Gabrielle Saunders*

Aims: During clinical audiological assessment and follow-up appointments, patients often complete a self-report questionnaire to evaluate hearing difficulties. There are many questionnaires available that use a similar format; patients rate their listening difficulty based on a written description of a listening situation. Based on the principle that “a picture is worth a thousand words”, we developed an image-based questionnaire (IBQ) that uses photographs instead of written descriptions of listening situations to assess self-reported hearing. The IBQ includes 14 questions/scenarios based on the Common Sound Scenarios (CoSS) framework (Wolters et al., 2016). The overall aim of this study was to pilot test IBQ against standard text-based questionnaires and behavioural measures of hearing (Digits in Noise, DiN, test). Our hypotheses were: (1) The IBQ will have a stronger correlation with DiN thresholds than text-based questionnaires. (2) The IBQ will have better sensitivity and specificity for categorising hearing loss than text-based questionnaires. (3) Participants will find it easier, prefer, and be more confident completing an IBQ than a text-based questionnaire. (4) Mean IBQ ratings will not differ from mean ratings on a text-based questionnaire. Population: Fifty-five adults (28 female). Participants’ ages ranged from 20 to 85 years. Twenty-eight participants reported having a hearing loss, 19 reported using hearing assistive technology (e.g. hearing aids, cochlear implant). Methods: Data were gathered online. Participants answered three questionnaires and performed a DiN test. The questionnaires were the IBQ, a text-based version of the IBQ, and the first two questions of the Glasgow Hearing Aid Benefit Profile (GHABP, Gatehouse, 1999). The antiphasic DiN test presented series of three digits against a masking noise (De Sousa et al, 2020). The digits used were from one to nine (excluding seven) spoken in English by a British female speaker. The masker was speech-shaped noise. Results: (1) Spearman’s correlation between IBQ and DiN (r_s = -0.448, p = 0.003) was stronger than that between GHABP and DiN (r_s = -0.295, p = 0.055), however, the magnitude of the correlations was not different (Olkin's z = -1.59, p = 0.11). (2) Receiver Operating Characteristic (ROC) plots were obtained calculating sensitivity and specificity of each questionnaire. The Area Under the ROCs were: ◦ IBQ: 0.84, 0.89, and 0.74 for self-reported of hearing loss, using hearing assistive technology, and DiN thresholds, repetitively. ◦ GHABP: 0.90, 0.90, and 0.64 for self-reported of hearing loss, using hearing assistive technology, and DiN thresholds, repetitively. (3) Participants significantly preferred, found easier, and were more confident completing the IBQ than the text-based equivalent. (4) The mean ratings (and 95%

confidence interval) of the IBQ and its text-based version were 6.2 (5.7/6.7) and 5.8 (5.3/6.3), respectively. Interpretation: Questionnaires showed good correlation with DiN and diagnostic performance. Despite similar ratings and performance between the IBQ and text-based questionnaires, participants' preference for the IBQ over its text-based version suggests they might engagement better with the IBQ which might lead to more reliable clinical assessments of self-reported hearing difficulties. Conclusion: The IBQ could be an effective clinical self-report outcome measure.

2. New methods of behavioural hearing testing in young children with social and communication disorders. *Josephine Marriage, Keiran Joseph*

A growing number preschool-age children are not responsive to warble tones (WT) and narrowband noise, the signals traditionally used in paediatric hearing assessment (Ref STP presentation this conference). Effective methods of hearing assessment are important for all children, both with and without complex needs. Bonino (2023) reports that the median age for establishing a single frequency hearing response for children with SCD is 3 years, with ongoing reviews continuing into teenage. She concludes: "Results reflect a failure in our methods-not in the child. We need new behavioural assessments and an informed strategy". Use of familiar tunes and songs can elicit hearing responses in children with complex needs. Method: we describe the development of a computer tablet using filtered music to derive frequency-specific hearing responses. This research program describes the development of a protocol for use of filtered tunes in preschool audiology clinics, moving from simple sounds of warble tones to use of familiar music signals. The research includes consideration of the frequency bandwidth required to maintain recognition of familiar songs. We describe the process for deriving minimal response levels (MRL) with the sensation level necessary for recognition (and response to) filtered music. These MRL are compared to detection levels for simple WT signals. Results: the pilot study of 30 cases is described with adjustments to the test protocol based on these findings. The aim is to establish a clinical protocol which is practical, insightful and timely for this new and challenging population. Results and conclusions: this study illustrates how collaboration between clinicians, academic researchers and acoustic engineers can produce new innovations and test techniques driven by changing clinical needs.

