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PODIUM ABSTRACTS

PODIUM SESSION I: ELECTROPHYSIOLOGY

Evidence of Conditioning in Preventing Synaptopathy

Christopher Spankovich, PhD; Drew Morgan, BS; Nicholas Bosworth, BS; Douglas Vetter, PhD; Alberto Arteaga, MD; Georgio Proctor, BS, University of Mississippi Medical Center, Jackson, MS
Edward Lobarinas, PhD, University of Texas at Dallas, Dallas, TX

The common model for cochlear synaptopathy (CS) is a single noise exposure in a na√Øve animal with an octave band of noise (OBN) resulting in a robust temporary threshold shift (TTS) 24 hours post the exposure. Yet, the size and duration of the TTS is inconsistent with the human literature. To further understand the exposure necessary to generate CS we performed repeated noise exposures at 97 dB SPL (8-16 kHz OBN) for 2 hours on a daily basis in rats (n = 12) and measured DPOAE and ABR wave I amplitude pre and post exposure. The maximal mean TTS 24 hours after the first exposure was 16 dB (range 10-30 dB) at 20 kHz. Twenty-four hours after 3 additional exposures, the amount of TTS reduced to < 10 dB. Suprathreshold wave I amplitude showed an initial mean 25% reduction at 20 kHz and 47% reduction at 32 kHz, but recovered to baseline despite repeated exposures. The animals underwent an additional week of noise exposures and again demonstrated recovery. The findings suggest that non-synaptopathic noise does not demonstrate an acute cumulative effect. Rather, the physiological changes are suggestive of conditioning, where the system shows diminished susceptibility to change despite repeated exposures.

Auditory Evoked Potentials in Veterans with Noise Exposure

Naomi Bramhall, PhD; Sean Kampel, AuD; Curtis Billings, PhD, VA RR&D NCRAR, Portland, OR
Christopher Niemczak, AuD, Syracuse University, Department of Communication Sciences and Disorders, Syracuse, NY

In animal models, noise-induced cochlear synaptopathy is associated with reduced auditory brainstem response (ABR) wave 1 amplitudes. We have previously demonstrated decreased ABR wave I amplitudes among young people with high reported noise exposure history, suggesting that humans may also experience noise-induced synaptopathy. To investigate how noise-induced reductions in wave I amplitude impact the central auditory system, we measured the ABR, the middle latency response (MLR), and the cortical auditory evoked potential (CAEP) in young Veterans and non-Veterans (40+ participants) with normal audiograms and varying levels of noise exposure. In response to a click stimulus, low ABR wave I amplitude was associated with decreased MLR and CAEP area among participants without tinnitus. Reduced MLR and CAEP area among individuals with low wave I amplitudes suggests that subclinical peripheral deficits in auditory nerve input may be associated with impaired processing at higher levels of the auditory system. Participants with tinnitus showed a reduction in MLR area compared to those without tinnitus, but an increase in CAEP area. This suggests central compensation in response to decreased peripheral input among individuals with tinnitus, consistent with the central gain hypothesis.

Cortical Correlates of Hearing Aid Processing in Older Hearing-Impaired Listeners

Christopher Slugocki, PhD; Francis Kuk, PhD; Petri Korhonen, MS, Widex Office of Research in Clinical Amplification (ORCA-US), Lisle, IL

The morphologies of cortical auditory-evoked potentials (CAEPs) from aided hearing-impaired listeners are positively correlated with audibility (Van Dun et al., 2016) and negatively affected by noise (Jenkins et al., 2017). Here, we examined whether hearing aid features that improve the signal-to-noise ratio (SNR) for speech affected CAEPs in sample of 19 older adults with moderate hearing loss (8 F; mean age = 73.6 years). Speech stimuli were presented from the front with continuous speech-shaped noise presented from the back at 3 SNRs (0, 5, and 10 dB). Cortical responses were recorded with hearing aids set to either omnidirectional or directional microphone modes and, for each mode, with digital noise reduction either enabled or disabled. Our results showed that directional microphone processing resulted in significantly larger and earlier P1, N1, and P2 components compared to omnidirectional processing. Components evoked in the directional mode were also less affected by SNR than those evoked in the omnidirectional mode. Lastly, we observed a small but significant positive effect of noise reduction on the peak-to-peak amplitude of the N1-P2 complex. Together, these results suggest that the CAEPs of aided hearing-impaired listeners are sensitive to hearing aid processing that improves the SNR for speech sounds.

Newborn Autism Spectrum Disorder Screening using Auditory Brainstem Responses

Rafael E. Delgado, PhD, Intelligent Hearing Systems Corp & University of Miami, Department of Biomedical Engineering, Miami, FL
Oren Miron, MA; Isaac S. Kohane, PhD, Department of Biomedical Informatics, Harvard Medical School, Boston, MA
Christine Delgado, PhD; Elizabeth Simpson, PhD; Anibal Gutierrez, PhD, University of Miami, Department of Psychology, Coral Gables, FL

Autism Spectrum Disorder (ASD) is a neurological disorder characterized by impaired social interaction and communication, with an estimated prevalence of 1 in 59 and a median age of diagnosis of 4.1 years. Early detection and intervention is associated with improved outcomes and is encouraged by the American Academy of Pediatrics, Healthy People 2020, and other agencies. Recent studies have shown prolonged Auditory Brainstem Response (ABR) peak latencies in small groups of premature infants later diagnosed with ASD. In a preliminary study, we retrospectively examined 98,715 newborn hearing screening ABR recordings. Newborn hearing screening demographic information was linked to the Florida Department of Education Children's Registry and Information System database. 64 children were identified as later being diagnosed with ASD. The ABR peak V' latency was compared between the ASD group and the remaining newborns, which served as controls. The ASD group consisted of 83% males, while the control group had 50% males. Wave V' latency was significantly prolonged for children with ASD in the right ear ($t=2.821$, $p=.005$, $d=.35$) and marginally significantly prolonged in the left ear ($t=1.949$, $p=.051$, $d=.24$). Data from additional newborns and additional ABR measures will be presented. The incorporation of higher intensity, fast rate ABR recording into newborn hearing screening protocols would provide significant information as to an infant's neurological wellbeing and facilitate early detection and intervention for disorders such as ASD.

Predicting the Audibility of Speech Using Envelope Following Responses

Vijayalakshmi Easwar, PhD; Jen Birstler, MS, University of Wisconsin-Madison, Madison, WI
Adrienne Harrison, BS; Susan Scollie, PhD; David Purcell, PhD, Western University, London, Canada
Steven Aiken, PhD, Dalhousie University, Halifax, Canada

Speech-evoked envelope following responses (EFRs) have multiple advantages for use as an objective hearing aid outcome measure. However, its predictive accuracy in estimating audibility of speech is unknown. Our study aimed to: (i) evaluate the sensitivity and specificity of speech-evoked EFRs in predicting audibility of different phonemes, and (ii) quantify the lowest sensation level (SL) at which EFRs can be detected. In 22 young normal hearing adults, EFRs were elicited by a male-spoken token 'soosaashee' presented at 20 to 65 dB SPL in 15 dB increments. EFRs were elicited at low, mid and high frequencies by the first vowel formants (F1), higher vowel formants, and fricatives, respectively. Stimuli were audible in 560 of 672 EFR recordings. Using the Hotelling-T2 to assess EFR detectability, the sensitivity ('EFR detection rate for audible stimuli') ranged from 80.6% at low frequencies to 95.3% at high frequencies whereas the specificity ('EFR non-detection rate for inaudible stimuli) ranged between 70 and 71.4%. The lowest SL at which EFRs were detected ranged from as low as 2.46 dB for /s/ to as high as 22.5 dB for /a/ F1. Findings indicate good predictive accuracy of EFRs to estimate audibility, at least for mid and high frequency speech.

