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POSTER ABSTRACTS

Topic areas and poster numbers:

ANATOMY and PHYSIOLOGY

Poster # 1

L-Serine Reduces ROS Yield in Cisplatin Treated Zebrafish Utricles
Elvin Irihamye; Satya Moolani, Western Kentucky University, Lexington, KY

Cisplatin is a chemotherapy compound effective against a variety of cancers. However, it can act as an ototoxin and cause hearing loss by promoting reactive oxygen species (ROS) production in auditory tissues. The antioxidant amino acid, L-serine has been hypothesized to lower levels of cisplatin-mediated ROS. In this project, we investigated whether L-serine can reduce cisplatin-mediated ROS production in auditory tissue and potentially act as an otoprotectant during cisplatin chemotherapy. We used a zebrafish utricular tissue culture system and fluorescent ROS indicator dye to spectro-photometrically measure if L-serine could decrease reactive oxygen species levels in cisplatin-treated tissues. We found that cisplatin treatment increased ROS yield in the utricular tissue while L-serine treatment alone did not alter ROS levels. Interestingly, we also found that equimolar L-serine treatment with cisplatin restored ROS to control levels. These results could be due to L-serine acting as an ROS scavenger. However, it is possible that L-serine could chemically inactivate cisplatin in these tissues. Future experiments are needed to see if L-serine can act as an otoprotectant in auditory tissue without mitigating the effects of cisplatin in cancer cells.

Poster # 2

The Accuracy of Automated Cortical Parcellation/Labeling for Human Auditory Cortex
Barrett Victor St George, BA; Bryan Wong, BS; Frank Musiek, PhD, University of Arizona, Tucson, AZ

Previous research has shown that human auditory cortex exhibits pronounced structural variability. Yet it is unclear how automated parcellation/labeling procedures handle such complex macroanatomical variances in this brain region. This study assesses the accuracy of a widely-used automated cortical parcellation/labeling procedure compared to expert manual surface area measures for planum temporale (PT). Additionally, the effects of surrounding auditory cortex morphology on PT surface area and its impact on structural hemispheric asymmetry is examined with respect to both measurement techniques. High-resolution structural MRI brain scans of 50 healthy, right-handed young adults were processed through an automated cortical reconstruction. Automated surface area measures of PT and surrounding auditory cortex structures were based on the Destrieux (2010) cortical parcellation atlas. Cortical surface area of PT, Heschl's gyrus (HG) and planum parietale (PP) were then measured manually in all same 100 hemispheres: state-of-the-art neuroimaging software was used to define virtual clipping planes that exposed PT, HG and PP for subsequent surface area measurements. A significant difference in cortical surface area and hemispheric asymmetry between manually- and automatically-defined labels of 'PT' was found. Examples and discussion of major issues in the automated process which leads to inaccurate anatomical localization of PT are provided and discussed.

Poster # 3

Impact of Spontaneous Otoacoustic Emissions (SOAE) on Audiometric Thresholds
Glenis Raewyn Long, PhD, Graduate Center of the City University of New York, New York, NY
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Otoacoustic Emissions which can be detected even when no external sounds are presented are called Spontaneous Otoacoustic Emissions (SOAE). The auditory system is relatively sensitive near SOAE frequencies, resulting in local threshold minima. Internal noise in the cochlear amplifier is thought to be responsible for the known variability of SOAE amplitude and Phase. Potentially, this internal noise also

determines tone-detection thresholds. This was investigated in a tone-detection experiment, where the ability to detect a tone was compared to the behavior of SOAEs in presence of the tones. Near threshold tones can capture the emission making it oscillate at the same frequency as the external tones, maintaining a stable relative phase. Investigation of the phase of SOAE during stimulation by near-threshold tones suggests that under these circumstances, the internal noise in cochlear amplification potentially plays minimal role in limiting the ability to detect a weak near-threshold tone.

Poster # 4

WITHDRAWN

Poster # 5

Use of Stimulus-Onset Jitter to Cancel Short-Latency SSOAE Energy
James Douglas Lewis, PhD; Amy Mashburn, BS, University of Tennessee Health Science Center, Knoxville, TN

Synchronized-spontaneous otoacoustic emissions (SSOAEs) are slow-decaying OAEs that persist up to several-hundred milliseconds post-stimulus. If the inter-stimulus interval is sufficiently short, SSOAEs may contaminate the stimulus window of the adjacent epoch. In medial-olivocochlear reflex (MOCR) assays, SSOAE contamination will present as a change in the stimulus between quiet and noise conditions, since SSOAEs are sensitive to MOCR activation. Traditionally, a change in the stimulus between MOCR conditions implicates acoustic reflex activation by the noise; however, this interpretation is potentially confounded by SSOAEs. This study examined the utility of jittering stimulus onset to desynchronize and cancel short-latency SSOAE energy. Transient-evoked (TE) OAEs were measured from 12 subjects in contralateral-quiet and -noise conditions. Clicks were presented at fixed and quasi-random intervals (by introducing up to 0.5-ms of jitter). For the fixed-interval condition, spectral differences in the stimulus window between quiet and noise conditions mirrored those in the SSOAE analysis window, consistent with SSOAE contamination. In contrast, spectral differences stemming from SSOAEs were absent in the stimulus window for the quasi-random-interval condition. Temporal jitter also facilitated identification of the TEOAE and improved estimates of TEOAE latency. MOCR, TEOAE and wideband immittance applications are all expected to benefit from stimulus-onset jitter.

Poster # 6

Reflections and Reflectance of Non-Uniform Ear Canals
Kren Rahbek Norgaard, MS, Technical University of Denmark, Kgs. Lyngby, Denmark
Christopher Shera, PhD; Karolina Charaziak, PhD, University of Southern California, Los Angeles, CA

The ear-canal reflectance is useful for quantifying the conductive status of the middle ear because it can be measured at a distance from the tympanic membrane. Deriving the reflectance requires decomposing the total pressure into its incident and reflected components, which is usually achieved from the measured ear-canal impedance using the characteristic impedance. The characteristic impedance characterizes the ratio of sound pressure to volume flow of a propagating wave in a uniform waveguide, however, in non-uniform waveguides, the impedance of a propagating wave is complex and depends on

the direction of propagation. These wave impedances are generally required to decompose the pressure into its incident and reflected components. The ear canal is inherently non-uniform and it may be necessary to employ such wave impedances to characterize the reflectance at the position of a non-uniformity in the ear canal. This presentation will discuss the concept of what one considers a reflection and investigate mechanisms that generate reflections in non-uniform waveguides. The physical properties of the analytical wave impedance of various types of horns will be discussed, and their applicability will be investigated in characterizing the ear-canal reflectance in a simulated non-uniform acoustic load similar to the human ear canal.

Poster # 7

Effects of Tonic Muscle Activation on Amplitude-Modulated Cervical VEMPs (AMcVEMPs)
Andrew Philip Thorne, BA; Christopher Clinard, PhD; Erin Piker, PhD, James Madison University, Harrisonburg, VA

The purposes of this study were 1) to characterize the effects of tonic electromyogram (EMG) activation on AMcVEMPs, 2) to compare interaural asymmetry ratios across AMcVEMP analysis methods, and 3) to characterize nonlinear response properties of AMcVEMPs. Young adults (ages 21-24) with no known vestibular lesions or middle ear pathologies participated in this study. Stimuli were 500 Hz tones amplitude modulated at 37 Hz. Five EMG conditions were tested: 0, 30, 50, 70, and 90 uV. AMcVEMPs were analyzed using FFT-based analyses which included amplitude, SNR, and phase coherence. As expected, AMcVEMP amplitude increased linearly as EMG level increased. However, from the 30 uV to the 90 uV EMG targets, SNR and phase coherence plateaued, or were constant (SNR: average = 12.47 dB, std. error = 0.54 dB; phase coherence: average = 0.82, std. error = 0.35). Robust phase locking was reflected in period histograms and high phase coherence values. Interaural asymmetry ratios for SNR and phase coherence were significantly lower and less variable than for amplitude measures. Harmonic distortion products were also detected at harmonics of the modulation frequency, consistent with known saccular nonlinearities. Additional analyses and clinical implications will be discussed.

AUDIOLOGY / OTOLOGY

Poster # 8

Heterogeneous Solution Strategies Following Pre-Synaptic Cell Death
O'neil Winston Guthrie, PhD, Northern Arizona University, Flagstaff, AZ

A fundamental paradigm in neuroscience is that sensory end-organs receive and ultimately transmit information to the brain. Therefore, damage to a given end-organ results in the loss of post-synaptic transmission. Although, this basic paradigm is well established, it is not consistently supported and no universally accepted theoretical framework has emerged to explain the inconsistency. In the current series of experiments, genetically identical subjects were exposed to a traumatic noise dose in order to damage pre-synaptic cells within the auditory end-organ. Morphological and physiological examination of the resulting damage profiles revealed expected and unexpected results. Among some subjects post-synaptic function decreased as the severity of pre-synaptic cell death increased. However, the data also showed that subjects with similar levels of pre-synaptic cell death exhibited post-synaptic functions that

ranged from normal to severe impairment. Furthermore, there were subjects who evidenced normal post-synaptic function with severe levels of pre-synaptic cell death. The combined results are reminiscent of a heterogeneous solution strategy, where the surviving pre-synaptic elements within each end-organ have established independent solution strategies to the task of post-synaptic sensory transmission. This framework could provide a novel basis for understanding why individuals with similar lesions exhibit disparate functional deficits.

Poster # 9

Noise Exposure Not Predicted by Suprathreshold Measures of Hearing

Aryn Michelle Kamerer, PhD; Sara Fultz, AuD; Judy Kopun, AuD; Carissa Allen, BA; Stephen Neely; Daniel Rasetshwane, PhD, Boystown National Research Hospital, Omaha, NE

Animal models of noise exposure (NE) suggest damage to the cochlea can result in hearing deficits despite normal auditory thresholds. In the present study, NE history was compared to a number of physiologic and behavioral measures of auditory function, including auditory brainstem responses, otoacoustic emissions, thresholds in noise, frequency-modulation detection threshold, and word recognition. Participants were categorized into two groups based on whether or not they had ever been exposed to impulse noise (e.g. gunshot). Participants also completed the lifetime exposure to noise and solvents questionnaire (LENS-Q). Physiologic and behavioral measures of hearing were predictors in a logistic regression model for impulse NE category and a multiple regression model for LENS-Q score. Hearing measures were regressed with pure-tone thresholds and the resulting residuals acted a proxy for suprathreshold deficit (i.e. the portion of that hearing measure that could not be explained by threshold). Pure-tone thresholds at 4 kHz were positively related to LENS-Q score, and sex was predictive of both impulse NE and LENS-Q score. Despite these observations, impulse NE and LENS-Q score were not predicted from physiologic or behavioral measures. The results do not support the hypothesis that NE is the primary etiology of suprathreshold deficits in humans.

Poster # 10

A Non-Linguistic Test for Audiology Clinics

David Landsberger, PhD; Natalia Stupak, AuD, New York University School of Medicine, New York, NY
Justin Aronoff, PhD, University of Illinois at Urbana-Champaign, Champaign, IL

Many clinics are faced with the difficulty of evaluating performance in patients who speak a language for which there are no validated tests. It would be desirable to have a non-linguistic method of evaluating these patients. Spectral ripple tests are non-linguistic and highly correlated with speech performance. However, they are generally not amenable to the clinical environment as they typically require the use of computers, which are often not found in clinic soundbooths. In this study, we evaluated the SMRT Lite for computeRless Measurement (SLRM), which is a new variant of the adaptive Spectral-temporally Modulated Ripple Test (SMRT). Unlike SMRT, SLRM can be implemented via a CD-player. SMRT and SLRM were measured for 10 normal hearing and 10 cochlear implant participants. The two tests were highly correlated (r=0.96). The results suggest that SLRM can be used interchangeably with SMRT but can be implemented without a computer, providing a tool for clinics with a linguistically-diverse patient population.