3. Using digital measures of cognition and audition to screen for cognitive decline in a Spanish-speaking population. *Esteban Sebastian Lelo de Larrea-Mancera,Yvonne Flores-Medina, Aaron Seitz, Ruth Alcalá-Lozano*

As adults advance into older age, they face increased risk of cognitive decline and dementia. Screening evaluations that target early detection of sensory difficulty and cognitive decline are necessary for preventive dementia care of the aging population of the World. Traditional screening costs that have obstructed screening efforts in the general population may be ameliorated by the use of accessible automatic digital screening procedures on a wide variety of clinically relevant measures. Although research and tool development for digital assessment and screening of cognitive and sensory function are on the rise, they are mostly restricted to the English language and fewer efforts have focused on other languages like Spanish. Objective: This study explores the potential of a novel digital screening battery for cognitive decline that utilizes digital cognitive and auditory tests with potential clinical value in the Spanish-language. Methods: We utilized the open-access digital assessment app "PART" (https://ucrbraingamecenter.github.io/PART_Utilities/), to test a group of 140 middle-age and older adults across measures of executive function, working memory, sustained and selective attention, language, dichotic sentence identification, speech-on-speech masking, binaural hearing, and pure-tone detection. All tests were automatically delivered by the PART app in the Spanish-language. We evaluated the ability to detect minimal cognitive impairment (MCI) and dementia of each digital test and the full battery. We further evaluated

concurrent validity for cognitive screening with the widely used screening instrument Montreal cognitive assessment (MoCA). Results: We found some of the digital tests were useful to discriminate minimal cognitive impairment (MCI; 3/10 tests) and dementia (10/10 tests). We further show significant correlations ($r = .24$ to $.62$, $p < .004$) between every digital test used and the MoCA with only one exception. We further explored the structure of the shared variance across digital tests and the MoCA using backwards regression and principal component analysis. Finally, we show multiple regression models predicted with medium sensitivity (57%) and high specificity (97%) the dementia cases, and with high sensitivity (93%) but low specificity (31%) the MCI cases. Conclusion: Overall, this study demonstrates discriminatory value and concurrent validity to screen for cognitive decline in Spanish-speaking middle-age and older adults using open-access digital auditory and cognitive assessments. Follow-up studies with larger and more diverse samples, as well as different testing scenarios that replicate and extend these findings can be transformative in achieving cognitive screening procedures for the general population.

4. Better, worse, or both ears? What's the best hearing-aid fitting? *Oliver Zobay, Graham Naylor, Gabrielle Saunders, Lauren Dillard*

Evaluate associations of hearing-aid (HA) fitting laterality with i) long-term HA use persistence, and ii) short term HA use and HA satisfaction, accounting for hearing loss (HL) asymmetry and severity and distinguishing between bilateral fittings and unilateral fittings in the better or worse ear. Design: We used longitudinal electronic health records data from the US Veterans Affairs healthcare system. The determinant of interest was HA fitting laterality, defined as bilateral fitting or unilateral fitting in the worse or better ear. Pure tone average (PTA; thresholds 0.5-4.0 kHz) was used to define HL asymmetry (≥10 dB between ears) and severity (normal: ≤25 dB; mild: 25-40 dB; moderate: >40-60 dB; severe: >60-80 dB; profound: >80 dB). We defined four types of binaural HL configurations based on HL asymmetry and severity: 1) profound HL in the worse ear with normal hearing to severe HL in the better ear, 2) mild to severe HL in the worse ear with normal hearing in the better ear, 3) moderately asymmetric HL (better ear PTA>25 dB, worse ear PTA ≤80 dB), and 4) symmetric HL. Long-term HA use persistence was defined by a metric constructed from longitudinal battery reorder data. Short term HA use and HA satisfaction were determined by self-reported use >4 hours/day (question 1) and the total score on the International Outcome Inventory for Hearing Aids (IOI-HA), respectively. Multivariable-adjusted logistic (long-term HA persistence, n=249,719; short-term HA use, n=65,028) or linear (HA satisfaction, n=65,028) regression models were fitted for each region, separately. Results are presented as odds ratios (OR) or regression coefficients (B). Results: Most patients had symmetric HL (79.1%), and fewer had one of the asymmetric configurations 1 (3.1%), 2 (4.2%) and 3 (13.3%). Most patients were fit bilaterally (92.8%), while 2.0% were fit unilaterally in the presence of symmetrical hearing, 3.2% unilaterally in the worse ear, 1.6% unilaterally in the better ear, and 0.5% unilaterally in the presence of a dead ear. Long-term HA use persistence was lower for worse-ear HA fittings compared to bilateral and better-ear fittings in the asymmetric HL configurations 2 and 3 (ORs between 0.57 and 0.72; three p-values < 0.001, one $p<0.05$), and for unilateral fittings for symmetric HL compared to bilateral (OR=0.59, $p<0.001$). In contrast, there was no difference in self-reported short-term HA usage (IOI-HA Q1) across laterality categories. However, short-term HA satisfaction was poorer for better-ear fittings compared to bilateral in configurations 1 and 3 (B=-0.72 and -0.69, respectively, $p<0.01$) and unilateral fittings for symmetric HL compared to bilateral fittings (B=-0.61, $p<0.001$). Conclusions: Our results indicate that bilateral aids yield the best short- and long-term outcomes and while unilateral devices can result in similar outcomes on some measures, we did not identify any hearing loss configuration for which a bilateral fitting would lead to a poorer outcome than a unilateral fitting. However, if a single HA is to be fitted, then our results indicate that a better-ear fitting has a higher probability of long-term HA use persistence than a worse-ear fitting. Reference: Zobay O, Naylor G, Saunders GH,

Dillard LK. Fitting a Hearing Aid on the Better Ear, Worse Ear, or Both: Associations of Hearing-aid Fitting Laterality with Outcomes in a Large Sample of US Veterans. Trends in Hearing. 2023;27. https://doi.org/10.1177/23312165231195987 8