TT-ECochG-Morphology Analysis by the Nonlinear Approximation of the Gauss Function

Krzysztof F. Morawski, MD; Marcin Masalski, MD, Department Of Otolaryngology, Wroclaw Medical University, Wroclaw, Poland
Katarzyna Pierchala, MD; Kazimierz Niemczyk, MD, Department of Otolaryngology, Medical University of Warsaw, Warsaw, Poland
Rafael E. Delgado, PhD, Intelligent Hearing Systems, Miami, FL, Miami, FL

Objectives: To investigate auditory evoked responses from the promontory recorded at high stimulation rates and analyzed by a new mathematical model. Methods and Measures: Control ears (CEs) and Meniere disease ears (MDEs) were tested using an evaluation strategy of the auditory system involving a 'Continuous Loop Averaging Deconvolution' technique (CLAD). TT-ECochG was performed using clicks (85 dB nHL; rates range 7/s-780/s). Compound action potential (CAP) and summation potential (SP) were modeled using the sum of two Gaussian functions. The parameters of the model, which describe latency and amplitude of CAP and SP , were determined based on the Lenvenberg-Marquardt nonlinear optimization algorithm (LM_noa). Results: CAP and SP amplitude-latency values recorded in CLAD option analyzed by LM-noa revealed reduction of CAP amplitude with the subsequent SP/AP ratio change in comparison to traditional model of analysis. CAP and SP latencies, as well as SP amplitude were relatively stable. SP/AP ratio in LM-noa for MDEs, was found to differ when compared to traditional analysis. Conclusions: High stimulation rates provide a valuable tool for the adaptation processes assessment of the peripheral auditory system. LM-noa verifies traditional thinking about the diagnostic value of SP/AP ratio in evaluation of typical cochlear auditory pathologies.

PODIUM SESSION II: TINNITUS, TRANSFER FUNCTIONS AND TURSIOPS

Reproducible and Long-Term Efficacy of a New Treatment for Tinnitus

Hubert H. Lim, PhD, University of Minnesota, and Neuromod Devices Limited, Minneapolis, MN
Caroline Hamilton; Stephen Hughes; Emma Meade, Neuromod Devices Limited
Martin Schecklmann; Berthold Langguth, University of Regensburg
Thavakumar Subramaniam, St. James's Hospital/Trinity College Dublin
Sven Vanneste, The University of Texas at Dallas, Dallas, TX
Deborah Hall, University of Nottingham, and NIHR Nottingham BRC
Brendan Conlon, St. James's Hospital/Trinity College Dublin, and Neuromod Devices Limited

Tinnitus affects ~10-15% of the population. Unfortunately, there are limited treatment options. A new non-invasive neuromodulation device using auditory (sound) and trigeminal nerve (tongue) stimulation has been evaluated in more than 500 tinnitus patients across two randomized and blinded clinical trials. The first study explored the effects of three MBT stimulation settings (PS1, PS2, PS3) that were presented for 12 weeks (~30-60 minutes per day) and evaluated during treatment and up to 12 months post-treatment (326 enrolled patients). Pre-specified primary outcome measures included the Tinnitus Handicap Inventory (THI) and Tinnitus Functional Index (TFI). All three MBT settings resulted in statistically and clinically significant improvements in tinnitus during treatment. Post-treatment, PS1 resulted in long-term improvements lasting 12 months that clinically outperformed the other stimulation settings. The treatment was safe and well-tolerated with a high compliance rate (84%). Encouragingly, the greatest therapeutic effects were observed within the first 6 weeks of treatment, which was repeatable for PS1 in an ongoing second clinical trial in 191 patients. These two clinical trials represent one of the largest clinical trial datasets for tinnitus treatments, demonstrating safe, fast-acting (within 6 weeks) and reproducible therapeutic effects that can last at least 12 months with appropriate stimulation settings.

Auditory, Metabolic, and Neuropsychological Aspects of Blast-Induced Tinnitus in Humans

Anthony Thomas Cacace, PhD, Department of Communication Sciences & Disorders, Wayne State University, Detroit, MI
John Woodard, PhD, Department of Psychology, Wayne State University, Detroit, MI

We assessed relationships among perceptual and electroacoustic auditory tests, metabolites from left and right auditory cortical areas, neuropsychological test performance, and questionnaire data from adults with blast-induced tinnitus (20 males, 2 females; mean age: 50 years; range: 26-73 years). Audiological-perceptual data included pure-tone averages using the Monsell Index, 6 kHz pure-tone thresholds, monosyllabic word recognition in quiet and in noise, and a psychoacoustic measure of tinnitus loudness. Electroacoustic measures included broadband middle ear power reflectance and distortion product otoacoustic emissions. Metabolites from left and right auditory cortex used single voxel proton magnetic resonance spectroscopy (1H-MRS) which included: N-acetyl aspartate, choline, creatine, glutamate, and myo-inositol. Neuropsychological test performance was based on the automated neuropsychological assessment metric (ANAM) focusing on code-substitution throughput, code substitution reaction time, code-substitution reaction-time variability, and code substitution mathematical processing. Data from the Tinnitus Handicap Questionnaire (THQ) included total scores and two subscales. These composite data show significant relationships obtained from multiple variables encompassing the newly emerging field of perceptual, electroacoustic, and cognitive MRS. This unique framework opens a new area in auditory psychophysical, physiological, and neuropsychological research to better understand normal and abnormal information processing in humans, including tinnitus. Supported by Department-of-Defense Grant W81XWH-11-2-0031.

Sound Therapy App for Tinnitus Suppression in Cochlear Implant Patients
Ann Perreau, PhD, Augustana College, Rock Island, IL
Richard Tyler, PhD; Patricia Mancini, PhD; Rachael Owen, BA, University of Iowa, Iowa City, IA

Low-level background sounds from sound therapy Apps have been effective for suppressing tinnitus in cochlear implant (CI) patients. Sounds perceived as rain, music, and waves were most acceptable, though results varied considerably across patients. Here, 20 adult CI patients participated in a within-subjects design study to evaluate the effectiveness of sound therapy (a chosen sound) to a control condition (white noise) for tinnitus suppression using an App. At the initial visit, participants listened to five tinnitus sounds and selected one as their chosen sound. Participants listened to the chosen sound for two weeks and completed weekly ratings of tinnitus severity, loudness, and annoyance of tinnitus. Tinnitus suppression was compared to a control condition used for two weeks using white noise set at hearing threshold. Preliminary results revealed that ratings of tinnitus loudness (31%) and annoyance (19.8%) were reduced with the chosen sound compared to initial ratings (53 and 50.9%). The most acceptable sounds for tinnitus relief included rain and waterfall. Tinnitus loudness and annoyance ratings with the control condition (46.4 and 47%, respectively) were similar to initial ratings. No significant difference was found in speech perception (60.9%) with the chosen sound compared to their typical listening configuration (67.3%).

Wideband Acoustic Immittance Measures for Assessment of Otosclerotic Ears
W. Wiktor Jedrzejczak, PhD; Lech Sliwa, PhD; Krzysztof Kochanek, PhD; Henryk Skarzynski, PhD, Institute of Physiology and Pathology of Hearing, Warsaw, Poland

Wideband acoustic immittance (WAI) is one of emerging methods for assessment of middle ear characteristics. Commercial devices for WAI are available, which facilitates popularization of the method. Literature reports indicate usefulness of WAI for qualification to reconstructive surgery and assessment of surgery results, especially in otosclerosis. In the present study 60 otosclerotic patients were examined, among whom 30 underwent stapedotomy surgery. The control group consisted of 50 normal-hearing subjects. Before WAI tests, all subjects were subjected to comprehensive otologic and audiologic examination. Energy absorbance (EA) measurement was performed, along with other quantities, before and after surgery. Standard instrumentation (Interacoustics Titan) and typical measurement settings were applied. EA values show significant changes in otosclerotic ears compared with normal-hearing ones, as well as in the ear before and after stapedotomy surgery. A meaningful changes in EA value were observed especially in mid-frequency region, 500-1000 Hz. ROC analysis showed that the test based on averaged EA may have good effectiveness in distinguishing between normal ears and otosclerosis. WAI is an effective method for detecting middle ear disorders. It proves much more sensitive than standard low-frequency tympanometry. It may also be used for assessment of surgery results.