Poster # 11

The Effects of the Carrier Phrase on Word-Recognition Performances by Younger and Older Listeners using Two Stimulus Paradigms

Victoria Ann Sanchez, PhD, Department of Otolaryngology - Head and Neck Surgery within the Morsani College of Medicine at the University of South Florida, Tampa, FL
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Monitored-live voice word-recognition testing required the use of carrier phrase in conjunction with the vu meter to present words at similar levels. With readily available recorded materials that no longer require real-time VU monitoring the carrier phrase is no longer needed, however, most recorded materials still include the carrier phrase. Recordings of NU-6 by two female speakers (VA-1 and VA-2) were used to compare word-recognition performances with and without the carrier phrase when the carrier phrase and test word were (1) in the same utterance stream with the words excised from the carrier (VA-1), and (2) independent of one another (VA-2). A quasi-experimental, repeated-measures design was completed with 24 young normal hearing (YNL) adults (YNL; M = 23.5 yrs) and 48 Older adults with hearing loss (OHI; M = 71.4 yrs) Each listener had four listening conditions (2 speakers by 2 carrier phrase conditions) with multiple presentation levels of 50 different words randomized to each speaker. Mean recognition performances for both VA-1 and VA-2 stimuli were better at lower presentation levels with the carrier phrase than without the carrier phrase for both groups of listeners; however, not at higher presentation levels. Although the mean results were clear, the variability in performance differences between the two carrier phrase conditions for the individual subjects and for the individual words was striking and is considered in detail. The current data indicate that word-recognition testing at the higher presentation levels produces equal performances with and without the carrier phrase. The preference would be to use words not appended to a carrier phrase. Audiologists need to be aware that there are individuals who perform better when the carrier phrase is used.

Poster # 12

Speech Perception Testing with Reversed Speech

Roselynn Rachel Schroeder, BS; Aparna Rao, PhD; Bryce Altus, BS; Robert Margolis, PhD, Arizona State University, Tempe, AZ

Purpose: To obtain performance-intensity functions with a closed-test word-recognition task using female and male voices in forward and reversed modes. Problem: Speech perception involves processes from spectro-temporal analysis to lexical representation (see Poeppel et al. 2007). When speech is reversed, the spectro- temporal features are preserved and the linguistic content is removed. We hypothesized that participants with hearing loss would perform worse with reversed speech due to loss of high-frequency information for spectro-temporal analysis. Methods: Fourteen normal hearing adults and fourteen adults with sensorineural hearing loss participated. Word-recognition testing was completed with forward then reversed words at various sensation levels (SLs) above pure-tone average using a forced-choice paradigm. Results: We did not find a main effect of mode of speech. An interaction was found speech mode √ó level ($p < .01$) and speech mode √ó gender ($p < .05$). Performance with

forward speech was more difficult at low SLs. Performance was better with female talker in the reversed mode, whereas it was comparable for male talkers in the two modes. Conclusion: In a closed-set task, word recognition with forward speech was difficult at low SLs possibly due to the lexical processing load associated with the task.

Poster # 13

Prevalence of Amikacin Ototoxicity and Associated Factors

Jennifer Chisholm, BA; Galya Levinson; Kelly King, PhD; Chris Zalewski, PhD; Talah Wafa, AuD; H. Jeff Kim, MD; Carmen Brewer, PhD, National Institute on Deafness and Other Communication Disorders, Bethesda, MD
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Andrea Beri, BS, NIH Clinical Center, Bethesda, MD

Amikacin is an aminoglycoside antibiotic known to be cochleotoxic. Permanent hearing loss may occur secondary to sensory cell damage, typically beginning in the basal turn of the cochlea. This study explores the prevalence of amikacin-associated ototoxicity in a large cohort of patients, and investigates the influence of sex, route of drug delivery (IV vs inhaled), previous amikacin exposure, and pre-existing hearing loss. Audiometric data on 156 patients (95 females) aged 3-81 years (M:40.8, SD:22) who were treated with inhaled or intravenous amikacin were reviewed to determine the amount of threshold shift from initial to final audiogram. Ototoxicity, defined by ASHA criteria, was observed in 50.6% of the study cohort. There was no statistically significant difference in the amount of hearing change between those with and without previous amikacin exposure ($p>0.05$). There were no statistically significant differences in prevalence or severity of ototoxic hearing loss between men and women ($p>0.05$). Our data show that comparison of post-treatment pure tone thresholds to sex and age-related norms in the absence of a baseline audiogram may lead to incorrect assumptions regarding ototoxicity. Baseline audiograms paired with regular monitoring should be a routine part of care in all patients receiving IV or inhaled amikacin.

Poster # 14

Incorporation of Multimarker Approach Including Molecular Genetics into Otologic and Audiologic Assessments for Young Adults

Razan Alfakir, MD; Greta Stamper, PhD; David Zapala, PhD; Haytham Helmi, MD; Samuel Antwi, PhD, Mayo Clinic, Jacksonville, FL

Currently, hearing healthcare delivery was built, and generally remains centered, on the treatment of single ear disease and disorder. Multi-morbidity and molecular genetics is a rapidly expanding field and both have become an emergent perspective in many health sectors including hearing healthcare delivery for ear resulting more recently in a call to move towards an integrated approach that considers multi-markers including molecular genetics. We believe that with the integrated approach, it will be possible to identify alterations in pathways involved in ear disease and disorder, rather than focus on a single marker-related to ear. In this study consisted of 434 patients who visited the hearing healthcare delivery at the Mayo Clinic during 2017 and have access to the Mayo Clinic BioBank, we have the opportunity to characterize a relationship between ear disease and disorder of and multi-markers induced by multi-morbidity as well as the Biobank collected data that includes the questionnaire data for the 434 subjects

and a whole genomic sequencing data for 2 subjects. A basic understanding of the importance of the multi-markers and genomic in patients with ear disease and disorder is believed to be crucial to the practicing Otologists/audiologists.

Poster # 15

Blood Pressure Level, Hearing Sensitivity, and Distortion Product Otoacoustic Emissions
Amy Sanders, BA; Katherine Lemons; Rachael Baiduc, PhD, University of Colorado Boulder, Boulder, CO

Cardiovascular disease (CVD) and hearing loss are two prevalent chronic conditions. Published reports are mixed regarding the association between hypertension and hearing loss. Reduced cochlear blood flow in hypertension may result in poorer hearing sensitivity and lower distortion product otoacoustic emission (DPOAE) amplitudes. Recruitment for this study is ongoing. Men and women between 18-55 years were enrolled (n=36; 51% female). Behavioral thresholds from 0.25-16 kHz were collected and DPOAEs obtained for f2 from 0.5-19.0 kHz (L1/L2=65/55 dB SPL). Participants were categorized by blood pressure level: (1) < 120/80; (2) 120-139 or 80-89; (3) 140-159 or 90-99; (4) >=160 or 100 mm Hg or medication use. Linear mixed models were used to model hearing thresholds and DPOAEs; e.g., DPOAE amplitude as the outcome variable and fixed (age, sex, blood pressure category, and f2) and random predictors (subject). Preliminary data do not support an association between blood pressure category and threshold (œá2 = 1.38; p=0.71) or DPOAE level (œá2 = 1.58; p=0.455). However, participants in this study were generally in good health with mean blood pressure of 120.8/71.3 (SD=17.2/13.0) mm Hg. A larger dataset with a wider range of blood pressure levels will be used to confirm or refute these preliminary findings.

Poster # 16

Clinical Application of OAE Suppression: A Pilot Study
Jackie Marie Davie, PhD; Katharine Fitzharris, PhD, Nova Southeastern University, Fort Lauderdale, FL

Suppression of OAEs is reported to be sensitive to assessing the efferent auditory system function. However, clinical application has been limited due to the need for additional equipment. A clinically-feasible DPOAE suppression protocol was developed using standard clinical equipment. OAEs were measured at 12-points (1.5-8kHz) using the Interacoustics Titan and Madsen Astera. The responses were analyzed to determine test-retest reliability. To control for probe placement changes, the OAE probe and insert earphone were placed in the respective ears during the duration of the procedure within an audiometric sound booth. A 60dBHL white noise was presented to the contralateral ear for contralateral noise runs. Eight runs of DPOAEs were completed in order: a) right DPOAE, b) right DPOAE with contralateral noise, c) repeat a&b; d) left DPOAE, e) left DPOAE with contralateral noise, f) repeat d&e. Currently, 12 adults and 13 children have been evaluated. Initial analysis of results indicates good test-retest reliability for the quiet and noise runs, respectively, suggesting good stability of the probe placement and response measurements. Further, measurable suppression was primarily in the lower frequencies (1-3kHz), similar to previous research. Results suggest that this protocol can be used clinically due to good reliability using standard clinical equipment.

Poster # 17

Audiologic Findings in People with Diabetes

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Jessica Staples, BS, University of Utah, Sandy, UT

Using various methods, numerous studies have suggested an association between diabetes and hearing loss. We reviewed the literature specifically to determine how many studies performed any audiologic measures, to report the most and least commonly used audiologic measures, and to describe the findings of these measures in people with and without diabetes. We performed PubMed searches using the keywords: diabetes and hearing loss, and diabetes and speech perception. We selected articles if the titles included our keywords or related variants such as metabolic disorder, hearing impairment, otoacoustic emissions, etc. PubMed searches yielded 1799 studies, and about 6% (102 studies) included at least one audiologic measure in people with and without diabetes. Pure tone audiometry was the most commonly used, followed by auditory brainstem responses and otoacoustic emissions. About 80% of studies using these hearing-sensitivity-related measures found statistically significant differences between people with and without diabetes. Although speech perception tests used the rarest (5 out of 102), most found significant differences. We will discuss results further regarding statistical significance and clinical importance of hearing-sensitivity-related audiologic findings. We will also discuss the need for further studies especially using speech-in-noise tests to better estimate our diabetic patients' hearing difficulties in everyday listening situations.

AUDITORY PROCESSING

Poster # 18

Caregiver and Self-report of Listening Difficulties in Children

Audrey J. Perdew, BS; Lisa Hunter, PhD; Nathan Clevenger, BS; David Moore, PhD, CCHMC, Cincinnati, OH
Nicholette Sloat, MA, University of Michigan, Ypsilanti, MI

About 5-10% of children referred to audiology services have listening difficulties (LiD), but normal hearing, as measured by standard clinical tests. Moore and colleagues (IJA, 2013) proposed that a well-designed, validated, standardized questionnaire could support assessment, management and understanding of children with LiD. Thus, the Evaluation of Children's Listening and Processing Skills (ECLiPS; Barry et al., E&H 2015) was developed in the UK. In this US study, caregivers of 68 children with LiD and 80 typically developing (TD) children completed US versions of the ECLiPS and the CCC-2 questionnaire (Bishop, Pearson, 2006). LiD participants scored significantly lower on the ECLiPS ($t(146) = 21.66$, $p < 0.001$) as well as the CCC-2 ($t(143) = 15.41$, $p < 0.001$). Total response scores on the two questionnaires were strongly correlated ($r(143) = 0.776$, $p < 0.001$). Some of the older participants (16 LiD, 16 TD) completed a self-report version of the ECLiPS. There was a strong correlation between parent- and self-report ECLiPS scores ($r(30) = 0.501$, $p = 0.003$). The data support convergent validity and inter-rater reliability for the US version of the ECLiPS.

Poster # 19

Role of Efferents in Supra-Threshold Sound Encoding: Evidence from Computational Modeling
Milan Biswal, PhD; Srikanta Mishra, PhD, New Mexico State University, Las Cruces, NM

Supra-threshold hearing is essential for everyday communication. New evidence suggests that noise-induced efferent degeneration could cause supra-threshold deficits (Boero et al., 2018). A converging, strong proposition is that the medial efferent feedback acts as a sophisticated control mechanism that can maintain and accentuate cross-channel differences in the low-frequency neural fluctuation amplitudes for encoding complex sounds, such as speech, at supra-threshold levels (Carney, 2018). Using a well-established phenomenological auditory efferent-inspired model, we compared auditory nerve firing rates with and without efferent feedback for speech signal detection in noise. Efferent feedback increased the peak-to-valley contrast of the auditory nerve firing rate histograms (spikes/s). Our results indicate that efferent feedback influences the auditory nerve activity depending on the fiber type (low/medium and high spontaneous rate fibers) and the signal-to-noise ratio. These findings support for a role of medial efferents in perception of speech-in-noise at conversational levels.