5. Do people with cognitive impairment benefit from cochlear implants? A scoping review. *Hannah Cross, Piers Dawes, Rebecca Millman, Iracema Leroi, Chistiane Völter*

Population data suggest that around half of people with severe-to- profound hearing loss who may be eligible for a cochlear implant also have cognitive impairment or dementia. Despite this comorbidity, the benefits of cochlear implants for people with dementia are unclear. Objective: To identify and evaluate the evidence for the benefits of cochlear implants for people with cognitive impairment or dementia. We focused on the following outcomes: speech recognition, quality of life, behavioural and psychological symptoms of dementia, cognition, function in daily life, mental well-being, and caregiver burden. Method: Ten electronic databases were searched systematically during December 2023. Studies reporting on outcomes for cochlear implants that included adults identified with cognitive impairment, mild cognitive impairment or dementia were eligible for inclusion. Study screening, data extraction and quality ratings (using the Downs and Black Checklist and Oxford 2011 Level of Evidence) were carried out by two independent reviewers. Findings: Searches identified 552 references. Thirteen studies (n = 222 people with cognitive impairment, mild cognitive impairment, or dementia) were eligible for inclusion. Two of the studies were non-randomised controlled design, whereas the remainder were single group studies, case series or single-subject case studies. Low quality evidence, according to our quality appraisal, suggested that people with cognitive impairment do benefit from cochlear implant, demonstrated by improved speech recognition and cognitive scoring. However, individuals with cognitive impairment may benefit less than those with healthy cognition. The degree of benefit from cochlear implant depends on the level of cognitive impairment. The included literature did not identify evidence for increased rates of adverse events following cochlear implantation among those with cognitive impairment. There was limited or no evidence for any other outcome. Conclusions: People with cognitive impairment or dementia can benefit from cochlear implants. To inform clinical practice, further research on outcomes - aside from speech recognition - for people with cognitive impairment or dementia is needed. There remains a lack of information on referral, eligibility, and cochlear implant support needs for people with cognitive impairment and their caregivers.

6. Developing a speech perception testing protocol for the COACH trial. *Catherine Killan, Terry Nunn, Tracey Twomey, Trish Hepburn, Caroline Rick, Imogen Gould, Garry Meakin, Alan Montgomery, Douglas Hartley, Padraig Kitterick*

COACH is a multi-centre randomised controlled trial COmpAring the clinical effectiveness of Cochlear implants to Hearing aids for adults with severe hearing loss. An important aspect of study design was the development of a speech perception testing protocol. This protocol aimed to maximise the relevance, quality, and consistency of the data and to minimise bias in the scoring and analyses of the primary outcome measure. It was embedded within a wider trial protocol, guided by pilot data, patients, the public, audiologists, surgeons, researchers, methodologists, statisticians, and an international trial steering group. Method: Phoneme perception is assessed using the Arthur Boothroyd (AB) word lists, at 70 dB(A) for participant inclusion, reflecting NHS practice, and at 60 dB(A) as the primary outcome measure. Word perception in quiet, sentence perception in quiet, and sentence perception in adaptive noise are secondary outcome measures. Trial participants are randomised to either cochlear implantation or hearing aids. The target sample size of 130 was based on the smallest meaningful change in phoneme perception score from a survey of expert opinion and the standard deviation of pilot data collected from adults with cochlear implants and blind-scored from videos of the live test. An audiology working practice document promotes consistency in audiometric assessment, aided configuration, test administration, and device

fitting. Custom speech perception software was developed and is used via dedicated equipment provided, with training, by the COACH team. This has resulted in consistent testing methods between sites, with lists of 90 AB phonemes and 100 sentence keywords per test. Speech materials are calibrated in dB (A) as per NICE guidance, using the lists' long term average speech spectra. Item presentation orders are randomised within the software. Running percentage correct scores and signal to noise ratios are hidden from the tester until test completion, to minimise tester bias. The primary outcome measure will be scored from video files by independent assessors, blinded to allocation and test interval, to minimise assessor bias. The test protocol has been further improved following internal monitoring of trial data and regular meetings with research audiologists at site. The AB word test to assess eligibility is now assessed only once rather than twice prior to randomisation to better replicate NHS care. Repeat eligibility assessments can now be carried out after 9 months for initially ineligible participants, to avoid excluding those with progressive hearing loss. Results: Feedback on the COACH software has been positive. By June 2024, 45 participants had been randomised and 21 had completed their final 9-month follow-up assessment, with 85.17% compliance for full data entry. Both live scores and video files of primary outcome measure tests are being entered into secure online systems. System log files are also collected, for data quality monitoring. Conclusion: Close collaboration between patients, the public, a multidisciplinary research team including clinical trials experts and audiologists at participating sites has strengthened the quality of the COACH speech perception protocol. Responsiveness to site feedback and internal monitoring have improved the protocol further.