Modulation Transfer Function of the Human Efferent System
Srikanta Mishra, PhD; Milan Biswal, PhD; Samantha Zambrano, NM State University, Las Cruces, NM

Most natural sounds, including speech, exhibit temporal amplitude fluctuations. This information is encoded as amplitude modulations (AM)-essential for auditory and speech perception. The neural

representation of AM has been studied at various stages from the auditory nerve to the cortex of the ascending auditory system. In contrast, research on neural coding of AM in the efferent pathway has been patchy. The objective of this study was to systematically investigate the encoding of AM signals in the medial olivocochlear system, by measuring the modulation transfer functions of the efferent response in humans. The efferent response was quantified by measuring changes in stimulus frequency otoacoustic emissions due to various modulated and unmodulated elicitors. BBN elicitors yielded either slightly larger or similar efferent responses relative to AM elicitors depending on the modulation frequency. The efferent system encoding of AM sounds-modulation transfer functions-can be modeled with a Butterworth low-pass filter with an order 1 and different cut-off frequencies for ipsilateral and contralateral elicitors. The ipsilateral efferent pathway showed a greater sensitivity to AM information comparted to the contralateral pathway. Efferent modulation transfer functions suggest that the ability of the system to follow AM decreases with increasing modulation frequency and that efferents may not be fully operating on the envelope of the speech.

The Offset ABR in the Bottlenose Dolphin (Tursiops Truncatus)
Robert Burkard, PhD, University at Buffalo, Buffalo, NY
James Finneran, PhD, US Navy, San Diego, CA
Jason Mulsow, PhD; Ryan Jones, BS, National Marine Mammal Foundation, San Diego, CA

We investigated auditory brainstem response (ABR) offset responses in three normal hearing (NH) and three hearing impaired (HI) bottlenose dolphins (Tursiops truncatus). Electrodes were placed posterior to the blowhole (noninverting) and immediately posterior to the right meatus (inverting). The common was in the ocean near the dolphin. Scalp activity was amplified (X50,000) and filtered (100-3000 Hz; Grass ICP511) . Repetition rate was 16.7 Hz. During data acquisition, the animal positioned on a bite plate ~0.7 m below the water surface in front of a sound projector in a 9 x 9 meter netted enclosure floating in San Diego Bay. Each ABR was the averaged response to 512 stimuli; two ABRs were obtained for each stimulus condition. Stimuli included spectrally pink noisebursts (bandwidth: 20-160 kHz), and tonebursts (40-kHz; 113-kHz for the NH dolphins only). Stimulus level was manipulated (112-136 dB re 1 ŒºPa), as was stimulus risetime (cosine envelope: 0.032- 1 ms) and duration (4-32 ms). In the NH animals, the offset response was largest to the fast risetime 40-kHz tonebursts, with the other stimulus conditions showing smaller amplitude offset responses. The fast risetime 40-kHz offset response was much less prominent in HI than NH dolphins.

PODIUM SESSION III: COGNITION AND PSYCHOACOUSTICS

Real-time Sound Localization Degradation while Preserving Binaural Speech-in-Noise Benefits
Sterling Wilkinson Sheffield, PhD, University of Florida, Gainesville, FL
Douglas Brungart, PhD; Joshua Bernstein, PhD, Walter Reed National Military Medical Center, Bethesda, MD
Griffin Romigh, PhD, U.S. Air Force Research Laboratory, Wright Patterson Air Force Base, OH
Patrick Zurek, PhD, Sensimetrics Corporation, Woburn, MA

This study investigated the role that sound localization ability plays in assisting speech reception in complex listening conditions. A real-time localization-degradation (LocDeg) algorithm was developed to isolate sound localization effects from the speech-in-noise benefits that binaural hearing is known to provide. The algorithm mixed alternating frequency channels between ears to confuse the direction of

interaural cues, while leaving intact within-channel binaural-detection cues in half of the channels. Normal-hearing listeners performed sound localization and speech-reception with the LocDeg algorithm in auditory and audiovisual environments with videos rendered virtually on a head-mounted display. LocDeg was found to degrade sound-localization performance while not disrupting speech-reception performance or spatial release from masking of speech in noise. The algorithm did, however, degrade speech-reception performance in tasks that are thought to rely on accurate rendering of talker spatial location: speech perception in the presence of spatially separated interfering talkers, and audiovisual speech perception when the listener relies on localization to orient toward the target talker to benefit from visual cues. This wearable, real-time LocDeg algorithm could be a valuable tool for studying the role of sound localization for speech communication across a wide range of complex, real-world settings, from cocktail parties to military operations.

Relationship Between Self-Reported Spatial Hearing Ability and Hearing Handicap

Hua Ou, PhD, Wayne State University, Detroit, MI
Liuxia Tang, MD; Houyu Zhao, MD, Guizhou Medical University, China
Ann Perreau, PhD, Augustana College, Rock Island, IL

One of the most important aspects of hearing ability is spatial hearing. The purpose of the study was to investigate the relationship between self-reported spatial hearing ability and hearing handicap in a Chinese population. Both the screening versions of the Chinese Spatial Hearing Questionnaire (CSHQ-S), and the Chinese Hearing Handicap Inventory for the Elderly (CHHIE-S) were administered to 58 patients with hearing loss (age ranged from 60 to 98 years old). All participants were outpatients at the Otolaryngology Clinic of Guizhou Medical University. The severity of hearing loss ranged from mild to severe in either one or two ears and included sensorineural and/or mixed loss. The average CSHQ-S score was 61.4% (SD = 14.4%) and the average total score of the HHIE-S was 16.4 (SD = 7.4) for all participants. There was a significant negative correlation ($r = -0.49$, $p = 0.0001$) between self-reported spatial hearing ability and hearing handicap after partialing out the better ear four-frequency pure-tone average (4F-PTA). The results from a stepwise multiple regression analysis indicated that 40.6% of the variance in CHHIE-S can be explained by the CSHQ-S scores. This suggests that the poorer the spatial hearing ability, the more self-reported hearing handicap.

Size of the Auditory Scene

William A Yost, PhD; M. Torben Pastore, PhD, Arizona State University, Tempe, AZ

In a series of experiments we have shown that the size of an auditory scene is likely to be fairly small when speech sounds are presented at about the same time and are somewhat similar. In several different psychophysical paradigms, normal-hearing listeners have great difficulty discriminating, enumerating, identifying, and localizing more than about five similar speech sounds presented at about the same time. In most paradigms spatially separating the sources or changing the similarity among the sounds has a small, at most, effect on determining the size or relative size of an auditory scene. If an auditory scene is small then it may not be necessary for machines or virtual reality systems to process/render a large number of sound sources in an auditory scene in order to replicate human performance. On the other hand, if human performance is limited, then perhaps machine processing can improve upon human performance and provide ways to aid humans in processing auditory scenes with large number of sound sources. The results of several of these experiments will be described, along with possible consequences

for auditory scene analysis of multiple sound sources. (Research supported by NIH and Facebook Reality Labs).