Poster # 20

Sensory Cortical Connectivity in Children with Listening Difficulties and ADHD
Hannah J. Stewart, PhD; Erin Cash; Jennifer Vannest, PhD; David R. Moore, PhD, Cincinnati Children's Hospital Medical Center, Cincinnati, OH

Children who experience listening difficulties (LiD) are often diagnosed with other developmental disorders, prompting debate on whether LiD are part of the ADHD symptomology or are separate. This study used resting state MRI to investigate the functional connectivity (FC) of different modality networks. Meta-analysis and data-driven parcellation identified three brain networks supporting speech perception, non-speech hearing, and vision. We compared four groups: 27 ADHD children; 21 children with ADHD and (parent-reported) LiD; 21 children with LiD but no reported ADHD; and 41 typically developing (TD) children. All children had normal pure tone audiometry. TD children showed strong temporal correlations within the speech-perception and non-speech hearing networks. The LiD groups showed a similar non-speech hearing network, but anticorrelations within the speech-perception network. The two LiD groups with and without ADHD diagnoses did not differ from one another. Children with ADHD showed similar but weaker correlations within the speech-perception network compared to TD children, but anticorrelations within the non-speech hearing network. No group differences were found in the vision network FC. These results suggest that LiD and ADHD have distinct brain signatures with cortical areas working at opposing rates in the LiD speech-perception network and the ADHD non-speech hearing network.

Poster # 21

Medial Olivocochlear Reflex in Children with Listening Difficulties
Lisa L. Hunter, PhD; Chelsea Blankenship, AuD; Audrey Perdew, BS; David Moore, PhD, Cincinnati Children's Hospital Medical Center, Cincinnati, OH
Linda Hood, PhD, Vanderbilt University, Nashville, TN

In a longitudinal study, we are exploring the role of peripheral and efferent auditory function on Listening Difficulties (LiD) in children. One mechanism that may underlie LiD or auditory processing disorder, is differences in efferent function that regulate cochlear processing of competing noise. All participants had normal audiometric thresholds (‚â§ 20dBHL; 0.25-8kHz). Children with LiD (N=34, 6-14 yrs), identified from parent report (ECLiPS, Barry et al. E&H, 2016), and typically developing (TD) children (N=35, 6-14 yrs) were assessed for Medial Olivocochlear Reflex (MOCR) strength using transient-evoked otoacoustic emissions (TEOAEs) in quiet and with a binaural noise suppressor in a forward masking paradigm (Berlin et al., 1995 Hear Res) using the Intelligent Hearing Systems paired two-channel TEOAE module. Wideband acoustic reflex input-output functions were measured to exclude middle-ear muscle reflex influence. TEOAE signal-to-noise ratios (SNR) in quiet did not differ significantly between the LiD and TD groups. There was approximately a 6-dB binaural MOCR effect for both groups in both ears. The TD group had slightly greater right ear MOCR, compared to the LiD group, but the difference was not significant due to high variability in both groups. Thus, MOCR reflex activation does not explain listening difficulties in this sample.

Poster # 22

Cortical Auditory Evoked Potentials in Children with Listening Disorders

Olivia Hacker, Villanova University, Villanova, PA
Tammy Riegner, AuD; Jessica Loson, AuD; Kyoko Nagao, PhD; Thierry Morlet, PhD, Nemours/Alfred I. duPont Hospital for Children, Wilmington, DE

Cortical auditory evoked potentials (CAEPs) are a promising tool in helping differentiate between true auditory processing difficulties and other developmental disorders in children with listening complaints. Moreover, the effects of background noise on neural encoding at the cortical level are thought to correlate with behavioral abilities in challenging listening environment. In the present study, we examined the characteristics of CAEPs recorded following the delivery of the stimulus /da/ in quiet and in ipsilateral, contralateral, and binaural noise conditions in children with listening disorders. One hundred sixty-six children, aged from 5 to 16 years with normal audiometric thresholds were included. Results from multidisciplinary tests including psychological, speech-language, ADHD and auditory processing disorder evaluations were assessed. CAEP latencies were found to be significantly longer and of higher amplitudes than in typically developing children in the quiet condition. N2 latencies were found to correlate with several behavioral measures. In those with the longest latencies in quiet, the introduction of background noise suggested a limitation of their available resources to process sounds in noise as the variation in latencies were limited compared to normal children. These findings suggest that CAEPs can help reveal neural deficiencies in a subgroup of children with listening disorders.

Poster # 23

Evaluating Right Ear Advantage using Dichotic Vowel-evoked Envelope Following Responses

Regan Flaherty; Sriram Boothalingam, PhD; Vijayalakshmi Easwar, PhD, University of Wisconson-Madison, Madison, WI

Auditory information from the right ear is processed preferentially by the brain in dichotic listening conditions. Behavioral evidence for this right ear advantage (REA) has been documented since the early

1960s. In addition, electrophysiological evidence conclusively indicates the presence of REA at the cortical level. However, compelling evidence for the presence of REA at the brainstem level is currently lacking. This predicament may in part be due to the use of monaural, instead of dichotic, stimulation in prior brainstem electrophysiological studies. We hypothesize that an REA will be present at the brainstem under dichotic conditions. We probed REA in the brainstem using envelope following responses (EFR) elicited by a naturally spoken vowel /u/. Dichotic conditions were created by presenting the original token /u/ (fundamental frequency [f0]=100 Hz) in one ear while presenting a lowered-f0 version of the same /u/ in the opposite ear (f0=92 Hz). Preliminary data in young normal-hearing adults show that EFRs to right ear stimulation with either f0 were higher in amplitude relative to left ear stimulation. Contrary to prior evidence, our preliminary support the presence of REA in the brainstem. Further results and discussion will be presented with additional data.

Poster # 24

Searching Away from the Lamp-post: Efferent Influence on Afferent Activity
Lindsey Sue Powell, BA; Vijayalakshmi Easwar, PhD; Sriram Boothalingam, PhD, University of Wisconsin-Madison, Madison, WI

The activity of the auditory efferent system, especially the medial olivocochlear reflex (MOCR), is typically assayed using otoacoustic emissions (OAEs). However, OAE-based efferent assays cannot determine the influence of the MOCR on afferent pathways. Afferent activity indexed by the auditory steady-state responses (ASSRs) demonstrate the putative MOCR effects when evoked at 40 Hz, but paradoxically, not at 80 Hz. If the MOCR activity does inhibit cochlear activity, the lack of efferent influence in the brainstem (80 Hz-ASSR) and its resurgence in the cortex (40 Hz-ASSR) is perplexing. We hypothesized that the reduction in brainstem activity (80 Hz-ASSR) is compensated by local feedback networks, and predicted an interim change in 80 Hz-ASSR when data are interpreted in shorter time intervals. We investigated the effect of noise-elicited efferents on the cochlea, the brainstem, and the cortex using click-evoked OAE, 80 Hz-ASSR, and 40 Hz-ASSR, respectively, using both short (1.5 s) and long (1 min) intervals. Preliminary data from six young normal-hearing adults show a robust reduction in all responses in the short-interval condition. However, an amplitude reduction was not apparent for the 80 Hz-ASSR in the long-interval condition. This interval-dependent effect likely reflects the activity of the predicted compensatory brainstem gain mechanisms.

Poster # 25

Hemispheric Processing Asymmetries for Fixed vs. Moving Auditory Stimuli
Barrett Victor St George, BA; Barbara Cone, PhD, University of Arizona, Tucson, AZ

Previous research has established a contralateral dominance of cortical processing for spatialized sounds. Accompanying this contralaterality, a right hemispheric dominance for auditory motion perception has been proposed. The purpose of this research was to measure hemispheric processing and perceptual asymmetries for fixed vs. moving auditory targets using P300 and psychoacoustic methods. The main hypotheses were: 1) spatialized targets will show a contralateral hemispheric dominance, 2) moving targets will show a rightward hemispheric dominance, and 3) perceptual laterality ratings will correlate with amplitudes and latencies of P300. 17 right-handed, young adults with normal hearing participated.

Broadband noise was systematically varied by four factors to create fixed or moving stimulus tokens: 1) duration, 2) inter-aural level difference (ILD) magnitude, 3) ILD direction (right vs left) and 4) stimulus type (moving vs fixed). Stimuli were delivered diotically or dichotically through circumaural headphones. P300 ERPs and perceptual laterality ratings were obtained for spatial listening tasks involving moving and fixed-location auditory targets. Hemispheric asymmetry patterns were calculated from 16 electrodes sites. Results show an effect for direction and stimulus type indicating hemispheric differences for lateralized sounds created by ILDs. These findings may be useful in developing objective tests of spatial listening ability.

COCHLEAR IMPLANTS

Poster # 26

How Children Recognize Emotions in Adult- or Child-Directed, Degraded Speech
Shivani Rhea Gajre; Aditya Kulkarni, MS; Monita Chatterjee, PhD, Auditory Prostheses & Perception Laboratory, Center for Hearing Research, Boys Town National Research Hospital, Omaha, NE

Emotion recognition is a vital component of communication. An important problem in cochlear implants (CIs) is CI users' difficulty in recognizing vocal emotions. Compared to peers with normal hearing (CNH), previous studies from our laboratory have shown reduced emotion recognition by school-age children with CIs (CCI). However, these studies used child-directed speech (CDS) stimuli (ie, with exaggerated prosody). School-going children hear both CDS and adult-directed speech (ADS) in everyday life, but little is known about emotion recognition by CCI with ADS (ie, with attenuated prosodic cues). As a first step, we compared vocal emotion recognition by 20 CNH (age range 6-18 years) using CDS and ADS stimuli that were unprocessed or simulating an 8-channel CI. The ADS and CDS stimuli were sentences spoken in a happy, sad, angry, neutral and scared tone. Participants heard each utterance and indicated the associated emotion in a 5-alternative forced choice procedure. Preliminary analyses indicate lower accuracy and shorter reaction times for ADS than CDS materials, for CI-simulated than full-spectrum materials, and for younger than older CNH. Although CCI may benefit from their experience with degraded speech, these results suggest that emotion recognition is more challenging for CNH with CI-simulated ADS than CDS materials.

Poster # 27

Factors Affecting Fitting of Electro-Acoustic Stimulation
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Outcomes for cochlear implant (CI) patients who utilize electro-acoustic stimulation are often superior to traditional CI users. As such, hearing preservation (HP) has become a priority for all patients, regardless of electrode length. However, not all patients are fit with the acoustic component (AC) of the speech processor, despite successful HP. We sought to determine influencing factors to inform a protocol for prospective use with HP patients. A retrospective chart review was conducted on 70 adult patients with thresholds ,â§85dB at 250Hz 3 months post-implantation. Twenty-one wore AC, 49 did not. The AC group had significantly better low frequency pure tone averages (125,250, and 500Hz) pre-operatively and 3

months post-operatively in both ears. No differences were found in speech perception scores at 3 months. For the non-AC group, non-auditory reasons were often as important as auditory reasons. As stated by the audiologist, these included comfort, cosmetics, age/dexterity, inconsistent use, or desire to use an off-ear processor. Based on these results, our protocol includes fitting during initial activation, measures of spectral and temporal resolution, music appreciation, and a patient survey. Preliminary results of this protocol will be presented, suggesting benefits of AC for non-speech measures such as sound quality and music.

Poster # 28

Vocal Pitch Cues in Electrodograms

EmilyAnn O'Brien; Bailey Harmon; Simin Soleimanifar; Abbigail Kirchner; Justin Aronoff, University of Illinois at Urbana-Champaign, Champaign, IL

Cochlear implant (CI) users have difficulty with vocal control. Since vocalizations are affected by what the speaker hears, vocal control deficits may be related to degraded encoding of vocal pitch. This vocal control deficit can hinder CI users' ability to accurately convey prosody through intonation. However, one of the challenges in improving CI users' vocal control is that it is unclear what specific cues CI users are relying on to perceive their own vocal pitch and that of other speakers. This is challenging because vocal pitch is distorted by the processors and it is unclear which cues are available post-processing. This study aims to investigate which vocal pitch cues are preserved by the processors. Vocalizations of a sustained vowel /a/ were recorded from twenty five participants. Each vocalization was presented through an Advanced Bionics Harmony processor using a HiRes processing strategy, and the resulting electrodogram was analyzed. The results suggest that the processors preserve reliable temporal pitch, especially for male voices and for basal electrodes. In contrast, the spectral centroid was not related to vocal pitch, despite its potential to encode place pitch. Further research is needed to determine if CI users make use of the available temporal pitch cues.