7. An automated digits-in-noise hearing test using automatic speech recognition and text-to-speech: A proof-of-concept study. *Mohsen Fatehifar, Kevin Munro, Michael Stone, David Wond, Timothy Cootes, Josef, Schlittenlacher*

With advances in machine learning, hearing tests that are managed by computers have been created. The aim was to build and evaluate a tool for AI-powered speech-in-noise (SIN) hearing tests. It specifically considers a digits-in-noise (DIN) hearing test with Automatic Speech Recognition (ASR) and Text-To-Speech (TTS). Validity and reliability were compared against a benchmark test. Methods Three methods of DIN tests were compared: 1. Benchmark test using pre-recorded stimuli and a graphical user interface. 2. Keyboard-based test using pre-recorded stimuli but ran on the code written by the researchers (before adding AI). 3. AI-powered test using TTS to synthesise the stimuli and ASR to transcribe responses. Apart from vocalisation and response capturing, its underlying code was identical to the keyboard-based test. The participant task in each test was to listen to the three digits and repeat these in the presented order. A 2-up/1-down staircase was used to obtain the signal-to-noise ratio for criterion performance of 71% correct. Retest was done on both the benchmark and AI-powered tests, all completed in one session of 90 minutes. The results were compared using Bland-Altman analyses. Results For reliability, the benchmark test-retest showed a mean of -0.5 dB with a 95%-limit of agreement (LoA) of ±3.8 dB, while the AI-powered test-retest had a mean of -0.8 dB with a 95%-LoA of ±6.0 dB. For validity, the Bland-Altman plot of benchmark and keyboard-based test had a mean of -0.8 dB with a 95%-LoA of ±5.9 dB. AI-powered test with benchmark had a mean of +0.3 dB and a 95%-LoA of ±6.3 dB. AI-powered test with keyboard-based test yielded a mean of -1.1 dB with a 95%-LoA of ±6.0 dB. Conclusion The results show that the developed tool is valid and reliable: it adds little error compared to the test-retest reliability of the benchmark test. The results also support the idea of using AI and show that it may be possible to use ASR and TTS in a SIN test.

8. Understanding cultural variations in stigma related to hearing loss and hearing aid use. *Suhani Pattanshetti, Gabrielle Saunders, Charlotte Vercammen, Samuel Couth*

The way disability, hearing impairment as well as hearing aid adoption is viewed differs across cultures and this is owed partly due to the manifestation of ‘stigma’. Stigma has historically been defined as an "attribute that significantly discredits," diminishing an individual from a complete and typical being to one seen as tainted and devalued and is a significant factor that can influence morbidity, mortality, and health disparities in determining one's health and well-being. However, stigma impacts not only person with a stigmatising condition (PwSC), but also those who have close associations with them, such as family members or primary caregivers (Associative stigma). ‘Affiliate stigma’ refers to when family members or caregivers accept and endorse stigmatizing beliefs that are projected onto them by society, thus making them the ‘affiliate’. In a recent scoping review conducted in our department found that affiliate stigma can cause affiliates to behave in a certain way that could impact the PwSC, like potentially influencing their health-seeking behaviours. Moreover, cultural factors were identified as potential exacerbators or mitigators of these effects on PwSC. The aim of our study was to explore if this extends to the way ‘affiliate stigma’ in is expressed in the context of hearing health. In the UK, which is a largely culturally diverse country, there has been a steady need on research on health-seeking behaviours especially among ethnic minorities, such as in South Asian communities, who exhibit a higher likelihood of poorer hearing. Despite free hearing care and English proficiency, there is lower adoption of hearing technology in these groups, indicating that this is possibly rooted in cultural perspectives as revealed in a research study addressing ethnic inequality during the investigation into the correlates of hearing loss using UK Biobank data. To understand this, we need to take into whether ‘Acculturation’ influenced their current perspectives associated with hearing loss and the use of hearing aids. Acculturation is characterized by the adoption of health behaviours from the new dominant culture and the loss of health behaviours from the original culture. Our objectives were- 1. To investigate cultural variations in the perception of stigma and affiliate stigma associated with hearing impairment and adoption of hearing aids. 2. To explore the influence of acculturation on the existence of stigma and affiliate stigma and its influence on hearing loss-related stigma. Design- Online survey using questionnaires from standardised questionnaires regarding stigma was assessed using subscales of validated questionnaires assessing the stigma linked to hearing loss (HL) and the adoption of hearing aids (HA), additionally, incorporating questions directed towards affiliates to assess the concept of affiliate stigma within this context. Open ended questions were also asked like- ‘What are the words or brief phrases that come to your thoughts when you reflect on hearing loss and hearing aids?’, ‘What do you believe is the attitudes of the general public towards adults with hearing loss? ’ Apart from questions relating to stigma, patients' sociodemographic data were taken into account, this included questions relating to age, gender, nationality, and education level along with questions related to i) Generational status (First/second generation UK citizen) (ii) Length of residency in the UK (iii) Languages known and language majorly spoken/proficient in. Results-Descriptive statistics will be used to summarize respondent demographics and questionnaire data. A multiple linear regression model will be applied to quantify the association between cultural background and stigma related to hearing loss and hearing aid use. This analysis will be conducted within both White British and South Asian groups, as well as within First generation and Second generation South Asian British groups. The assessment of

9. Diagnosing listening difficulties in children: A tri-level approach to explore the relationship between auditory processing, speech processing, language processing, and cognitive abilities in typically developing children as a first step. *Xuehan Zhou, Harvey Dillon, Kelly Burgoyne, Dani Tomlin, Antje Heinrich*