Measuring Listening-Related Fatigue in Children: Validating the VFS-CHL

Benjamin W.Y. Hornsby, PhD; Hilary Davis, AuD; Stephen Camarata, PhD; Fred Bess, PhD, Vanderbilt University Medical Center, Nashville, TN

Research suggests children with hearing loss (CHL) are at increased risk for listening-related fatigue. However, measures to assess listening-related fatigue in CHL are lacking. This presentation describes the validation of a tool to fill this gap- the Vanderbilt Fatigue Scale for Children with Hearing loss (VFS-CHL). The VFS-CHL has child, parent and teacher versions. To develop the VFS-CHL we used information from interviews/focus groups to create a large pool of potential test items. Using best practices and an iterative process, including Factor analyses, Classical Test Theory and Item Response Theory (IRT), we reduced the number of items to 8-12, depending on the scale. Using these scales, responses from ~870 participants have been collected (~380 Parents; ~140 Children; ~350 Teachers). Factor analyses revealed a unidimensional structure for the Child and Teacher scales. The Parent scale was best fit as a two-factor model with physical and social-emotional-cognitive factors. IRT analyses confirmed all items were high quality (high information and discriminability). Additional analyses comparing results from the VFS-CHL, a generic fatigue scale, and a depression scale revealed good convergent and discriminant validity. Together, results suggest the VFS-CHL is a sensitive, reliable and valid tool for assessing listening-related fatigue in CHL.

Objective Measurement of Cognitive Systems During Effortful Listening

David Benjamin Ryan, PhD; Kim Schairer, PhD, Hearing and Balance Research Program James H. Quillen VAMC, Mountain Home, TN
Eric Sellers, PhD, East Tennessee State University, Johnson City, TN
Mark Eckert, PhD, Medical University of South Carolina, Charleston, SC
Sherri Smith, PhD, Div. of Head & Neck Surgery and Communication Sciences, Duke University, Durham, NC

Adults with hearing loss who report difficulty understanding speech with and without hearing aids often also report increased mental or listening effort. Although speech recognition measures are well known and have been in use for decades, measures of listening effort are relatively new and include objective measures such as working memory tasks, pupillometry, heart rate, skin conductance, and brain imaging. The purpose of this study is to evaluate an electroencephalogram (EEG)-based method to assess cognitive states associated with high frequency alpha (11-13 Hz), low frequency alpha (8-10 Hz), and theta (4-7 Hz) during a speech in noise perception task at seven different signal-to-noise ratios. Changes in high frequency alpha have been associated with cognitive demands and low frequency alpha has been associated with cognitive inhibition. Changes in theta have been associated with encoding information and increased listening effort. Correlations between EEG frequency recordings, self-report, and behavioral measures in a speech recognition task will be described. Results will be presented demonstrating the extent to which high frequency alpha, low frequency alpha, and theta explain the neurological underpinnings of word recognition performance in noise and self-reported listening effort in those with and without hearing loss.

Factors Influencing Reaction Time in Speech-in-Noise Testing
Dougas S Brungart, PhD; Matthew Makashay, PhD; Benjamin Sheffield, MS, Walter Reed NMMC, Bethesda, MD
Hector Galloza, BS, 2GaRi

Although reaction time is commonly used as an outcome measure in research studies addressing listening effort and the role of cognitive processing in speech perception, response times are rarely recorded during traditional clinical tests of speech-in-noise performance. As part of its effort to develop more efficient tests for assessing hearing performance, the Audiology and Speech Pathology Center at Walter Reed has collected closed-set speech-in-noise data on many thousands of Service Members. Here we analyze the results of those tests, in particular those from the Modified Rhyme Test, to identify factors that influence the response time measured in speech-in-noise testing. Preliminary results show a systematic age effect across subjects, and systematic effects of specific token difficulty, including those associated with SNR, within subjects. There are also some response patterns, such as unusually fast response times, that appear to be associated with invalid responses. It is hoped that a better understanding of the factors that modulate response times in audiometric testing will make it possible to use response time data to extract additional clinically-useful information from an audiological assessment without increasing the time burden on the patient or provider.

PODIUM SESSION IV: COCHLEAR IMPLANTS AND HEARING AIDS

Examining the Roots of CI Users' Difficulties with Vocal Control
Justin Aronoff, PhD; Abbigail Kirchner, BS, University of Illinois at Urbana-Champaign, Champaign, IL
Kevin Shi, BS; Elise Lippmann, MD; Jeffrey Yu, MD, University of Illinois at Chicago, Chicago, IL

Cochlear implant (CI) users can have considerable difficulty with vocal control, a critical ability for tasks such as expressing emotion and differentiating questions and statements. Vocal control in normal hearing listeners relies on the ability to monitor and correct ones ongoing vocalizations. Previous research indicates that CI users have considerable difficulties accurately perceiving changes in pitch. This would suggest that CI users' difficulty with vocal control may reflect their difficulties with hearing changes in pitch. To determine if that is the case, 15 CI users completed three tasks. In the first task, participants completed a musical contour identification task. In the second task, vocal control was measured by analyzing the variability in the pitch of participants' voice when producing a sustained vowel. In the third task, participants sung "Happy Birthday" and vocal control was measured by analyzing the accuracy of the sung contour. The results indicated that increased accuracy when identifying musical contours was correlated with increased vocal control. This suggests that CI users' difficulty with vocal control reflects, in part, their difficulties with accurate pitch perception.

Spectral Processing and Language Development in NH and CI Children
Susan Nittrouer, PhD; Joanna Lowenstein, PhD; Donal Sinex, PhD, University of Florida, Gainesville, FL

In spite of tremendous benefits derived from cochlear implants (CIs), deaf children continue to lag behind children with normal hearing (NH) in language development. Deficits are especially large for language processes dependent upon phonological structure, and for speech-in-noise recognition. Morphosyntactic and lexical processes are closer to typical. We have hypothesized that the extreme phonological and the

speech-in-noise problems of children with CIs arise from poor spectral processing. Accordingly, we measured spectral modulation detection (SMD) thresholds and correlated them with scores on morphosyntactic, lexical, and phonological skills, as well as speech-in-noise recognition. Participants were14-year-olds with NH (49) or CIs (42). Children with CIs had only slightly higher SMD thresholds than those with NH, but much poorer phonological sensitivity and speech-in-noise recognition. SMD thresholds were correlated with different skills for children with NH and CIs. For children with CIs, even though SMD thresholds were related to their abilities to recover phonological structure from the speech signal, that structure was not used in other language processes, as it is for children with NH. These outcomes reveal that children with CIs are not simply delayed in language development, but process linguistic signals qualitatively differently from children with NH. Intervention programs must address this distinction.

Incorporating Electrode Angular Insertion Depth in Electric-Acoustic Stimulation Programming
Margaret Dillon, AuD; Brendan O'Connell, MD; Michael Canfarotta, MD; Meredith Rooth, AuD; Emily Buss, PhD, University of North Carolina at Chapel Hill, Chapel Hill, NC

Patients who listen with electric-acoustic stimulation (EAS) demonstrate improved speech perception as compared to a cochlear implant (CI) alone condition, likely due to better resolution of low-frequency cues provided acoustically. However, EAS users' speech perception may be limited by discrepancies between the pitch-to-place association of acoustic transduction and electric stimulation. The discrepancies are driven, in part, by the frequency filter assignments for individual electrodes, which currently do not consider the place of stimulation. Electrode array angular insertion depth (AID) varies across CI recipients, and is dependent upon the cochlear anatomy, electrode array design, and surgical approach. An algorithm using computed tomography scans can estimate the AID and calculate the associated place frequency for each electrode. Adjusting the electric frequency filter assignments to include the associated place frequency may improve the pitch-to-place association, resulting in better speech perception with an EAS device. Speech perception was compared between two programming approaches: the default filter assignment and a place-based method. The place-based method determined the frequency filter assignments for the two most apical electrodes based on the imaging findings. EAS user's performance was assessed after acute listening experience. Participants demonstrated a trend for better speech perception with the place-based method than the default.