Poster # 29

Evaluating and Optimizing ESRT in Adult Cochlear Implant Recipients

Brittany K. Wilson, AuD; Timothy Hullar, MD; Carrie Slough, AuD, OHSU, Portland, OR

Background: Implementation of the electrically-evoked stapedial reflex threshold (eSRT) may be less wide spread as a result of lacking consensus on how to best obtain the reflex, and how eSRT should be applied in programming. Objective: To evaluate the incidence and stability of eSRT obtained (1) during surgery (2) post-operatively over time, and (3) with various probe tones, as well as to (4) better understand the functional impact of eSRT programming on the listening experience. Methods: Adult Medel Synchrony recipients will undergo eSRT measurement intra-operatively during CI surgery, and at routine intervals from activation up to 12 months post-activation. A low and higher frequency immittance bridge probe tone (226 Hz/678 Hz) will be used in each subject to elicit the reflex at post-op intervals, which will be compared to behaviorally-measured comfort levels. Speech perception testing will be completed in eSRT-based programs after sufficient experience with the cochlear implant and the subject will be administered a questionnaire probing their experience with both standard and eSRT-

based programs. Preliminary Results: In one subject, reflexes were obtained at lower charge units post-operatively and with a higher rate of presence using the 678 Hz probe tone.

Poster # 30

Can Vocal Stability be Achieved by Bilateral Cochlear Implants?

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In the absence of auditory feedback, speakers experience difficulty maintaining their fundamental frequency (F0) and vocal intensity. With a cochlear implant (CI), speakers show improved control over both F0 and intensity. However, it is unclear whether bilateral CIs will improve vocal control or degrade vocal control compared to unilateral performance with the best ear. While two inputs could provide redundant cues that benefit auditory-vocal feedback, mismatched pitch and loudness growth between ears could degrade control over F0 and intensity. To test this clinically-relevant question, sixteen bilateral CI users were asked to sustain a stable vocalization using the right CI, left CI, or both CIs. Variability was then compared across conditions and with that of 10 normal hearing controls. At the onset of vocalization, using both CIs or only their best CI yielded significantly more stable F0 than using their poorer CI. However, as the vocalization continued F0 stability was only significantly better with the use of their best CI compared to both CIs. There was no effect of listening condition on intensity stability. It is possible that conflicting information from bilateral CIs can compromise the perception-production loop for vocal control when compared to best CI performance.

Poster # 31

Methods For Quantifying Psychophysical Tuning Curves In Cochlear Implantees

Julie G. Arenberg, PhD, Massachusetts Eye and Ear, Boston, MA
Lindsay DeVries, PhD, University of Maryland, College Park, MD
Kelly Jahn, AuD, University of Washington, Seattle, WA

Psychophysical tuning curves (PTCs) are used to estimate spatial selectivity (or channel interaction) in cochlear implant (CI) listeners. Previous studies have demonstrated a relationship between channel interaction and behavioral detection thresholds and the CT-estimated distance of each electrode from the inner wall of the cochlea. Various studies have used different methods for quantifying channel interaction, typically the slope of the PTC or the equivalent rectangular bandwidth (ERB). The aim of this study was to compare these methods of PTC quantification to both electrode-to-modiolus distance and detection thresholds. Fourteen adult CI listeners with Advanced Bionics devices participated. Detection thresholds were measured on electrodes 2-15 using a spatially-focused electrode configuration (steered quadruplar). CT imaging was obtained to estimate the electrode-to-modiolus distance. Forward-masked PTCs were measured on 14 channels using a monopolar probe and steered quadrupolar masker. Results showed that ERB and PTC slope measures were moderately correlated with one another. However, PTC slopes did not predict focused threshold and electrode-to-modiolus distance, whereas PTC ERBs did. These results suggest that while the two methods for quantifying channel interaction with PTCs are

moderately correlated, they may be capturing different aspects of spatial selectivity as the electrode-neuron interface.

Poster # 32

Application of Neural-Health Measures in Humans with Cochlear Implants
Kara Chantal Schvartz-Leyzac, PhD; Deborah Colesa, BS; Yehoash Raphael, PhD; Donald Swiderski, MS; Teresa Zwolan, PhD; Bryan Pfingst, PhD, University of Michigan, Ann Arbor, MI

Specific characteristics of the electrically-evoked compound action potential (ECAP) relate to neural status in electrically-stimulated guinea pig cochleae and we can use such measures to estimate neural status in cochlear-implanted humans. While studies using postmortem temporal bone analysis do not provide strong evidence that speech recognition outcomes in humans relate to peripheral neural density, interpretation of these studies is complicated by the temporal separation between the functional and histological measures and across subject comparisons in patients with diverse central and cognitive processing abilities. We propose that ECAPs can be used to estimate neural status and thus allow comparison between auditory nerve function and speech understanding in humans during the same time period and using a within-subject design. Results show that some ECAP measures are differentially affected by neural factors (e.g., spiral ganglion density) and extraneous non-neural factors (e.g., distance from the electrode to presumed site of neural excitation). Therefore, some measures may be better suited than others for estimation of neural status in humans. This presentation will examine the relationship between electrophysiological measures of neural health and CI performance, and discuss clinical application and limitations of these measures to improve outcomes in CI patients.

Poster # 33

Differences in the Cochlear Implant Electrode-Neuron Interface as a Function of Hearing Loss Etiology
Molly D. Bergan, BS; Kelly Jahn, AuD, PhD; Julie Arenberg, PhD, University of Washington, Seattle, WA

Different hearing loss etiologies can result in distinct patterns of damage or malformation in the inner ear, which may influence how cochlear implant (CI) electrodes interface with the auditory nerve. However, little is known about the influence of etiology on psychophysical and impedances measures. The goal of the present study was to determine whether behavioral and objective measures of the CI electrode-neuron interface differ as a function of etiology. Participants included 16 CI listeners that received their first implant during childhood. Four participants were diagnosed with enlarged vestibular aqueduct (EVA), which is characterized by an abnormally dilated vestibular aqueduct and typically some degree of cochlear malformation. Five participants presented with the Connexin-26 mutation, and the remaining five had unknown etiologies. Electrode-specific monopolar thresholds, steered quadrupolar (spatially-focused) thresholds, clinical impedances, and electrical field imaging (EFI) were measured. Results indicated that CI listeners with EVA have higher intracochlear resistance values and higher behavioral detection thresholds than listeners with other hearing loss etiologies. Between-group differences were more pronounced in the apical region of the cochlea than in the basal region. These findings support the need to investigate CI outcomes and optimized interventions for listeners with distinct hearing histories.

Poster # 34

Implications of High Frequency Audibility for Potential Cochlear Implant Candidates
Alexa Victoria Patton, BS; Michael Cevette, PhD; Sarah Holbert, AuD; Jamie Bogle, PhD, Mayo Clinic, Scottsdale, AZ

Previous research by Cavanaugh et. al (1962) has shown that high frequency audibility is important for speech understanding. The importance of high frequency audibility has also been demonstrated in word recognition testing and speech in noise testing (Pascoe, 1975; Skinner, 1982; Hogan & Turner 1998; Turner & Henry, 2002).Furthermore, it is known that up to 70% of speech intelligibility is attributed to frequencies above 1000 Hz (Mueller & Killion, 1992). Cevette, et al, (2016) showed improved word recognition by greater than 20% in several clinical cases by the addition of 14dB above 1000 Hz to the presentation level for patients with scores initially poorer than 80%. The aim of the present study was to determine whether the addition of 14 dB of gain to frequencies above 1000 Hz contributes to better word recognition scores and AzBio sentence performance in ten potential cochlear implant candidates with severe-to-profound hearing loss. These findings may have possible implications for criteria for cochlear implantation as well as alternative approaches for patients with very poor word recognition scores who struggle with traditional amplification. The results of the study and recommendations for future research will be discussed.

Poster # 35

Naturalistic Temporal Verb Morphology Usage in Children with Hearing Loss
Kristina Bowdrie, BA; Rachael Frush Holt, PhD; Andrew Blank, AuD, The Ohio State University, Department of Speech and Hearing Science, Columbus, OH
Laura Wagner, PhD, The Ohio State University, Department of Psychology, Columbus, OH

Children with hearing loss (CHL) present with more difficulties in their development of morphology compared to children with normal hearing (CNH). However, specific areas within morphosyntactic development have not been studied in CHL, such as their use of tense and aspect markers. The purpose of this study was to examine tense-aspect verb morphology in CHL (who use cochlear implants and hearing aids), CNH, and their parents in a naturalistic play environment. Results revealed that both children and adults adhered to prototypical use of tense-aspect combinations. A greater production of atelic verb forms (i.e., verbs that indicate events that can go on indefinitely) was also observed in CHL relative to CNH. Differences in the productions of tense-aspect combinations in CHL parents and CNH parents was ruled out as a concomitant variable. The greater use of atelic verb forms has also been found among children with specific language impairment (SLI), suggesting it is linked to early language difficulties in general. These patterns can provide insight into how morphosyntax develops in children who are deaf and hard-of-hearing, and facilitate more targeted language interventions for this population.

ELECTROPHYSIOLOGIC RESPONSES

Poster # 36

Auditory Evoked Potentials and Speech-in-Noise Perception in Older Adults
So Eun Park, PhD; Cynthia Fowler, PhD, University of Wisconsin-Madison, Madison, WI

The study was designed to investigate (1) the effects of aging and peripheral hearing loss on auditory neural coding, (2) interrelationships between auditory evoked potentials occurring at early and later stages of auditory processing, and (3) electrophysiological correlates of age-related declines in speech-in-noise perception. AMLR Pa and N1, P2 and N2 of ALLRs were recorded for 500 Hz tone bursts and syllable /ba/ for three groups; young normal-hearing adults (YNH), older adults with normal/near-normal hearing (ONH), and older adults with presbycusis (OHI). Low-predictability (LP) sentences from Revised Speech Perception in Noise test (R-SPIN) were measured for correlation with electrophysiological responses. Pa and N1 amplitudes were significantly enhanced and Pa, P2 and N2 latencies were significantly prolonged in ONH versus YNH group, indicating the effects of aging. N2 latencies were significantly prolonged in OHI versus ONH group, indicating the effects of peripheral hearing loss. Both amplitudes and latencies of all components were significantly increased in OHI versus YNH group, indicating stronger effects of presbycusis, which reflects the interplay between aging and peripheral hearing loss. Significant positive correlations between the amplitudes of AMLR Pa and ALLR components were found in both older groups, indicating that amplitude-based interrelationships may reflect age-related changes in a transfer of neural information between subcortical and cortical auditory network. Significant correlations between the latencies of AMLR Pa and ALLR components were found in all groups, indicating that latency-based interrelationships may reflect the association between neural timings at subcortical and cortical levels. In both older groups, lower R-SPIN-LP scores are significantly correlated with prolonged N2 latencies for syllable /ba/, indicating electrophysiological correlates of age-related declines in SIN perception.

Poster # 37

A Comparison of Amplitude Growth Function Derived From Continuous Tones and Chirp Auditory Steady-State Responses
Vanesa Caballero Gonzalez; Franz Zenker Castro; Jose Juan Barajas de Prat, PhD, Clinica Barajas, Santa Cruz de Tenerife, Spain

The ASSR is an electrophysiological response that is evoked by sinusoidally amplitude-frequency modulated continuous tones (s-ASSR). Recently a chirp stimulus has been developed in order to compensate for the cochlear delay of the traveling wave along the cochlear partition. This stimulus has shown better ASSR amplitudes than those obtained with conventional modulated tones. The aim of this study was to compare the amplitudes derived from modulated tones and chirps stimulus in a group of normal hearing subjects. Ten young adults aged 18-25 with normal hearing participated in this study. An amplitude vs. intensity function were calculated for chirps and continues tones for two carrier frequencies (2000 Hz and 500 Hz).The amplitude for chirps stimulus were significantly higher than s-ASSR for both frequencies studies. Separate amplitude/intensity linear regression was computed for each carrier frequency. A significant positive correlation between amplitude and intensity was found. ASSR thresholds were higher than behavioral thresholds for both types of stimulus. ASSR thresholds obtained with chirp stimulus were significantly lower than those obtained with continuous tones. Chirp-evoked ASSR requires a 15 dB smaller correction factor than continuous tones for estimating auditory threshold.

This study illustrates that chirp-evoked ASSR shows a better amplitude growth function than conventional continuous tones.