Children with listening difficulties often struggle to understand speech in challenging environments, which can impact long-term academic outcomes. These difficulties can arise from deficits in auditory, speech, language, and/or cognitive abilities, all of which can present

similarly, complicating diagnosis. A systematic tri-level test battery has been proposed, evaluating sentence understanding in noise and reverberation in simulated classroom environments, phoneme identification in noise and reverberation, and analysis of spectrally complex non-speech sounds. The testing integrates language and cognitive test scores, providing insights into the fundamental relationships between these abilities in typically developing children. Methods: 227 children aged 5–11 years with normal hearing were recruited from six primary schools in Greater Manchester. Each child completed 7 of 12 randomly assigned tests in a comprehensive battery assessing auditory processing of non-speech signals, speech sound identification in noise, sentence understanding in noise, reading ability, teacher-rated listening ability in the classroom, cognitive abilities (memory, attention, and non-verbal intelligence), and language ability over 2-3 sessions. Results: Sentence understating in noise and reverberation is significantly influenced by language ability and nonword perception in noise. Additionally, nonword perception in noise and reverberation correlates significantly with auditory processing skills and is unaffected by language abilities. Attention does not appear to influence performance on either the sentence perception or nonword perception tasks used in this study. Further, a structural equation model has been established to show the multiple relationships among all the abilities in the test battery. Conclusion: Understanding children's listening in noise ability, reading skills, and real-life listening capabilities requires consideration of how auditory processing, language, and cognitive abilities may have impacted not only task results, but also the functional difficulties the child experiences. The tri-level approach with a structured framework enhances assessment accuracy, leading to more precise and targeted audiological services for children with listening difficulties.

10. Speech used in broadcast is more difficult to comprehend and more effortful for older people who wear hearing aids than for older people with "normal hearing"
Rebecca Millman, Lorenza Curetti, Ben Shirley, Lauren Ward, Alan Archer-Boyd, Matthew Paradis, Michael Stone

Understanding the speech used in the media (“broadcast speech”) can be challenging, particularly for older people who have a hearing loss. Here we measured the comprehension of broadcast speech and assessed the contribution of speech clarity, accents and background noise (Armstrong, 2014) to the listening effort needed to understand it for older participants with ‘normal hearing’ (NH group) and participants who wear hearing aids (HA group). Participants were native-English speakers (41 female, aged 51-75 years): N=37 in the NH group and N=38 in the HA group. Novel stimuli were created from BBC programmes. Excerpts of “foreground speech” were mixed with plausible “background noise” recorded for the same programme. Foreground speech was selected based on its subjective diversity (UK and Ireland) and accentedness. The eSTOI model (Jensen & Taal, 2016) was used to equate predicted intelligibility across stimuli. Therefore, the mixes presented in this test platform were different from the original broadcast mixes. The comprehension of the speech was measured using multiple choice questions designed to assess overall understanding of each excerpt and the response times were used as an objective measure of listening effort. Participants were asked to provide subjective ratings of their listening effort and also to report on relative contributions of the factors “clarity”, “accents” and “background noise” to their listening effort. Comprehension scores were significantly lower for the HA group than the NH group. The HA group used more listening effort than the NH group and reported that the factors “clarity” and “background noise” contributed to more of their listening effort (there was no effect of “accents”). Linear regression analyses showed that the comprehension of broadcast speech was predicted by hearing thresholds only, objective listening effort was predicted by age only and subjective listening effort was predicted by the factors “clarity” and “background noise”. These results suggest that broadcast speech is more difficult to understand and more effortful for older people who wear hearing aids than for older people with normal hearing. Improving the clarity of broadcast speech and permitting personalised

foreground-background mixes based on multi-factor demographics may improve the accessibility of broadcast speech.

11. Hearing loss and Parkinson's Disease, are they related? A UK Biobank analysis. *Megan Readman, Yang Wang, Fang Wan, Ian Fairman, Sally A. Linkenauger, Trevor J. Crawford, Chris J Plack*

Emerging evidence has implicated hearing impairment as a potential risk factor for the incidence of Parkinson's Disease (Parkinson's), with some suggesting that clinically diagnosed hearing loss increases Parkinson's risk 1.5-1.6 fold over 2-5 years follow up. However, the evidence is mixed, with additional studies observing that self-reported hearing capabilities are not significantly associated with the incidence of Parkinson's. Thus, additional large-scale cohort analyses that draw on alternative neurophysiological and functional aspects of the auditory system are required to further corroborate the link between Parkinson's and hearing impairment and shed light on the potential mechanism behind this relationship. Objectives: This study aimed to model statistically whether or not hearing impairment, measured using a speech-in-noise test (the Digit Triplet Test, DTT), is a risk factor for the incidence of Parkinson's. Methods: This is a prospective cohort study using UK Biobank data. Data pertaining to 159,395 individuals who underwent the DTT and were free from diagnosis of Parkinson's at the point of audiometric testing were analysed. The time to progression was summarized according to the Kaplan Meier method. A stratified Cox proportional hazard model, with hearing impairment as a single covariate, was conducted to model the time to progression. The stratum included age, sex, and educational attainment. Results: During a median follow up of 14.24 years, 810 cases of probable Parkinson's were observed. The risk of incident Parkinson's increased with baseline hearing impairment (hazard ratio 1.57 (95%CI: 1.018, 2.435; P = 0.041), indicating 57% increase in risk for every 10 dB increase in SRT. Conclusions: Hearing loss is independently associated with Parkinson's. However, it remains unclear whether hearing loss is a causal risk factor for Parkinson's or rather is a marker for early-stage Parkinson's prior to the point of diagnosis.