Use of Electrocochleography to Determine Electrode Location in the Cochlea
Aniket Saoji, PhD; Colin L W Driscoll, MD, Mayo Clinic at Rochester, Rochester, MN
Scott Shapiro, MD; Adam Cassis, MD, West Virginia University, Morgantown, WV
Kanthaiah Koka, PhD, Advanced Bionics

Using electrocochleography (ECOG), a cochlear implant electrode array can be used to measure electrical activity generated by different acoustic stimuli at various locations along the basilar membrane. Maximum ECOG amplitude is recorded at an electrode closest to the site of peak excitation on the basilar membrane and is used to determine the location of that electrode across the cochlear space. In this study, ECOG was used to determine electrode location in cochlear implant patients with significant residual hearing. A 50 millisecond acoustic tone burst with two alternating phases was varied in frequency and intensity over the patient’s audible frequency range to generate ECOG. ECOG waveforms were recorded using 16 intra-cochlear electrodes in separate conditions. An extra-cochlear ring

electrode was used as the return electrode. ECOG waveforms were analyzed by computing the difference response for the two alternating polarity stimuli to estimate cochlear microphonics (CM). Analysis of data shows (1) changes in acoustic stimulus frequency correspond to changes in location of the CM maxima across the electrode array and (2) CM amplitude is directly proportional to the presentation of the acoustic stimulus. These results indicate that intra-cochlear ECOG can be used to determine cochlear implant electrode location across the cochlear space.

Validation of the Speech Quality Instrument for Cochlear Implant Users

Michael B. Chun, BS; Tiffany Peng, MD; Lisa Tian, BA; Dean Mancuso, AuD; Ilana Cellum, AuD; Anil Lalwani, MD, Columbia University Medical Center, New York, NY
Stephanie Chen, MD, Washington University School of Medicine in St. Louis, St. Louis, MO

Objectives: Speech recognition among cochlear implant(CI) users has improved drastically in recent years due to improvements in technology and surgical techniques. Nonetheless, many CI users report poor quality of speech. Here, we validate the first tool to measure speech quality for CI users. Methods: The Speech Quality Instrument(SQI), previously validated in normal-hearing individuals and consisting 2 original and 7 manipulated speech clips accentuating selected speech characteristics, was presented in-person or online to adult English-speaking CI recipients >6 months after CI implantation(N=44). Each clip was rated using a visual analog scale(VAS) on 14 characteristics: Cartoonish/not-cartoonish, clear/unclear, like/dislike, breathy/not-breathy, smooth/rough, echo-y/not-echo-y, tinny/bassy, soothing/not-soothing, natural/unnatural, mechanical/not-mechanical, hoarse/smooth, pleasant/unpleasant, male/female, and speech-like/not-speech-like. Results: Content validity was confirmed during instrument design. Construct validity by item-item correlation analysis demonstrated correlation of 12/14 items with 1 other item(r0.35, Spearman). Reliability was confirmed by internal consistency; factor analysis using two subsets selected by Scree plot and factor loading 0.4 demonstrated Cronbach's alpha of 0.89 and 0.74 for factors 1 and 2, respectively. Tinny/bassy and male/female did not pass construct validity or internal consistency. Conclusions: The SQI is the first validated tool to measure speech quality following cochlear implantation and can be used to compare outcomes among electrodes, devices, and speech processing strategies.

Mitigating the Effect of Noise in Cochlear Implant Simulation

Frederic Apoux, PhD; Victoria Sevich; Eric Healy, PhD, The Ohio State University, Columbus, OH

A common complaint of even the most successful cochlear implant (CI) users is that intelligibility deteriorates rapidly with increasing levels of background noise. One of the most common approaches for improving speech recognition in noise involves suppressing the background. Noise-reduction techniques can significantly improve performance. However, noise reduction can also deprive CI users of awareness of their surroundings and it make it difficult for the user to select the desired signal from the mixture. Here, a technique is introduced that selectively removes a limited subset of time-frequency (T-F) units that appear to be the most detrimental to intelligibility, based on their signal-to-noise (SNR) ratio. Contrary to current understanding, we previously showed that units with approximately equal target and noise energy (i.e., 0 dB SNR) were the most detrimental. Accordingly, we evaluate a speech-processing strategy that primarily seeks to enhance sound-source segregation and concomitantly improve intelligibility by removing only those detrimental units. The intelligibility of vocoded sentences in a competing-speech background obtained with this new strategy is compared (i) to that observed without

any processing and (ii) to that observed using a noise-reduction approach which suppresses all the T-F units corresponding to the noise (e.g., < 0 dB SNR).

Hearing-aid Output and a Zone of Acceptable Listening
Arthur Boothroyd, PhD; Carol Mackersie, PhD, San Diego State University, San Diego, CA

The goal was to determine, in listeners with hearing loss, a 'zone of acceptable listening' within an area defined by self-selected amplitude and spectral slope. While listening to speech in quiet, seventeen adults adjusted amplitude and spectrum to preference, using the authors' Goldilocks protocol. They did this twice for each of three variants of the protocol, to provide six real-ear values of self-selected amplitude and spectral slope (the latter from 750 to 3000 Hz). Group-means were not significantly different from NAL-NL2 prescription. There was considerable variability, however, both between and within individuals. Roughly half of the sample adjusted to values that differed significantly ($p <= .05$) from prescription in amplitude or slope. Within-individual amplitudes ranged over ¬±1 to ¬±15 dB with a mean of ¬±7. Within-individual self-selected slopes ranged over ¬±1 to ¬±6 dB/octave with a mean of ¬±4. There was a significant correlation between amplitude and slope, across and within listeners. These data support the concept of a zone of acceptable listening but indicate substantial individual differences in its size, and in its location relative to prescription. These differences could well affect an individual's experience with amplification and may need to be considered during hearing-aid fitting.

What Does the Envelope Difference Index (EDI) Measure?
James M. Kates, University of Colorado, Boulder, CO

The envelope difference index (EDI) quantifies the difference between the envelopes of two signals. When applied to hearing aids, the EDI has often been interpreted as indicating the amount of nonlinear envelope distortion introduced by the processing. However, the envelope at the output of the hearing aid is modified by the linear as well as the nonlinear processing occurring in the device. For example, providing linear amplification to compensate for a high-frequency hearing loss will increase the contribution of the high frequencies relative to that of the low frequencies in the overall signal and will change the envelope. The EDI is therefore increased by any linear frequency-dependent gain in the hearing aid and not just by the nonlinear distortion. This presentation will demonstrate how the EDI is affected by both linear and nonlinear signal processing. For measuring nonlinear distortion in a hearing aid, modifications to the EDI are proposed and compared to other metrics that have been specifically designed to determine the amount of nonlinear distortion in a hearing-aid processing system.