Poster # 38

Effects of Music Through Earphones on DPOAEs in Young Adults
Rebecca Anne Vieira; Damok Min; Shannon O'Donnell, BA; Peter Torre, San Diego State University, San Diego, CA

There is increasing research on the effects of recreational noise exposure on hearing. The purpose of this study was to evaluate how personal music (PM) system listening levels affect DPOAEs in young adults. Two hundred, ten young adults, 156 women and 54 men (mean age=20.9 yrs; SD=2.8 yrs) participated. Questionnaire data included self-reported PM system use and preferred listening level in quiet. Measures were otoscopy, tympanometry, and DPOAEs. DPOAE data were obtained from 1-6 kHz using stimulus tones (L1,L2=55,40 dB SPL, f2/f1=1.22; f2 >f1) swept in frequency at 8 sec/octave. DPOAEs were measured before and after one hour of music exposure. A probe tube was placed in the ear canal to measure equivalent continuous sound level (LAeq) of one hour of music. DPOAE data were collapsed into third-octave bands (1, 1.5, 2, 3, 4, and 5 kHz) and considered present >-20 dB SPL. Mean LAeq was 72.9 dBA (SD=10.9 dBA) and 12% (n=25) listened at >85 dBA. Men listened at a statistically significant higher level than women. For both men and women, and after adjusting for Pre-Music DPOAE level, there was more of a decrease in DPOAEs after music for those young adults who listened at a higher level.

Poster # 39

Electrophysiologic (EEG) Responses in Blast and Non-Blast Exposed Military Service Members
Kimberly A. Jenkins, AuD; Jennifer Myers, PhD; Ken Grant, PhD, Walter Reed National Military Medical Center, Bethesda, MD
Alessandro Presacco, PhD, University of Maryland, College Park, MD

Over the past decade military and VA audiologists have been perplexed by rises in service member complaints of difficulty hearing speech in the presence of background noise while exhibiting clinically normal audiograms. Previous work found that many listeners with normal to near-normal hearing thresholds exposed to blasts performed worse on a simple hearing screening test consisting of a six-question hearing and speech survey, time-compressed speech-in-noise, and N0SœÄ tone detection. This indicates blast exposure in humans may cause auditory dysfunction undetected by traditional diagnostic hearing tests. Electrophysiologic measures are currently being utilized to investigate auditory processing in blast- and non-blast exposed military personnel with normal-hearing thresholds. The stimulus consisted of a synthetic speech syllable (/da/). Comparisons of overall response amplitudes indicated decreased signal-to-internal noise ratio (SNR) in blast-exposed individuals. Detailed analyses revealed decreased stimulus response amplitudes and increased pre-stimulus response amplitudes in test subjects. Further, a measure of stimulus-driven response stability was poorer in blast-exposed individuals compared to controls. This suggests blast exposure causes increased extraneous neural activity that increases internal noise, reduces SNR, and impedes the auditory system's phase-locking ability. These changes in physiologic response properties observed through EEG recordings may help explain behavioral and subjective complaints in blast-exposed individuals.

Poster # 40

Auditory Cortical Gating to Speech Stimuli

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Many adults with normal hearing (NH) sensitivity and good word recognition scores report significant difficulties listening to speech in the presence of noise. These self-reported hearing problems are often unexpected and disproportionate given the normal peripheral auditory system. For these patients with NH, one hypothesis is that their self-reported deficits could stem from an inability to inhibit irrelevant auditory information, causing them to be overwhelmed by sounds in different environments. The obligatory P1-N1-P2 complex of the auditory event-related potential (ERP) response elicited using an auditory gating paradigm serves as an objective measure of auditory cortical inhibition. However, it remains unknown whether electrophysiological differences in cortical auditory gating are related to self-reported listening difficulties. The present study examined whether listeners with NH who report being more bothered by noise exhibit differences in cortical inhibition to auditory stimuli. Brain-behavior correlations indicated listeners who reported more difficulty listening in background noise showed weaker cortical gating to repeated auditory stimuli. These data suggest that an objective auditory test of cortical inhibition could be a potentially useful clinical tool for explaining why some listeners with NH report problems in difficult listening situations.

Poster # 41

Effects of Inter-Stimulus Interval on Speech-Evoked Frequency-Following Response in Elderly Adults

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The speech-evoked frequency following response (FFR) has shown to be useful in assessing complex auditory processing abilities. The effect of timing, as measured by inter-stimulus-interval (ISI), especially in the older adults, has yet to be thoroughly investigated for FFR. The purpose of this study was to examine the effects of different ISIs on FFR in older and younger adults, and to investigate whether the older adults are more susceptible to the change in ISI. Twenty-two normal hearing participants were recruited in our study, including 11 elderly participants. FFR was recorded in four ISI conditions (40, 80, 120 and 160 ms). A recorded speech with a falling tone /yi/ was used as stimulus. Two indices, stimulus-to-response correlation coefficient and pitch strength, were used to quantify the responses. Two-way ANOVA was used to analyze the differences in different age groups and different ISI conditions. Results showed no significant difference in FFR responses among different ISI conditions, in either age groups. In conclusion, shorter ISIs did not result in worse FFRs from older adults or younger adults. For FFR using a speech token that is 250 ms in length, an ISI of 40 ms appeared to be sufficient and effective for elderly adults.

HEARING LOSS / REHABILITATION

Poster # 42

Longitudinal Decline on the Dichotic Digits Test

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Mary Fischer, PhD; Alex Pinto, MS; Carla Schubert, MS; Ted Tweed, MS, Department of Ophthalmology and Visual Sciences, School of Medicine and Public Health, University of Wisconsin - Madison, WI
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The Dichotic Digits Test (DDT) is often used as a measure of central auditory function. Five-year longitudinal change of performance in DDT free recall scores and right ear advantage (REA) was investigated in the Epidemiology of Hearing Loss Study (n=865) (age range 64-94) to better understand 1) decline in DDT performance, and 2) whether biomarkers relating to neuroprotection, inflammation, and cardiovascular conditions are associated with longitudinal DDT decline. On average, participants declined by 3% (4.5 digits) over five years. A substantial decline was defined as a 10% decline (15 digits), equating to approximately 1 standard deviation below the mean. In those with a substantial decline, the mean decline was 16.8% (25.2 digits). In age- and sex-adjusted models, hearing impairment (4 frequency PTA > 25 dB HL) and lower education level were significantly associated with substantially declined scores. Brain-derived neurotropic factor in women showed a significant protective relationship with substantial DDT decline. On average, REA increased by 1.9% (1.4 digits). In those with substantial decline, REA increased by 5% (3.7 digits). Higher level of interleukin-6 was associated with increased REA. This study documents longitudinal change in DDT and REA, and association between DDT and certain biomarkers.

Poster # 43

A Multivariate Multiple Regression Model Of Threshold-Independent Hearing Disorder

Judy G Kopun, MA; Aryn Kamerer, PhD; Stephen Neely; Sara Fultz, AuD; Carissa Allen, BS; Daniel Rasetshwane, PhD, Boys Town National Research Hospital, Omaha, NE

The purpose of this study was to determine which of three outcome measures has the most predictive power in a statistical model for identification of suprathreshold hearing deficits in normal hearing and hearing impaired individuals. Nine physiological predictor variables that reflect auditory function at different points along the auditory pathway, age, sex and three outcome variables (thresholds in noise at 1.5 kHz, thresholds in noise at 4 kHz, and frequency-modulation detection thresholds) were included in the model. Linear dependence on threshold (in quiet) was removed from each explanatory and outcome measure to derive residualized measures that are independent of threshold and are assumed to be related to suprathreshold deficits. The residualized measures were standardized by transformation to z-scores. The three residualized and standardized outcome measures were combined in a multivariate multiple regression model. The predictor variables were reduced to a model that accounted for a statically significant amount of variance in the outcome measures. Preliminary analysis indicates that the

model in which threshold in noise at 1.5 kHz was the outcome variable accounted for the most variance. Data collection is ongoing.

Poster # 44

Early Identification of Hearing Loss with A Novel Consumer Headphone

Philip Inouye, BS; Aimee Paredez; Ashley Richards; Beau Campa; Jiong Hu, University of the Pacific, San Francisco, CA

Current consumer electronic technology allows devices to assess individual listener's hearing status and adjust sound output accordingly. One of the challenges is how accurate these measurements are compared to the real audiometric information. The purpose of this study is to measure the accuracy of thresholds obtained from both a consumer hearing device and clinical audiometer. Ninety-seven subjects' audiometric thresholds were obtained from both Even headphone and a clinical audiometer (stored in Noah). Pearson's correlation coefficient r were calculated to compare the thresholds. The average differences between Even and Noah thresholds were later applied as correction factors. Results showed that: 1) A statistically significant correlation between Even thresholds and Noah thresholds at all frequencies tested, for both ears ($p < 0.001$); 2) Even,ÄìNoah threshold differences hold relatively smaller distributions at lower frequencies than higher frequencies, in the left ear than the right ear ($p < 0.01$). 3) Pairwise t test showed no statistically significant differences between corrected Even thresholds and Noah thresholds. This suggests that consumer headphones can have consistent and stable threshold measurement that correlated well with those obtained from audiometers. Manufacturers could use these device-measured thresholds in their sound design and could potentially help identify hearing loss earlier.

Poster # 45

NOISE Study Key Findings: Data from 600 Research Participants

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Kelly Reavis, MS; Leslie Grush, AuD; James Henry, PhD, VA RR&D National Center for Rehabilitative Auditory Research, Portland, OR

The Noise Outcomes in Servicemembers Epidemiology (NOISE) study is a joint research effort between the Department of Veterans Affairs (VA) Rehabilitation Research and Development (RR&D) National Center for Rehabilitative Auditory Research (NCRAR) and the Department of Defense (DoD) Hearing Center of Excellence (HCE). The impetus for conducting this study was to follow up on research recommendations from the congressionally-mandated Institute of Medicine report (2005) to better understand how noise exposure relates longitudinally to hearing loss and tinnitus. A primary aim of this prospective study is to describe and estimate the prevalence, etiology, and effects of hearing loss and tinnitus in the military population over time. In addition to the effects of noise exposure on military hearing health, the NOISE study focuses on other military exposures and their association with auditory injuries including exposure to ototoxic drugs, chemicals, heavy metals, fumes, explosive blasts, and traumatic brain injuries (TBIs). A cross-sectional analysis of baseline data from the first 600 participants revealed three important associations: 1) ototoxic exposures with tinnitus and hearing loss, 2) TBI

history with probable PTSD and tinnitus, and 3) tinnitus and hearing loss with reduced quality of life. These and other findings from the NOISE study will be presented.

Poster # 46

Cisplatin, Carboplatin and Dexamethasone: Investigations in Ototoxicity and Otoprotectants

Brianna Ralston, BS, University of Wisconsin-Madison and Washington University School of Medicine and the Program for Audiology and Communication Sciences, Madison, WI
Lavinia Sheets, PhD; Mark Warchol, PhD, University of Wisconsin-Madison- Department of Otolaryngology Washington University, St. Louis, MO

Cisplatin and carboplatin are common chemotherapeutic agents used in cancer treatments. The use of such platinum drugs can cause permanent sensorineural hearing loss (ototoxicity), which occurs in up to 90% of pediatric patients who undergo treatment. This kind of hearing loss can also lead to developmental, speech and language delays, isolation, depression, and other social and economic deficits. Although platinum drugs have shown to be an efficacious cancer treatment, damage to the auditory system caused from such interventions have yet to be evaded. Drugs that prevent otoxicity have important clinical implications, and while emerging data are optimistic, there is no conclusive consensus for clinically applicable otoprotectants. Clinical trials using hypothesized otoprotectants (e.g., dexamethasone) have promising preliminary data; however, the situation remains inconclusive due to population and experimental limitations. Performing studies with large numbers of humans is arguably unattainable; however, studies involving animal models, such as zebrafish, offer unique advantages. The aim of the current investigation was to observe hair cell death caused by exposure to cisplatin and carboplatin, and to compare cisplatin and carboplatin ototoxicity. Hair cell injury was assessed using immunohistochemistry techniques after fish were treated in cisplatin and carboplatin. Significant hair cell loss was observed after 24-hour exposure to 100, 200, 500 and 1000¬µM carboplatin treatment ($P=0.0488$, DFn-=1, DFd=3, $R2=0.77$; figure 1.1). 30.4% of hair cells died directly after 24-hour exposure to carboplatin ($P<0.0005$; Figure 1.2) with significantly more death (49.1%) after 24-hour recovery time ($P<0.0001$). Similarly, maximal hair cell death caused from 2-hour 1mM cisplatin treatment occurred 24-hours after intervention (Figure 1.3). Such data suggest that cisplatin is more ototoxic than carboplatin. Lastly, preliminary experiments investigated possible otoprotective benefit from dexamethasone. Fish were pretreated in 10mM dexamethasone for 2 or 12 hours followed by 2 hour treatment in 1mM cisplatin. No statistically significant benefit was measured; however, this may be due to the gross variability of the experiments and testing error. Zebrafish provide an advantageous model to understand ototoxic, nephrotoxic and neurotoxic effects from chemotherapeutic agents. Our model will also be useful in large-scale drug screening experiments aimed at identifying drugs that can protect against chemotherapy-induced ototoxicity.