12. Exploring the impact of tactile defensiveness in those with cognitive needs during audiology appointments: perspectives from audiologists and carers on behalf of patients. *Georgia Cook*

Tactile defensiveness (TD) can be described as hypersensitivity to the sensation of touch which can evoke a variety of behaviours including avoidance, defensiveness and aggression (Baranek and Berkson, 1994). TD is characteristic amongst certain cognitive needs and, although it is not always present in conjunction with these diagnoses, it is common (Cascio, 2010). As well as the cognitive needs population already facing barriers within healthcare (McShea, Corkish and McAnelly, 2014), TD can contribute to the challenges faced during appointments, assessments and intervention. With the prevalence of hearing loss higher for those with cognitive needs compared to the rest of the general population (Meuwese-Jongejeugd et al., 2006), it is necessary to address challenges such as those brought about by TD in order to provide beneficial audiological care to those who need it most. Managing TD behaviours in audiology appointments means appropriate adaptions and management techniques may be necessary so procedures can be conducted successfully whilst any potential stress or discomfort is alleviated. Currently, the British Society of Audiology (BSA) guidelines suggest referring individuals with TD to occupational therapy (OT) with the aim of managing defensive behaviours and in turn allowing audiological procedures to take place (BSA, 2019). However, guidelines do not go much further than this, and it could be said that additional recommendations would be valuable, so that audiologists can carry out management techniques themselves or continue the work of OTs. Literature concerning TD within the healthcare discipline of audiology is sparse, however other fields have explored

how different strategies can be implemented to decrease defensive responses. Various examples of behavioural therapies have demonstrated how individuals who initially presented with a defensive response to stimuli related to a medical procedure were eventually able to tolerate this (Ellis et al., 2006 and Slifer, Avis and Frutchey, 2008). This evidence suggests that similar therapy techniques may be applicable to the context of audiology and aid individuals with TD in accepting and tolerating necessary procedures. The current study aims to gain the insight of both audiologists and carers, on behalf of individuals with cognitive needs, through semi-structured interviews. Thematic analysis will be conducted on interview transcripts in order to identify themes that may help establish ways in which clinicians can manage TD more effectively during appointments. Through the use of these two groups of participants, this study aims to gather alternate perspectives with the hope of uncovering the most effective forms of management. As data collection is currently ongoing for this study, final results will be presented at the conference.

13. A study protocol to assess the effects of cancer treatments on speech perception in noise, cognition, and hearing-related quality of life. *Tytti Willberg, Akseli Tommila, Outi Alanko, Iiris Nieminen, Heikki Irjala, Maria Sundvall*

Ototoxicity is a well-known side effect of several cancer treatments. However, adherence to ototoxicity monitoring programs is often low, and hearing assessments are typically limited to otoacoustic emission (OAEs) or pure-tone thresholds. Speech perception in noise (SPIN) is rarely assessed in cancer patients post-treatment, although it provides a better assessment of functional hearing than pure-tone thresholds. Cognitive impairment is another well-known side effect of cancer treatment that can further impair SPIN, either independently or in combination with peripheral hearing loss. A comprehensive evaluation of the effects of cancer treatment on hearing should include measures of inner ear function, speech perception in noise, cognitive performance, and subjective assessments of hearing and hearing-related quality of life. The poster will present a protocol for a prospective longitudinal observational study on the effects of different types of cancer treatments on SPIN, cognition, and hearing-related quality of life. Materials & Methods: This study will recruit 200 participants receiving one of four different types of cancer treatments and a control group of 50 healthy volunteers. The treatment groups (50 participants per group) will consist of patients receiving cisplatin (group 1), cisplatin-based chemoradiation in the head and neck region (group 2), radiation therapy in the head and neck region (group 3), or oxaliplatin (group 4). The inclusion criteria are age 18-75 and Finnish as the native language. Exclusion criteria include any prior or current significant audiological or otological condition, severe bilateral or unilateral hearing loss, prior use of ototoxic medications, and a diagnosis of cognitive impairment. The baseline assessment prior to the start of treatment consists of high-frequency audiometry, OAEs, impedance audiometry, SPIN measures (Finnish matrix sentence test (FMST) and Finnish digit triplet test (FDTT)), neuropsychological assessment, cognitive self-assessment with the Functional Assessment of Cancer Therapy - Cognitive Function (FACT-Cog) questionnaire, and patient-reported outcome measures. The assessments will be repeated 3-4 months, 1 year, and 3 years after the end of initial cancer treatment. The main outcome measure is the change in SPIN measured using the FMST from baseline to the first follow-up at 3-4 months post treatment. Secondary outcomes include long-term changes in SPIN, changes in pure-tone thresholds, and changes in cognition measured using the FACT-Cog and the standard neuropsychological test battery. Exploratory outcomes include the correlations between changes in pure-tone thresholds, SPIN, individual cognitive measures, and hearing-related quality of life. Discussion: The aim of our study is to better understand how the current standard treatments for cancer affect hearing thresholds, SPIN, hearing-related quality of life, and cognition. Through our extensive test battery, we aim to assess what measures, objective or subjective, are needed to reliably and efficiently detect hearing problems related to cancer treatment.