PODIUM SESSION V: ADVANCES IN AUDITORY TESTS

FreeHear: A New Hearing Test for Children
David Moore, PhD, University of Manchester, Manchester, UK
Helen Whiston, MS; Melanie Lough, MS; Antonia Marsden, PhD; Iain Bruce, MD; Kevin Munro, PhD; Maichael Stone, PhD, Manchester Centre for Audiology and Deafness, UK

Pure tone threshold audiometry is currently the standard test of hearing. However, in everyday life we are more concerned with listening to speech of moderate loudness and, specifically, listening to a

particular talker against a background of other talkers. FreeHear delivers strings of digits (0-9) against a background babble via 3 loudspeakers placed in front and to either side of a listener in any quiet room. It is designed as a rapid quantitative initial assessment of hearing, using an adaptive algorithm. FreeHear is designed for children and for testing listeners using hearing devices. To date we have tested 100 children (4-12 y.o) and 24 adults (18-30 y.o.) with normal audiograms. Speech reception threshold (SRT) on both the co-located digits/noise and the 90o separated stimuli improved linearly across 4-12 y.o., with a further 2 dB improvement for the adults. The spatial release advantage at 90o remaining constant at about 6 dB across all ages. SRT test-retest reliability was good for adults (mean ~1dB), but poorer for children, with little evidence of a practice effect in either group. Children showed increased variability after 20-30 trials and in the 90o configuration. FreeHear shows promise as a clinical test.

Virtual Reality Assessment of Auditory Performance

G. Christopher Stecker, PhD, Vanderbilt University School of Medicine, Nashville, TN

Emerging technologies in virtual, augmented, and mixed reality (VR/AR/MR) present exciting new opportunities to study perception in the lab and clinic. In particular, assessment of auditory performance in simulated but realistic multisensory settings can bring the real world into the lab. Together with colleagues at various institutions, our work has developed VR-based approaches to evaluate listening in complex reverberant, multi-talker scenes, to examine the real-world benefits of task-irrelevant multisensory input, and to test the impacts of adaptive signal processing in hearing aids and related devices. This presentation will review examples of that work, introduce Multisensory Identification, Segregation, and Localization (MISL) tasks that approximate real-world communication goals in complex scenes, and describe A-SPACE, a client-server architecture we have used to control VR-based interactions directly from existing laboratory workflows (e.g. MATLAB). [Work supported in part by NIH R41-DC16578, R01-DC016643, T35-DC008763, Vanderbilt University Medical Center, GN Resound, Visisonics Corp., and Auditory Space, LLC]

Audiovisual Speech Enhancement in School-Age Hard-of-Hearing Children

Kaylah Lalonde, PhD; Ryan McCreery, PhD, Boys Town National Research Hospital, Omaha, NE

Visual speech can improve perception of acoustically degraded speech via multiple mechanisms, including reducing uncertainty as to when to listen, supplementing masked phonetic information, and reducing informational masking. This study examined whether hearing loss impacts school-age children's ability to use each of these mechanisms. Forty-seven 6- to 12-year-old children (17 with sensorineural hearing loss) completed auditory-only and audiovisual syllable detection and sentence recognition tasks in a two-talker masker and a speech-spectrum noise. Hearing status did not affect audiovisual enhancement of speech detection, suggesting that hearing loss did not influence children’s ability to use visual speech to reduce uncertainty as to when to listen. Conversely, hard-of-hearing children demonstrated greater audiovisual enhancement of sentence recognition than their typically-hearing peers, suggesting that they were better at using visual speech to supplement masked phonetic information. Audiovisual enhancement was greater in the presence of the two-talker masker than the speech-spectrum noise, suggesting that children used visual speech to reduce informational masking. However, this effect was independent of hearing status, indicating that hearing loss did not influence children's ability to use visual speech to reduce informational masking. Additional data will be presented,

relating audiovisual enhancement to age, vocabulary, working memory, and attention. [Supported by NIDCD-R01DC013591, NIGMS-P30DC004662]

Visual Speech Recognition Program (VSRP) Improves Speech Perception in Noise
Arun Manakal Raghavan, BS, University of Cincinnati College of Medicine, Cincinnati, OH
Gavriel Kohlberg, MD; Noga Lipschitz, MD; Joseph Breen, MD; Rai Samy, MD, University of Cincinnati, Department of Otoloaryngology, Cincinnati, OH

Ten Normal Hearing (NH) participants were situated in a sound-isolated audio booth facing a speaker through a window. In non-VSRP conditions, speech perception was evaluated on 40 Bamford-Kowal-Bench Speech-in-Noise test (BKB-SIN) sentences presented by the speaker at 50dBA with varying degrees of background noise. In VSRP conditions, a video/infrared camera was used to track 35 points around the speaker's lips during speech in real-time. Lip movement data was processed through a neural-network based VSRP, which was developed to identify BKB-SIN sentences. Speech perception was evaluated in the same way as in the non-VSRP condition on 42 BKB-SIN sentences, with the addition of visually displayed output from the VSRP on a screen in front of the listener. Participants achieved 97.0% word recognition accuracy in low-noise (noise <70dBA) and 39.4% in high-noise (noise 70dBA) in the non-VSRP conditions. With the VSRP, accuracies were 99.8% in low-noise and 75.8% in high-noise. In high-noise, the VSRP led to a 36.4 ¬± 3.8% (¬±SE, $p < 0.0001$) increase in accuracy. A statistically significant increase in speech perception was observed with use of real-time VSRP for NH listeners. Further evaluation is needed to demonstrate the functionality of this system for patients with hearing loss.

Multi-site Validation of CEDRA, Consumer-based Screening Questionnaire for Ear Disease
Niall A.M. Klyn, PhD; James Griffith; Sumitrajit Dhar, Northwestern Universty, Evanston, IL
Samantha Kleindienst Robler, Norton Sound Health Corporation
Razan AlFakir; Larry Lundy; David Zapala, Mayo Clinic Florida, FL
Donald Nielsen, Don Nielsen Consulting, LLC
Deborah Carlsen, University of Texas Medical Branch - Galveston, TX
Jamie Bogle, Mayo Clinic Arizona, AZ

Most individuals seeking hearing amplification have age- or noise-related hearing loss, but some have an underlying disease with otologic symptoms that may go undetected without professional intervention. Recognizing this, we created a consumer-based questionnaire, Consumer Ear Disease Risk Assessment (CEDRA), to allow patients to quickly and easily self-screen for rare ear diseases. Here we present results from our CEDRA large population validation study (NIDCD R33DC013115). Audiology patients aged 40 years and older with a new hearing-related complaint (< 3 years since their last evaluation) were offered participation at Mayo Clinic Florida, Mayo Clinic Arizona, University of Texas Medical Branch ‚Äì Galveston, Northwestern University, and three private practice clinics in Illinois and Florida. Participants (n = 591) completed CEDRA before their initial consultation with an audiologist. Participants were subsequently evaluated by an otolaryngologist to determine if the observed hearing loss was likely age- or noise-related, and whether they would clear the participant for hearing aid use. We present validation results comparing CEDRA scores with the otolaryngologist's decisions. Our validated CEDRA could provide the safety net missing in the new hearing healthcare landscape, where consumers will seek interventions without professional input.

The Prevalence of Hearing Loss Accessed by Mobile-based app: Countries Related Differences
Marcin Masalski, PhD; Krzysztof Morawski, PhD, Wroclaw Medical University, Faculty of Postgraduate Medical Training, Department and Clinic of Otolaryngology Head and Neck Surgery, Wroclaw, Poland

Exposure to hearing loss risk factors varies worldwide. The differences in hearing threshold may be easily evaluated on a global scale and at a low cost by means of mobile-based hearing app.
The objective of the study was to compare the prevalence of hearing loss among mobile app users across various countries. The research was conducted by means of Android-based app Hearing Test, offered free of charge by Google Play Store. It was carried out on mobile phones, for which the application contains predefined calibration coefficients determined by the biological method for bundled headphones. The study included over 500 000 tests carried out in 200 countries. User age was introduced for 25 000 tests. Time restrictions for the test were determined by the analysis of the hearing threshold variance, disregarding the examinations whose duration was below the 60th centile. Finally, 6000 examinations were qualified for further analysis, after excluding the second and the following examinations conducted on one device for the same age. The examination results turned out to be convergent with literature data. Significant statistical differences were identified in the prevalence of hearing loss across countries in the lack of significant statistical differences relating to the device model.