Poster # 47

Hearing Disability and Hearing Aid Use - Comparing US to Norway

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Hearing impairment is a societal and public health concern. In 2010, disabling hearing loss (DHL) affected half a billion adults globally and was the third leading cause of years-lived-with-disability. The US National Health and Nutrition Examination Survey (2005-2006, 2009-2010, 2011-2012; N=5,513) and the Nord-Trondelag Hearing Loss Study (1997-1998; N=51,574) collected health information and audiometric thresholds on adults 20+ years. Hearing aid (HA) use, self-reported hearing loss (SRHL), age, sex, education, smoking, noise exposure, and chronic disease were ascertained. Multivariable logistic regression was used to model associations between HA use and potential predictive factors, which included socio-demographic variables. DHL was defined by pure-tone average (PTA) of thresholds 0.5-1-2-4 kHz ,-35 dBHL, better ear (BE), as recommended by the WHO/Gates Foundation 2010 Global Burden of Disease Study. The strongest associations were: US-SRHL odds ratio [OR]=11.8(95% CI: 5.6-25.0) and DHL BE PTA -35-<50% OR1=12.9(6.1-27.3); -65% OR2=43.3(21.2-88.4); Norway-SRHL OR=4.1(3.6-4.8) and DHL BE PTA OR1=13.1(11.0-15.8), OR2=99.4(80.3-123.3). Weaker associations were found with occupational noise exposure in Norway, OR=1.5(1.2-1.8), and education in the US, OR=1.8(1.1-3.0). SRHL was a stronger predictor in the US, however, the strongest associations for both countries were with increasing DHL severity.

Poster # 48

Facial Expressions as an Indication of Listening Difficulty

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Most behavioral and physiological measures that are currently used to assess listening difficulty, such as speech recognition tests and dual-task paradigms, cannot be administered in the real world (i.e., in-situ) to collect real-time data. In the present study we explored the feasibility of using real-time facial-expression recognition algorithms as an in-situ measure to assess speech listening difficulty. Twenty adults with normal hearing completed the lab experiment. Facial expressions were recorded and analyzed using Emotient FACET software during the task of speech perception at various signal-to-noise ratios (SNRs: -3,-5,-7,-9,-11 dB, and in quiet). The FACET software automatically and continuously computed the probability of the presence of a variety of expressions, including confusion and frustration. Results indicated that the probability of confusion and frustration expressions increased monotonically as SNR decreased. Linear mixed models further showed a significant main effect of SNR on the probability of these two facial expressions. Follow-up testing suggested that the probability of confusion and frustration was significantly higher for the SNR conditions of -7, -9 and -11dB as compared to speech in quiet. These findings support the feasibility of using facial expression to assess listening difficulty, at least in controlled environments.

Poster # 49

Improving the Probability that War Fighters Will Wear HPDs
Mead C. Killion, PhD, Etymotic Research/lucid Audio, Elk Grove Vlg, IL

One third of war fighters reportedly return home with hearing damage, and an estimated 80% of them decline to wear their issued Combat Arms Hearing Protection Devices (HPDs), whose high-frequency attenuation can reduce the distance for detecting the sound of an AK-47 being prepared from 600 feet to 300 feet. In-Ear electronic HPDs can restore the normal detection distance, but are often rejected by war fighters because they interfered with localization. Localization tests typically compare the results with a novel HPD to that with the open ear -- which has had over 100,000 hours of training. Fortunately we have found that 12 hours of appropriate training scan result in restoring essentially normal localization with a well designed electronic In-Ear HPD. During training, both the HPD and open-ear scores improve. In one series of tests, Casali and Robinette (2014) reported an initial localization-accuracy deficit of 20% for one HPD, but after training the scores for both the HPD and the open ear were statistically indistinguishable (at 89% and 92%, respectively). Several years ago, Jillyen Curry-Mathes reported subjective results from 12 Drill SGTs with experience in Iraq and Afghanistan: The majority reported "I would wear these [electronic] HPDs." All had custom earmolds.

Poster # 50

Reviews Investigating Hearing Loss and Daily-Life Fatigue
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Avril Drummond, PhD, University of Nottingham School of Health Sciences, Nottingham, UK

Recent years have seen growth in research investigating the increased fatigue experienced by people with a hearing loss compared to people without. The basic energy depletion theory states that decreased audibility and fidelity result in an increased need for listening effort to maintain conversational performance. This in turn drains finite cognitive resources and results in increased fatigue. By the same logic, hearing aid fitting should decrease fatigue. Recent research has, however, not entirely supported this theory. Since fatigue is generally a result of activity, we hypothesize that the abovementioned relationships may be more complex, due to the potential influence of hearing loss and/or hearing aid fitting on lifestyle. In order to summarize the current state of knowledge pertinent to the above theorizing, we will report the results of two reviews; a systematic review of relationships between hearing loss, hearing aid fitting and fatigue, and a narrative review of the impact of hearing loss, hearing aid fitting and fatigue on social and work activity.

Poster # 51

Accessibility to Hearing Health Care and Quality of Life
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Accessibility to hearing health care is highly variable across differing residential regions and across individuals, for varying reasons. It is possible that hearing health care disparities could have direct implications for overall quality of life (QOL). The purpose of this preliminary project was to examine how

accessibility and place of residence impacts QOL for those with and without hearing loss. Sixty-one study participants, 43 females and 18 males, were recruited for this study. The mean age was 60 years old with a range of 20 to 82 years. Independent variables included hearing loss, access to hearing health care, geographical residency, age, income, race, and other physical diseases. The dependent variable was overall QOL as measured using the Quality of Life Inventory (Frisch, 1992). Generally, poor access to hearing health care resulted in decreased QOL but other variables, including age, other physical diseases and income affected the outcomes. Additionally, there was a large range of variability in QOL outcomes with adults who had moderate hearing losses reporting high QOL and others with mild hearing losses reporting low QOL. These results suggest that assessing QOL in adults with hearing loss is a complex issue involving a number of non-audiological factors.

Poster # 52

Audiologic Changes Beyond the Audiogram in Patients Receiving Ototoxic Therapies
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Patients undergoing ototoxic therapies including platinum-based agents such as cisplatin are likely to have changes in their hearing. However, to date, no current research has investigated speech-in-noise performance or the patient's perception of audiologic changes when undergoing these treatments. The purpose of this study seeks to address the functional outcomes of patients who receive ototoxic treatments and to investigate the impact it has on their quality of life and communication abilities. An audiometric evaluation was completed using an ototoxic protocol at baseline, 3, 6, and 12 months. The test battery includes case history, immittance testing, hearing thresholds (frequency range 250-16,000 Hz), and DPOAEs using a high-frequency protocol. In addition to the standard ototoxic hearing evaluation, speech in noise testing using the QuickSin was completed in order to measure the subject's average signal-to-noise ratio (SNR). Finally, all patients enrolled in the study were given the Hearing Handicap Inventory for Adults (HHIA). Results showed that by 3 months, patients receiving ototoxic treatment demonstrated increased difficulty at signal to noise ratios consistent with noisy, complex, real world listening environments. In addition, patients' decreased hearing abilities appear to have negative social and emotional effects as reflected in their responses on the HHIA.

HEARING SCIENCE / PSYCHOACOUSTICS

Poster # 53

Clinical Approach for Early Diagnosis of Hidden Hearing Loss
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Loud noise can cause the damage to spiral ganglion neurons (SGNs), not only outer hair cells in human. However, loss of the SGNs is not detectable by the current clinical tests, which referred as Hidden Hearing Loss (HHL). For a total of 104 participants, various tests were applied: pure-tone audiometry with high-frequency extension, uncomfortable level (UCL) test, and sentence and word recognition in noise for the subjective tools, acoustic reflex thresholds (ART), distortion-product otoacoustic emissions (DPOAE), and

auditory brainstem response (ABR) for the objective tools. Also, Non-Occupational Noise Exposure Questionnaire (NONE-Q) was conducted for evaluating any possible history of noise exposure from the participants. Data was analyzed in three criteria such as gender, military-service, and noise-history. There was the biggest difference between the gender at the extended high frequency pure-tone audiometry. It showed a similar pattern in the ART. Women had the highest correct percentage for the sentence and word recognition under noisy conditions. In the ABR test with noise, both waves I and V were delayed in the latency and decreased at the amplitudes, especially in men with military-service. Although we need to find any relation among our measurements, the results will help better understand clinical features of HHL.

Poster # 54

WITHDRAWN

Poster # 55

Middle-Ear Muscle Reflex and Word-Recognition in "Normal Hearing" Adults: Evidence for Cochlear Synaptopathy

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Animal studies show that hair cell loss after noise exposure, ototoxic drugs or aging is often preceded by degeneration of synapses between sensory cells and auditory nerve fibers. The silencing of these neurons, especially those with high thresholds and low spontaneous rates, degrades auditory processing and may contribute to difficulties understanding speech in noisy environments. In mice, cochlear synaptopathy is correlated with measures of middle-ear muscle reflex strength, possibly because the missing high-threshold neurons are important drivers of this reflex. To determine if reflex assays can reveal cochlear synaptopathy in humans, we recruited normal-hearing subjects and measured word recognition in difficult listening situations. Cochlear function was assessed by otoacoustic emissions and electrocochleography, while middle-ear function was assessed via wideband acoustic-reflex tests. Results show that reflex thresholds and electrocochleographic measures of neural health are correlated with word-recognition performance, whereas measures of hair cell function are not, consistent with selective neural loss. Our results further support the idea that cochlear synaptopathy leads to deficits in hearing-in-noise, despite the presence of normal thresholds at standard audiometric frequencies.

Poster # 56

Assessing Auditory Nerve Function in Humans Using the Acoustic Reflex

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Although auditory brainstem response (ABR) wave I amplitude has been the focus of many human studies of noise-induced synaptopathy, the results are mixed. One possible explanation is that wave I amplitude is impacted by factors unrelated to synaptic/neuronal function such as sex and outer hair cell dysfunction. Animal studies suggest that the acoustic reflex (AR) is even more sensitive to synaptopathy than ABR wave 1 amplitude. The AR is relatively insensitive to threshold elevation and does not appear to be impacted by sex. Therefore, the AR may be a more reliable indicator of synaptic/neuronal function in humans than the ABR. This study measured ABR wave I amplitude and wideband ARs in young Veterans and non-Veterans with normal audiograms. Lower wave I amplitudes, higher reported noise exposure, and tinnitus were all associated with weaker ARs. A positive relationship between wave I amplitude and AR strength suggests that both types of measurements are providing similar information about synaptic/neuronal function. The negative relationship between noise exposure and AR strength is consistent with animal models of noise-induced cochlear synaptopathy. The AR reduction among individuals reporting tinnitus adds support to the hypothesis that some forms of tinnitus are a perceptual consequence of cochlear synaptopathy.

Poster # 57

Constitutive Activation of DNA Damage Signaling in the Cochlea

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The physiochemical design of the DNA molecule ensures persistent degradation of this important biomolecule. Therefore, it is postulated that all cells must constitutively activate DNA damage signaling that maintain the integrity of DNA. Protein substrates of DNA damage signaling are activated by posttranslational modifications within consensus motifs. A series of experiments discovered that cochlear cells constitutively express protein substrates of DNA damage signaling. Additionally, cells from other organ systems such as the heart, brain and liver also exhibited constitutive expression. Such constitutive expression across cells from various organ systems supports the notion that DNA integrity must be actively maintained. Interestingly, each organ system evidenced unique molecular fingerprints. However, all organ systems exhibited an abundance of protein substrates that were between 31-125 kDa, with the 125 kDa substrate as the most ubiquitous. Furthermore, the number of protein substrates were homologous between the various organ systems. The combined results, suggest that DNA damage signaling is perpetually activated under normal conditions within the cochlea and other organ systems. Therefore, stressors that perturb endogenous DNA damage signaling may contribute to cochlear dysfunctions. Conversely, biomedical interventions that augments endogenous DNA damage signaling may preserve gene functions and thus limit the progression of acquired hearing loss.