14. Self-reported hearing handicap for older adults: Questionnaire evaluation and relation to common audiological measures. *Stefanie Goicke, Christian, Brandt, Larry Humes, Tobias Neher*

Self-reported hearing difficulties are a strong predictor for hearing aid uptake and use. They are often assessed using the Hearing Handicap Inventory for the Elderly (HHIE) or the Hearing Handicap Inventory for Adults (HHIA). These two self-report measures differ by only three of the 25 items in each and are referred to here as the HHI. Various brief versions of the HHI have been developed and evaluated, with the shortest being a 10-item screener. The HHI was recently translated into Danish but has not been systematically evaluated so far. OBJECTIVES: To evaluate the Danish HHI and to relate the collected HHI scores to common audiological measures. METHODS: In the first part of the current study, participants (n = 62) aged 50 and above completed the Danish HHI twice within approx. four weeks via an online questionnaire tool. Participants with a wide range of hearing abilities were included. Current or prior hearing aid use was not an exclusion criterion, whereas cochlear implant use was. Two different orders of the 25 HHI items were compared: (1) the conventional order and (2) an experimental order in which the items were presented in blocks beginning with the 10-item screener. Internal consistency and test-retest reliability were assessed and compared for both item orders. In the second part of the current study (n = 39), high-frequency audiometry, tympanometry, and speech audiometry were completed. For speech audiometry, the Danish Hearing In Noise Test (HINT) was performed under headphones. HINT signal-to-noise ratios were obtained with and without individual linear amplification. Potential associations among these audiological measures and the HHI scores were then examined. RESULTS: Data collection and analyses are currently ongoing. Regarding the first part, there do not seem to be any differences between the two tested HHI item orders. Furthermore, internal consistency and test-retest reliability appear to be excellent. Regarding the second part, pure-tone average hearing loss and HINT scores appear to be correlated with HHI scores (r » 0.48-0.72). Work is underway to determine how much of the variance in the HHI scores that is left unexplained by pure-tone hearing loss can be accounted for by the other audiological measures. DISCUSSION: The Danish HHI seems comparable to the original English version. It appears to be a good and highly reliable instrument for assessing self-reported hearing abilities in older adults with and without elevated hearing thresholds. The HHI item order seems to not influence HHI scores. Audiometry shows a moderate correlation with HHI scores, whereas some variance of HHI scores cannot be explained by audiometric thresholds.

15. **Can we measure the social and emotional well-being of adults with hearing loss?** *Jack Holman, Paulina Hagyariova.*

Hearing loss has been demonstrated to have a negative impact on myriad factors related to social and emotional well-being such as loneliness, isolation, social participation, social networks and emotions. As a result, in recent years there has been increased focus on the importance of well-being and quality of life in individualised hearing healthcare. However, it is not clear how to best measure social and emotional well-being, or if measuring the full breadth of the issue is even possible or practical given time and resource constraints. Methods In our first study we aimed to discover: 1. What existing self-report questionnaires have been used to measure the social and/or emotional well-being of adults with hearing loss. This was accomplished using a systematic literature search, with the resulting list of questionnaires assessed to determine those with the most promise for clinical use. Given previous results identifying various social and emotional variables significantly related to hearing loss, the next study aimed to determine: 2. Is social and emotional well-being of adults with hearing loss multidimensional? And if so, what factors do social and emotional well-being variables map onto? 3. Are existing well-being measures adequate for measuring the social and emotional well-being factors? For this purpose, 135 participants with hearing loss completed a battery of questionnaires, a social network analysis interview and one

week of ecological momentary assessment to gather information on the relevant variables. Exploratory factor analysis was then conducted. Spearman's rank correlation was then used to examine the links between the factor output and previously validated social and emotional well-being measures identified in study one. Results Following exploratory factor analysis of twelve variables, three factors were established. These were named Communication Barriers, Social Engagement and Network Utility. As the most widely used and potentially promising questionnaires from the systematic search, the subscales of the SF-36 and WHOQOL-BREF were then compared to the factor analysis output. While the SF-36 social functioning subscales correlated with factors one and two (Communication Barriers and Social Engagement), the emotional subscale did not significantly correlate with any factor. The WHOQOL psychological subscale had the strongest correlation with factor one, while the psychological and social relationships subscales both correlated moderately with factor two. No subscale captured the variables present in factor three (Network Utility). Conclusion We established that, for the twelve chosen variables, social and emotional well-being is not unidimensional as three factors were identified. Existing scales align moderately with factors one and two, with the WHOQOL-BREF being the most promising. No subscales correlated with factor three. It is not clear if this is due to the lack of network information in the scales of choice (e.g. support, communication) or due to factor three variables determined using social network analysis. The next steps are to further investigate the validity of three factors and work towards establishing a preferred measure of social and emotional well-being for adults with hearing loss for clinical and research purposes.