Speech in Noise Abilities in Patients with Acoustic Neuromas
Matthew Blair Fitzgerald, PhD; Noor Ali, MD; Z. Jason Qian, MD; Steven Gianakas; Yona Vaisbuch, MD, Stanford University, Palo Alto, CA

Audiologic assessment is crucial in managing patients with auditory pathology. In the routine audiogram, word-recognition in quiet (WRQ) has been the default test of speech perception for decades, despite having little relationship with real-world communication abilities. In contrast, the primary complaint of most patients with hearing loss is difficulty understanding speech in noise (SIN). Such complaints have led to increasing awareness that audiologic assessment should include SIN measures. Recent work from our lab indicates that SIN abilities can largely predict categories of WRQ scores. Here we explore whether SIN can better predict the presence of an acoustic neuroma than WRQ scores; this is crucial for the widespread adoption of SIN measures, as between-ear differences in WRQ scores have been used as a flag for potential retrocochlear pathology. Results from over 150 patients with unilateral acoustic neuromas indicate that WRQ scores differ between ears in approximately 50% of patients. In contrast, 75% of patients have SIN scores that differ between ears. These results further suggest that SIN can replace WRQ in the audiologic test battery. Making this subtle, but fundamental shift is likely to have both research and clinical implications, allowing for better diagnosis and management of individuals with hearing loss.

Impact of Talker Familiarity and Aging in a Real-world Environment
Julie Cohen, AuD; Sandra Gordon-Salant, PhD, University of Maryland, College Park, MD, College Park, MD
Douglas Brungart, PhD, Walter Reed National Military Medical Center, Bethesda, MD

Previous studies have shown that speech intelligibility performance improves when the talker's voice is familiar to the listener due to prior auditory training or previous exposure to that talker in their daily

lives (as would be the case with a friend or spouse). One potential limitation of previous studies of voice familiarity is that they were conducted in laboratory environments, which may not capture the dynamic strategies that familiar talkers and listeners might be able to adopt to better understand one another in noisy environments. These studies also have not explored whether talker familiarity benefits might extend to tasks involving auditory working memory. This study evaluates talker familiarity benefit younger and older adult couples during a dynamic speech understanding task, conducted with talkers and listeners seated at a table at a local restaurant. The stimuli were novel hybrid sentences composed of a call sign and two CVC words. After four consecutive trials, all listeners were prompted to report the call signs from the previous trials. Preliminary data suggest that both older and younger adults have a familiarity benefit on the speech intelligibility test, but that performance on the working memory task was not modulated by familiarity.

PODIUM SESSION VI: HEARING ACROSS THE POPULATION

Healthcare Access Among Hearing-Impaired Older Adults: Results Using MEPS Database

Hua Ou, PhD; Mark Luborsky, PhD; Jinping Xu, MD, Wayne State University, Detroit, MI
Chuan-Ming Li, PhD; Howard Hoffman, MS, NIH/NIDCD, Bethesda, MD

There is a pressing need to improve access to affordable hearing healthcare. However, first we must evaluate the status of access to healthcare before planning interventions. The purpose of this study is to determine the characteristics of access to usual source of care among older adults (> 65 years) with self-reported mild-to-moderate hearing loss, as defined by affirmative responses to 'some difficulty hearing, can hear most things people say' or 'some difficulty hearing, cannot hear most things people say, can hear some things people say.' We have pooled data from the Medical Expenditure Panel Survey (MEPS) Household Component (2002-2011). We will describe the characteristics of access to healthcare for all 5,623 eligible respondents. Preliminary results from the multivariate logistic regression (all p values < 0.05) revealed that individuals who were older age (odds ratio [OR]=1.1), non-Hispanic (OR=1.3), married (OR=1.5), self-perceived good health (OR=1.2), and able to drive to providers (OR=1.3) were more likely to use hearing aids whereas Black (OR=0.5, versus White) were less likely to report the use of hearing aids. Racial/ethnic disparities in hearing healthcare need to be addressed. The satisfaction with the healthcare providers will be discussed for different racial/ethnic groups.

Insights from Conducting Research with VA Clinical Databases

Graham Naylor, PhD; Oliver Zobay, PhD, University of Nottingham, School of Medicine, Nottingham & Glasgow, UK
John Cannon, BA; Patrick Feeney, PhD, VA RR&D NCRAR, Portland, OR
Lauren Dillard, AuD, University of Wisconsin-Madison, Madison, WI
Gabrielle Saunders, PhD, VA RR&D NCRAR/Eriksholm Research Centre, Denmark

Analyses of longitudinal data originating from electronic health records (EHRs) can dramatically influence our understanding of health conditions and interventions. This is particularly important in audiology, because outcomes are impacted by multiple factors. In this presentation we will provide an overview of such a project and insights gained from working with data collected for clinical rather than research purposes. The data originate from EHR systems used by the US Department of Veterans Affairs (VA). Audiological records were collected for all individuals with procedural codes indicating a hearing

aid fitting appointment between April 2012 and October 2014. In addition, for these 731,209 patients, demographic, diagnostic and procedural codes were extracted for the period 2007-2017. Records thus include: patient demographics, audiometric test results, hearing aid information (style, uni/bilateral, previous experience), hearing aid outcome measure responses, hearing aid battery orders, and codes for specific non-audiological diagnoses and interventions. In the first of two presentations, we describe the structure of the data, how we chose and computed a proxy measure of long term hearing aid usage from battery order data, and report on the complexities, advantages, drawbacks and the enormous potential of using clinical EHR data for research purposes in audiology.

Preliminary Hearing-Related Findings from Analyses of Clinical VA Data

Gabrielle Helena Saunders, PhD, VA RR&D NCRAR/Eriksholm Research Centre, Snekkersten, Denmark
Lauren Dillard, AuD, University of Wisconsin-Madison, Madison, WI
John Cannon, BA; Patrick Feeney, PhD, VA RR&D NCRAR, Portland, OR
Oliver Zobay, PhD; Graham Naylor, PhD, University of Nottingham, School of Medicine, Nottingham & Glasgow, UK

As described in our previous abstract (Naylor et al. Doing research with system-wide clinical data from VA Audiology) analyses of longitudinal data originating from electronic health records (EHRs) can provide unique insights and yield novel findings that are not typically available from datasets collected from epidemiological studies. In this second presentation, we present an overview of a project in which data were extracted from EHR systems used by the US Department of Veterans Affairs (VA) for all individuals with procedural codes indicating a hearing aid fitting appointment between April 2012 and October 2014. In addition, data about non-audiological diagnoses and interventions were extracted for the period 2007-2017. In this report we describe summary statistical characteristics of the sample, and preliminary analyses of some first-order relations between variables, including those of hearing aid usage over time and age, PTA, experience, comorbidities, and health burden. These investigations provide grounds for assessing the validity of each data dimension, and thus any relationships observed. They also illustrate the huge potential of using clinical EHR data for research purposes in audiology.

BEAR - A Large Scale Effort to Improve Clinical Practice

Nikolai Bisgaard, MS, GN Hearing, Ballerup, Denmark

A large scale study on clinical practices and hearing aid fitting has been started in Denmark in 2016 with aim of achieving better precision in fitting and creating new improved clinical guidelines. This $ 7.5 mill. program is a joint effort by 3 Universities, 3 Danish University Hospitals, 3 Danish hearing aid manufactures and the Danish certification laboratory. The program has three phases. The first phase has three focus areas: Acquisition of 2000 patients as a reference set using current clinical practices, development of improved outcome assessment and patient profiling and new signal processing strategies adapted to the more detailed profiling. Phase two centers on validation of the new strategies, studies on subpopulations with low benefit and development of a new efficient clinical strategy. Phase three includes studies on patient driven diagnostics and fitting and revising standards for clinical practice. The presentation will give an overview of the program as well as some of the first results.