Poster # 58

Optimizing Distortion Product Otoacoustic Emissions by Adopting Cochlear Place-Specific Stimuli

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Shawn Goodman, PhD, University of Iowa, Iowa City, IA

Currently utilized distortion product otoscoustic emission (DPOAE) measurement protocols are not optimized to detect dysfunction across the entire cochlea. Recent advances in calibration techniques and hardware have allowed for delivery and recording of accurate emission levels up to 20 kHz. The purpose of this study was to tackle a remaining important step: developing a DPOAE test protocol guided by cochlear mechanical properties to derive physiologically motivated, locally appropriate, stimulus conditions. To do this, we undertook an investigation of the DPOAE stimulus parametric space in humans in order to identify the most appropriate stimulus frequency ratio and level parameters up to 20 kHz. DPOAE sweeps were recorded using 18 frequency ratios ranging from 1.06 to 1.40 (in 0.02 steps) and five L1/L2 levels (45/20, 50/30, 55/40, 65/55, and 75/75 dB FPL) 72 conditions in total. Preliminary data analysis reveals a systematic decrease in the optimal stimulus frequency ratio across the cochlear length with wider ratios needed at the cochlear base and narrower ratios at the apex.

Poster # 59

Simulated Reverberation Effects on Discrimination of Sound Booth Environments
Sterling Sheffield, PhD; Elena Hoogland, BS; Caitlin Smith, BS; Leeann Hutker, University of Florida, Gainesville, FL

Listeners can perceive properties of acoustical spaces, such as size and reverberance, to differentiate acoustic environments. These acoustic differences between rooms impact speech perception. This study evaluated discrimination of two sound booths and the effect of simulating virtual rooms in the sound booths using a loudspeaker array. Binaural impulse responses (BIRs) were recorded in KEMAR for each booth with and without virtual room simulations. Normal hearing adults were presented with speech samples convolved with the BIRs to evaluate sound booth discrimination in a two-alternative forced choice task with two intervals from one booth and one from the other booth. The four conditions tested included speech presented from the front and uncorrelated multi-talker babble presented from the left and right in the (1) unaltered booths (reverberation times (RTs) ~60 ms) and virtual room simulations with RTs ~ (2) 90 ms, (3) 150 ms, and (4) 330 ms. Preliminary results demonstrate that listeners could discriminate the two unaltered sound booths with ~50% accuracy. Simulating a virtual room in the booths, at least with lower RTs, improved discrimination. These results indicate that simulating a virtual room exaggerated rather than decreased acoustical differences between the sound booths.

Poster # 60

Tradeoffs Among Intelligibility, Quality and Preference for Hearing-Aid Processed Speech
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Lewis Harvey, PhD, University of Colorado Boulder Psychology and Neuroscience, Boulder, CO
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The purpose of this study is to understand the tradeoffs between intelligibility and quality both on average and for individual listeners with hearing loss, and to determine how these tradeoffs drive listener preference for signal processing settings. The processing includes simulations of three different fittings (linear, mild, strong) which vary in the parameter settings used for wide dynamic range compression, frequency lowering and noise suppression. The processing also includes two venting conditions (a vented fit (300 Hz) and an open fit (800 Hz)). Stimuli are low-context sentences spoken by multiple talkers and presented at three signal-to-babble ratios and two input levels (65 dB SPL and 75 dB SPL). In adult listeners with sensorineural hearing loss, performance-intensity functions for intelligibility are compared to ratings made by listeners for several dimensions of sound quality (e.g., overall quality, loudness, annoyance). In addition, the intelligibility and quality functions are compared to paired-comparison ratings for a subset of the hearing-aid processing conditions chosen to span a wide range of quality ratings and intelligibility scores. The results are discussed in the context of trade-offs between intelligibility and quality in forming preference judgments for hearing-aid processed speech. (Supported by NIH and GNReSound).

Poster # 61

Gap Detection in Chinchillas with Selective Inner Hair Cell Loss

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We previously found that selective inner hair cell (IHC) loss increased gap detection thresholds. In the current study, we sought to evaluate whether deficits were frequency specific. Auditory brainstem responses (ABRs) and distortion product otoacoustic emissions (DPOAEs) were evaluated to assay the status of normal cochlear nonlinearity and as an objective measure of hearing ability. Adult chinchillas were trained on a shock avoidance task as part of a larger study aimed at assessing a variety of functional changes in hearing associated with selective IHC loss. Gap detection thresholds were assessed with narrowband noise carriers centered at 1, 2, 4, 8, and 12 kHz with an overall intensity of 60 or 80 dB SPL. Pre and post ABR and DPOAE measures were obtained using a commercially available clinical system. Following baseline measures, animals were treated with a single dose of 75 mg/kg of carboplatin (i.p.). Post-carboplatin assessments were performed three weeks post-treatment. Carboplatin treatment had minimal effect on DPOAEs and ABRs, while gap detection thresholds showed significant increases. The observed results demonstrate substantial suprathreshold deficits even in the presence of near normal thresholds and normal cochlear non-linearity. The overall findings highlight the importance of suprathreshold testing in assessing cochlear status.

Poster # 62

Sound Booth and Simulated Reverberation Effects on Speech Perception

Sterling Sheffield, PhD; Caitlin Smith, BS, Elena Hoogland, BS; Leeann Hutker, University of Florida, Gainesville, FL

Assessing speech perception in the sound field is important to estimate a patient's performance and the benefit of treatment (e.g. hearing aids) in real-world settings. With variability in booth structure, speech perception in the sound field with multiple loudspeakers varies between sound booths. This study

evaluated how simulating a virtual acoustic room using loudspeakers affected speech perception differences between sound booths. Adults with normal hearing were tested using QuickSIN stimuli presented over headphones, created with binaural impulse responses, in four listening conditions in two sound booths. The conditions were (1) co-located speech and multi-talker babble and (2) spatially separated speech and multi-talker babble, both in unaltered sound booths. The two booths had baseline reverberation times (RTs) of 59 and 61 ms. The last two conditions were spatially separated speech and multi-talker babble with a simulated virtual room with two different RTs (~150 and ~330 ms). Preliminary results demonstrated that performance was similar in the two booths for co-located and spatially-separated conditions. The addition of a virtual room simulation with increased reverberation decreased performance but also exaggerated speech perception differences between the two sound booths. These results indicate that simulating a virtual room in sound booths does not equalize speech perception.

Poster # 63

Talker Identification in Noisy Environments

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The ability to localize sounds in noise is affected upon reverberation, separation between sound sources, and presence of visual information. The present study analyzed the ability of eight young-adult normal-hearing listeners to locate and identify audiovisual targets in different acoustically complex environments, and under different directionality schemes in hearing aid technology. In the first experiment, listeners oriented to a target talker in the presence of a single distractor and diffuse background noise using a virtual-reality system. Identical visual markers indicated the target and distractor locations. A loudspeaker array presented direct sound along with simulated reverberation in four conditions: no reflections, reflections up to the thirteenth order, early reflections (first-third order) only, or late reflections only (order 4-13). Accuracy and reaction-time measures revealed that performance decreased with target-distractor separation and as more reflections were presented. In the second experiment, listeners wore hearing aids set in one of two binaural directionality schemes: symmetric adaptive microphone sensitivity and asymmetric fixed sensitivity (omnidirectional in right ear / beamforming in left ear). Results indicated better performance in individuals that wore hearing aids in asymmetric fixed directionality than those who wore hearing aids in adaptive directionality. [Supported by NIH-NIDCD T35-DC008763, R01-DC016643, and GN Resound]

Poster # 64

Development of Auditory Stream Segregation: Temporal and Spectral Cues

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Auditory stream segregation is a basic auditory skill that allows listeners to process a target sound in the context of competing background sounds. School-age children are poorer than adults at stream segregation tasks, but little is known about the component skills responsible for this child-adult difference. This study measured detection thresholds for a pure-tone signal in a random-frequency multi-

tonal masker. The signal frequency for each trial was either predictable (1 kHz) or unpredictable (roved ¬± 0.5 octaves), and the signal consisted of either 1, 2, 4, or 8 sequential 80-ms bursts. We hypothesized that children would be less adversely affected by the unpredictable signal frequency, due to their reduced ability to listen in a frequency-selective manner in the predictable condition, but that they would benefit similarly to adults from the temporal coherence associated with sequential signal bursts. Listeners were normal-hearing children (5-13 years) and adults. Overall, thresholds were lower for the predictable than unpredictable signal frequency, and better for larger numbers of signal bursts. Contrary to the initial hypotheses, effects of signal frequency predictability were similar across groups, and adults showed greater benefit from temporal coherence than children. These results implicate temporal processing in the development of auditory stream segregation.

Poster # 65

WITHDRAWN

Poster # 66

Personal Music and Alcohol Effects on DPOAEs in Young Adults
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While most young adults in college have normal hearing, they may also exhibit certain risk factors for hearing loss. The purpose of this study was to evaluate how self-reported personal music (PM) system use and alcohol use affect DPOAEs in young adults. A total of 216 young adults (161 women and 55 men; mean age=21.0 yrs; SD=2.8 yrs) participated. Questionnaire data included self-reported PM system and alcohol use. Measures were otoscopy, tympanometry, and DPOAEs. DPOAE data were obtained from 1-6 kHz using stimulus tones (L1,L2=55,40 dB SPL, f2/f1=1.22; f2 >f1) swept in frequency at 8 sec/octave. The alcohol variable, reported drinks per last month (DPM), was categorized as none, light (‚â§15), and heavy (>15). All DPOAE data were collapsed into third-octave bands (1, 1.5, 2, 3, 4, and 5 kHz) and were considered present at >-20 dB SPL. Men who reported loud/very loud volume use had statistically significant lower DPOAEs than men who reported lower volume use. Self-reported light and heavy DPM had statistically significant lower DPOAEs than non-drinking men. There were no DPOAE differences for either variable in women. These sex-specific differences for certain risk factors on DPOAEs need further study.

HEARING TECHNOLOGY / AMPLIFICATION

Poster # 67

Emotion Recognition and Emotional Range in Adults with Hearing Loss
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Recent evidence suggests that the presence of hearing loss reduces accuracy in identifying the emotional intent conveyed by a communication partner. The ability to recognize emotion provides a foundation for

social relationships by facilitating identification of communicative intent - a skill necessary for successful interpersonal interactions. Thus, disruption of emotional interpretation or recognition may significantly impact social well-being and overall quality of life. An ongoing study at the Phonak Audiology Research Center (PARC) examines relationships among emotional perception, hearing loss, and amplification using a battery of tests, including behavioral measures of emotion recognition and responses to non-speech sounds, subjective assessments of emotional intelligence, and speech-evoked electrophysiologic measures. Study outcomes provide further understanding of the difficulties listeners with hearing loss may experience beyond a reduction of hearing sensitivity. These observations may therefore facilitate more impactful conversations between healthcare provider and patient.

Poster # 68

Effect of Wireless Streaming on Cellphone Conversation for Hearing Aid

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Wireless connectivity technology (WCT), which streams sounds from a cellphone to hearing aids, could improve signal-to-noise ratio in a noisy environment. This study aimed to evaluate the effects of two different types of WCT streaming on cellphone conversation performance in background noise. For the unilateral streaming condition, the cellphone captured the sound and transmitted it to the hearing aid closer to the phone. For the bilateral streaming condition, the cellphone streamed the sound to both hearing aids. Twenty-four adults with symmetrical bilateral moderate to severe sensorineural hearing loss participated. Listening effort (LE) during speech recognition tests in noise was measured. Results showed that (1) there was no statistical difference in the LE scores between the unilateral and bilateral streaming, (2) the unilateral wireless streaming provided a significant benefit in LE for patients with a flat-audiometric configuration compared to the unaided condition, and (3) bilateral transmission provided a benefit for both flat and decreasing audiometric configuration during phone use in a noisy background.