16. Does the method matter? Quantitative and qualitative perspectives in the self-adjustment of hearing-aid gain. *Janin Benecke, William Whitmer*

In conventional hearing-aid personalisation, clinicians cannot hear how their patients hear, and patients often cannot reliably detect or describe what they hear. Letting individuals adjust frequency gain themselves could overcome these issues but requires self-adjustment methods to be effective, efficient and easy. To better understand self-adjustments, this mixed-methods study evaluates how the number of controls and the type of stimulus affect self-adjustment endpoints and satisfaction, as well as how individuals navigate their own adjustments. Methods: Current hearing-aid users (aged 61-81 years) with mild to moderate symmetrical sensorineural hearing loss were asked to repeatedly adjust the gain to their preference from an individual prescription (n = 41), and then to rate the adjusted sound. In a second session, the same participants (n = 36) were asked to verbalise their thoughts while adjusting to preference to obtain think-aloud protocols. Both tasks used three interfaces with 1, 2 and 3 user-controls representing different bass/mid/treble configurations (±18 dB per control) and three stimuli (music, speech, or speech-in-noise excerpts, 14-21 s). Stimulus playback was looped and presented at 65 dB ± adjustable gain via headphones. Participants additionally completed questionnaires about their hearing aids, locus of control, personality and views on technology. Results: Participants' self-adjustment endpoints (i.e. personalised gains) were generally reliable (median σ = 2.8 dB) and invariant across stimuli while showing variability in deviation from the initial prescription. Endpoints could be grouped into three patterns: increased bass relative to mid and/or treble, overall gain reduction, and settings close to the initial prescription. These groups also differed in how they rated adjustments depending on stimulus and interface type. None of the questionnaires were correlated with individual settings. Analysis of think-aloud protocols revealed a range of thoughts and behaviours that can be categorized into two archetypal mindsets: exploratory and anticipatory. The exploratory type first assesses control functions, then chooses the preferred setting from the available options, whereas the anticipatory type first evaluates the sound, then adjusts to address the identified issues relying on prior experience with controls. Conclusions: These findings suggest that while it can be difficult to predict individuals' behaviours, each individual may apply similar self-adjustment behaviours across stimuli and interfaces, driven by approaches identified in the think-aloud protocol. Identifying and

promoting these behaviours can provide more efficient and effective hearing-aid personalisation. [This work was supported by funding from the Medical Research Council [grant number MR/X003620/1]; and GN Hearing A/S]

18. Towards international priorities for hearing research. *Antje Heinrich, Christian Sumner, Robert MacKinnon, Frederick Gallun*

Hearing research is of wide relevance to health and society. However, it can be challenging to provide clear evidence of expert consensus about areas of priority within the field. It is our objective in this study to consult the international field of hearing researchers about what they think the priorities in hearing research should be for the next 5-10 years, and then publish these priorities. By creating such a resource, we hope to increase the competitiveness of hearing research projects seeking funding, and as a result increase the capacity of the field overall. This study uses both qualitative and quantitative methods. In a first step we generated a set of priorities from an open response questionnaire based on detailed replies from 66 international experts. These responses underwent thematic analysis, yielding 36 themes / priorities. Based on these priorities we created a priority ranking exercise for which we are currently seeking input from the entire international field of hearing research, junior and senior. The ranking questionnaire can be accessed here: https://tinyurl.com/hearingranking Results from the first qualitative stage and the thematic analysis used to elicit the 36 themes will be discussed. We will also provide an interim update of results of the ranking exercise. The present work represents the first comprehensive and wide-ranging effort to provide up-to-date and geographically diverse priorities across the field of hearing research. Their publication will form a useful resource for those seeking funding and in justifying the importance of hearing research, and its constituent fields over the coming years.

19. The UK National Eye Health and Hearing Study (UKNEHS). *Carolina Leal, Rupert Bourne, Adrian Davis, Michael Akeroyd, Jameel Muzzaffar*

The UK National Eye Health and Hearing Study (UKNEHS; uknehs.org.uk) has been developed to address the urgent/desperate need in the UK for high quality, up-to-date data on hearing loss and eye health as well as take-up of services and its variablility, so that the UK can plan future services in the most effective way, improve outcomes for those affected, and develop a more effective public health strategy in these crucial areas.
The UKNEHS is a nation-wide study encompassing all four nations. It focusses on four key objectives; Effectiveness, Efficiency, Economy and Compliance, with digital transformation opportunities at the heart of the study. More specifically, it will identify the prevalence of hearing loss and vision impairment (and their causes) in the UK population aged 50 and over, providing an up-to-date and comprehensive picture of the UK's eye and hearing health. The results of this work will feed into a wider programme of activities which will enable us to seriously consider the future screening for and prevention of eye disease and hearing loss in the UK. The UKNEHS will provide vital information, for health policy makers at national and local levels and those developing and commissioning health services. It will provide a baseline to support future impact assessment of novel eye health and hearing interventions, and service delivery models. This will help the government efficiently and effectively target spending for the delivery of services and ensure that vulnerable groups can access the services they need to continue to participate fully in society. Supported by a wide stakeholder group across government, public sector and professional organizations, the UKNEHS team has submitted a Case for Investment to the Secretary of State for Health and Social Care.