Prospective Study of Dietary Intake and Auditory Threshold Decline

Sharon G Curhan, MD, Channing Division of Network Medicine, Brigham and Women's Hospital, Harvard Medical School, Boston, MA
Christopher Halpin, PhD, Massachusetts General Hospital, Boston, MA
Molin Wang, PhD; Gary Curhan, MD, Channing Division of Network Medicine, Brigham and Women's Hospital, Harvard TH Chan School of Public Health, Boston, MA
Roland Eavey, MD, Vanderbilt Bill Wilkerson Center for Otolaryngology and Communication Sciences, Vanderbilt University School of Medicine, Nashville, TN

Background: Adherence to healthy diets was associated with lower risk of self-reported hearing loss, but associations with auditory threshold decline have not been prospectively studied. METHODS: We conducted a longitudinal study among 3,749 US women (mean age 57y). Diet adherence scores to the Dietary Approaches to Stop Hypertension Diet (DASH) and Alternate Mediterranean diet (AMED) were calculated using food-frequency questionnaires. Baseline and 3-year follow-up hearing sensitivities (0.5-8 kHz) were assessed by pure tone audiometry in sound booths. Cox proportional hazards regression models examined independent associations between diet score and auditory threshold decline. RESULTS: Among women with baseline PTA(3,4 kHz) (n=2,469) or PTA(6,8 kHz) (n=1,576) ,â§25 dBHL, 917 and 775, respectively, demonstrated ,â•5 dB decline in either ear over 3 years. Higher diet scores were associated with lower risk of threshold decline. Comparing those in the highest quintile of DASH score with the lowest, the multivariable-adjusted relative risk (MVRR(95%CI)) of decline in PTA(3,4) was 0.75 (0.57,0.98) and in PTA(6,8) was 0.74 (0.53,1.03). For AMED, the MVRR of decline in PTA(3,4) was 0.77(0.59,1.00) and PTA(6,8) was 0.78(0.56,1.09). No association between diet and PTA(0.5,1,2) decline was observed. CONCLUSION: Eating a healthy diet may be helpful in reducing the risk of acquired hearing loss.

Hearing Aid Use Among Hispanic/Latino Adults in the US

Michelle Arnold, PhD, University of South Florida Sarasota-Manatee, College of Science and Mathematics, Sarasota, FL
Kathryn Hyer, PhD; Brent Small, PhD; Cathy McEvoy, PhD, University of South Florida, School of Aging Studies, Tampa, FL
Theresa Chisolm, PhD, University of South Florida, Dept. of Communication Sciences & Disorders, Tampa, FL
Gabrielle Saunders, PhD, Eriksholm Research Centre, Denmark
David Lee, PhD, University of Miami Health System
Sumitrajit Dhar, PhD, Northwestern University, Evanston, IL
Kathleen Bainbridge, PhD, NIDCD, Bethesda, MD

We sought to describe hearing aid prevalence, facilitators, and barriers associated with use among US Hispanic/Latino adults. We analyzed data collected from 2008-2011 as part of the Hispanic Community Health Study/Study of Latinos. Included participants were hearing-impaired adults aged 45-76 from Hispanic/Latino backgrounds including Central American, Cuban, Dominican, Mexican, Puerto-Rican, South American, and Mixed/Other. We conducted weighted multivariate survey logistic analyses to examine the role of age, sex, objective and subjective hearing loss, socioeconomic indicators, and acculturation on self-reported hearing aid use. Of 1898 hearing impaired individuals, 87 (4.6%) reported hearing aid use. Increased odds of self-reported use was associated with poorer measured hearing (OR=1.06, 95% CI - 1.03 to 1.06), higher Hearing Handicap Inventory-Screening scores (OR=1.06, 95% CI -1.03 to 1.06), health insurance coverage (OR=2.30, 95% CI - 1.20 to 4.37), and state of residence (OR=2.42, 95% CI - 1.17 to 5.02) in an adjusted model. Our findings pointed to a stark underutilization of

hearing aids among adults from Hispanic/Latino backgrounds. The primary barrier to use was lack of health insurance (i.e., access, and not culture, characterized use). Changes to policy and clinical service provision are needed to increase hearing aid access among aging Hispanic/Latino adults in the US.

Auditory Lifestyle Differences between Urban and Rural Areas

Erik Jorgen Jorgensen, AuD; Yu-Hsiang Wu, MD, PhD, University of Iowa, Iowa City, IA
Jingjing Xu, PhD, Starkey Hearing Technologies, Eden Prairie, MN
Jeff Crukley, PhD, Starkey Hearing Technologies, Mississauga, Ontario, Canada

Auditory lifestyle affects hearing aid preferences and benefit. Little is known, however, about how demographic factors affect auditory lifestyle. The purpose of this study was to determine the effect of geographic location (urban vs. rural) on auditory lifestyle. Fourteen younger adults with normal hearing (YNH) and 18 older adults with hearing impairment (OHI) were recruited at San Francisco bay area, CA (urban) and Iowa City area, IA (rural). Auditory lifestyle was characterized using a smartphone and hearing aid system that collected (1) real-time hearing aid parameters (e.g., sound levels and auditory scene classification) and (2) in-situ self-reports that described the environment (e.g., noisiness). Auditory lifestyle was also assessed using the Auditory Lifestyle and Demand (ALDQ) questionnaire. Real-time hearing aid information showed that although YNH in the urban group encountered higher sound level environments than the rural group, sound levels did not vary between rural and urban groups for OHI. Urban OHI encountered a higher number of auditory scenes than the other groups. In-situ self-reports indicated that the rural groups reported lower noisiness levels than urban groups. Finally, ALDQ scores were not different among the groups. These findings provide insight into the connections between demographics, auditory lifestyle, and hearing aid benefit.

Hearing Loss is Associated with Depressive Symptoms in Older Adults

Aishwarya Shukla, BA, Johns Hopkins School of Medicine, Baltimore, MD
Nicole Armstrong, PhD, National Institute of Aging, Baltimore, MD
Nicholas Reed, AuD; Frank Lin, MD, Department of Otolaryngology, Johns Hopkins School of Medicine, Baltimore, MD
Adele Goman, PhD, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD

OBJECTIVES: To investigate the cross-sectional association between hearing loss, hearing aid use and depressive symptoms among older adults in the Atherosclerosis Risk in Communities Study. METHODS: Hearing status was categorized using Pure Tone Average in the better hearing ear as normal (<25 decibels of hearing level, [dB HL]), mild hearing loss (25 to 40 dB HL), and moderate/severe hearing loss (40 dB HL). A score of 9 on the 11-item Center for Epidemiologic Studies Depression Scale was considered 'positive' for depressive symptomology. Hearing aid use was obtained using self-report. Covariates included age, sex, race, education, BMI, smoking status, hypertension, diabetes, heart disease, and stroke. Logistic regression models were used for statistical analysis. RESULTS: The mean age of our study population (n=3220) was 79 (SD= 4.6) years. 4.4% had depressive symptoms. 33.5% had normal hearing; 36.9% had mild hearing loss; and 26.9% had moderate/severe hearing loss. Hearing loss was associated with higher odds of depressive symptoms after controlling for all covariates (mild hearing loss Odds Ratio, [OR] 2.09, 95% Confidence interval, [CI] 1.33-3.27; p-value=0.001; moderate/ severe hearing loss OR 2.78, 95% CI 1.68-4.62, p-value <0.001). Among those with hearing loss, hearing aid use was not associated with reduced depressive symptoms.