Poster # 69

A Digits-in-Noise Test with Higher Sensitivity to High-Frequency Hearing Loss

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The digits-in-noise (DIN) test is sensitized for detection of high-frequency hearing loss (HFHL) by low-pass filtering the speech-shaped noise masker at 1.5 kHz. We investigated whether sensitivity of the DIN to HFHL can be enhanced using low-pass noise filters with higher cutoff-frequencies. For 20 normal-hearing (NH) and 40 hearing-impaired (HI) listeners with bilateral mild sensorineural hearing loss,

separate speech reception thresholds (SRTs) were obtained using broadband and three low-pass (cutoff at 2, 4, 8 kHz) filtered noises. Narrower noise bandwidth produced better mean SRTs. There were weak, nonsignificant correlations between SRT and audiometric pure-tone average (PTA) of NH listeners. These correlations were statistically significant in the HI group. The SRTs of 2 kHz noise-filter had the highest correlation and steepest slope with lower frequency PTA (0.5, 1, 2, 4 kHz). Broader filters all had similar, weaker correlations. In contrast, higher frequency PTA (4, 8, 10, 12.5 kHz) correlated best with SRTs of 4 and 8 kHz filtered noises. The 4 kHz low-pass filters had the highest sensitivity (92%) for detecting an average HFHL of 20 dB. Using higher cutoff-frequency filters, this study improved the sensitivity of DIN test to higher frequencies at which a hearing loss may be present.

Poster # 70

WITHDRAWN

Poster # 71

Development of Evidence-Based Gain-Frequency Responses for Preconfigured OTC Hearing Aids
Dana Patton Urbanski, AuD; Yu-Hsiang Wu, PhD, Department of Communication Sciences and Disorders, the University of Iowa, Iowa City, IA

Over-the-counter (OTC) hearing aids are intended to promote affordability and accessibility of amplification; however, they must provide sufficient audibility in order to achieve quality outcomes. Previous research has shown that most OTC amplification devices have inappropriate gain characteristics for age-related hearing loss. The present study was undertaken to develop a set of evidence-based gain-frequency responses for use in OTC hearing aids. Audiometry data from 267 adults age 55+ with mild-to-moderate sensorineural hearing loss were obtained from CDC's National Health and Nutrition Examination Survey (NHANES) database. For each NHANES individual, NAL-NL2 real-ear aided response (REAR) prescriptive targets were obtained. Next, a set of 642 candidate hearing aid gain-frequency responses was developed by: 1) generating 642 hypothetical audiograms representing mild-to-moderate age-related hearing loss; 2) obtaining the associated NAL-NL2 REAR targets for each audiogram. An algorithm was then used to determine the combination of four gain-frequency responses (out of 642 candidate responses) that fit the highest number of NHANES individuals within +/- 5 dB of REAR target from 250-4000 Hz. Our results demonstrate that a set of four gain-frequency responses can fit 70% of older adults with mild-to-moderate sensorineural hearing loss, regardless of whether the individual selects a unilateral or bilateral fitting.

Poster # 72

Evaluation of an Open Source Audio Processing Platform: Feedback Management
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William Audette; Odile Clavier, Creare LLC, Hanover, NH

To encourage innovation in hearing aid (HA) research, NIH-NIDCD is supporting development of open source audio processing platforms. As part of this effort, we have developed a reconfigurable and reprogrammable platform called Tympan that allows engineers to implement custom algorithms directly on wearable hardware and allows audiologists to modify parameters via a simple user interface. Tympan has been updated recently to include adaptive feedback cancellation (AFC). In this study, we compared Tympan performance to a commercially-available HA. AFC was activated on both devices. Gain was set to NAL-NL1 prescriptions. Participants were 20 adults with mild-moderate sensorineural hearing loss. Electroacoustic tests included ANSI 3.22-2009 standard clinical measurements, real-ear measurements, the HA speech perception index, and the HA speech quality index. Behavioral tests included recognition of CASPA words in quiet at three levels and AzBio sentences in noise. Tympan performance was similar to the commercial HA on these measures. We are currently working on adding advanced features such as increased computational power, nonlinear frequency compression, noise reduction, and binaural microphones. These efforts have the potential to advance HA research, as well as contribute to research in other audio signal processing fields.

Poster # 73

Hearing Aid Self-Adjustment: Effect of Number and Sequence of Listener Controls
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The purpose was to optimize the Goldilocks self-adjustment procedure which allows sequential adjustment of Volume (V), High-frequency boost (H), and Low-frequency cut (L), while listening to connected speech. Beginning with amplification matched to the NAL-NL2 prescription for a generic mild-to-moderate hearing loss, seventeen adult participants re-adjusted amplitude and spectrum to their liking. The original 3-control starting sequence (LVH) was compared with an H-first sequence (HVL) and with a 2-control version (VH) (in which L was reduced as H increased). Outcomes were compared in terms of real-ear output spectra, listener preference, and phoneme-in-word recognition. Group-mean output spectra were equal to, or close to, NAL-NL2 prescription. Changing from three to two controls did not affect real-ear outputs but participants tended to prefer three. Changing from V-first to H-first resulted in somewhat lower amplitude with a compensatory increase in high-frequency boost, but most participants expressed no preference. Group-mean phoneme recognition was 93% for both the V-first and H-first protocols. It was unchanged over a range of ¬±7 dB relative to the self-selected amplitude - but significantly higher than the generic starting condition. The findings continue to support the efficacy of hearing-aid self-adjustment but indicate possible benefit from beginning with adjustment of high-frequency output.

Poster # 74

User Interactions with Smart Phone Self Adjustment App
Lisa Standaert, AuD, Sonova U.S., Warrenville, IL
Nicola Hildebrand; Marius Beuchert Sonova AG, Stafa, Switzerland

Hearing aid users often state the desire to have control over their device settings that go beyond adjusting loudness. Several manufacturers have released smart phone fine tuning applications; however there is little published research regarding users' patterns and interactions with these applications.

During the development of a fine tuning app, Phonak researchers worked closely with participants to discern their patterns of change and preferences to improve future iterations. This qualitative research study evaluated the use of a prototype smart phone fine tuning app and desired fine-tuning adjustments of hearing aid users. The app offered a variety of modifiers that included volume, low frequency, high frequency, noise reduction and microphone directionality. During the study, participants were instructed to create custom scenarios in a variety of environments, relating to their daily lives. Follow up visits included interviews, blinded comparisons between self-created settings and hearing aid default settings in a variety of simulated environments, and speech in noise testing with both created settings and default settings. User adjustments were uploaded to a server which allowed researchers to analyze the most utilized modifiers, the acoustic conditions in which the app was used, and specific patterns of use in those conditions.

Poster # 75

Remote Microphones and Hearing Aid Processing

James M. Kates; Kathryn Arehart, PhD, University of Colorado, Boulder, CO

A remote microphone (RM) transmits speech directly from the talker to the listener's hearing aids, bypassing the noise and reverberation in the room but also bypassing the acoustic cues needed to perceive the spatial characteristics of the signal. Previous work [Kates et al., J. Acoust. Soc. Am. 143, 2666-2677] showed that adding early room reflections plus a head-related impulse response (HRIR) to the RM signal improved externalization. In this study, speech intelligibility, clarity, quality, externalization, and apparent width of the sound source were evaluated by hearing-impaired listeners. The HA inputs were the RM signal alone or with early reflections plus HRIR, the HA acoustic input without the RM, or the attenuated HA acoustic input mixed with the RM signal modified by early reflections and HRIR. The HA processing comprised linear amplification or wide dynamic-range compression. The vent effects comprised an occluded fitting, a moderate vent, or an open fitting. The results show that adding early reflections plus HRIR to the RM signal slightly reduced intelligibility but improved its perceived spatial characteristics and could therefore be beneficial in enhancing the naturalness of RM signals used with hearing aids.

Poster # 76

Evaluating an Adaptive Non-Linear Frequency Compression with Hearing-Impaired Mandarin Speakers

Solveig Christina Voss, BS; Jinyu Qian, PhD, Sonova Canada Inc, Mississauga, Canada
Li Xu, PhD, Communication Sciences and Disorders, Ohio University, Athens, OH
Jing Yang, PhD, Communication Sciences and Disorders, University of Wisconsin-Milwaukee, Milwaukee, WI
Evelyn Lu, MS, Sonova (Shanghai) Co. Ltd., Shanghai, China
Julia Rehmann, BS; Volker Kuehnel, PhD, Sonova AG, Staefa, Switzerland

The present study examined the performance of speech perception and sound quality ratings by Mandarin-speaking hearing-impaired listeners using hearing aids with an adaptive Nonlinear Frequency Compression (aNLFC, i.e., SoundRecover2 or SR2). The participants included 15 Mandarin-speaking adults aged between 32 and 84 years old with symmetric sloping severe-to-profound sensorineural

hearing loss. The participants were fitted bilaterally with Phonak Naida V90-SP hearing aids. The outcome measures included Mandarin Phonak Phoneme Perception Test (M-PPT), the extended version of Mandarin-Hearing in Noise Test (M-HINT), and sound quality ratings on human speech in quiet and noise, bird chirps, music, and participants' own voice in quiet. For each test, five different SR2 settings were applied and compared: SR2 default, SR2 weak (3 steps towards distinguishability), SR2 strong 1 (3 steps towards audibility), SR2 strong 2 (6 steps towards audibility), and SR2 off. The results showed that listeners performed better with SR2 strong 1 and strong 2 settings than with SR2 off or weak settings for speech recognition threshold and phonetic detection threshold. No significant improvement was observed in sound quality rating among different settings. These preliminary findings suggested that the new aNLFC (SR2) algorithm provides perceptual benefit to Mandarin-speaking people with severe-to-profound hearing loss.

Poster # 77

Enabling Automatic In-Field Hearing Aid Optimization

Justin Jensen, BS; Yu-Hsiang Wu, PhD, University of Iowa Department of Communication Sciences and Disorders, Iowa City, IA
Harinath Garudadri, PhD, Qualcomm Institute, UC San Diego, La Jolla, CA
Dhruv Vyas, BS; Octav Chipara, PhD, University of Iowa Department of Computer Science, Iowa City, IA

Our goal is to optimize hearing aid (HA) configurations in-situ and in real-time so HA outcomes can be maximized. Our approach leverages (i) the HA user's listening experience (e.g., speech understanding), (ii) characteristics of listening context (e.g., signal-to-noise ratio), and (iii) the status of HA signal processing (e.g., omnidirectional vs. directional microphones) simultaneously. In this presentation, we will demonstrate a prototype of an in-field HA optimization system that integrates (1) the wearable units of the Open Speech Platform (OSP) developed at UC San Diego and (2) the smartphone-based ecological momentary assessments (EMA) system developed at the University of Iowa. The combined system collects time-aligned, real-time data from all three domains: listening experience (EMA), listening context (EMA and audio recordings via OSP), and signal processing/HA state (OSP). This data enables continuous updating of a machine learning algorithm that can control the HA's state in-situ in response to user feedback. Changes made to the HA configuration are validated via EMA and validation results are incorporated by the algorithm. With frequent input comprising multiple real-world listening conditions, the algorithm eventually converges on optimal configurations that better meet a patient's individualized needs. The implication of our system on future audiology will be discussed.

Poster # 78

Comparison of Cellphone Conversation Performance using the Bluetooth Wireless Connection of Hearing Aids and Earbuds

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Young Soo Chang, MD, Department of Otorhinolaryngology-Head and Neck Surgery, Korea University School of Medicine, Korea University Ansan Hospital, Gyeonggi-do, Korea

Su Yeon Park; Yeon Kyoung Park; Hye Yoon Seol, PhD, Hearing Research Laboratory, Samsung Medical Center, Korea

The purpose of this study was to compare the cellphone conversation performance for hearing impaired listeners in a quiet and noisy situation when subjects were fitted with either Bluetooth hearing aids or Bluetooth earbuds. Twenty-three adults with hearing loss participated (Mild: 3, Moderate: 12, Moderately severe: 7, Severe: 1). For the hearing aid condition, subjects were fitted with binaural hearing aids paired to a cellphone through a Bluetooth communicator. For the earbud condition, subjects wore two earbuds that were directly paired to the same type of cellphone used for the hearing aid condition. Subjects were seated in a sound-proof booth and target speech signals, captured by the cellphone located outside the booth, were transmitted to the cellphone located inside the booth. The cellphone in the booth transmitted the signal either to the hearing aids or earbuds. For the noisy condition, babble noise was presented from four loud speakers at 75 dBA in the booth. Listening effort and sound quality questionnaire were also measured. Results include that (1) there was no statistical difference in speech recognition performance in quiet and noise and listening effort between the hearing aid and earbud conditions, and (2) subject preferred earbuds for sound quality.

PEDIATRIC AUDIOLOGY / OTOLOGY

Poster # 79

High-Frequency Otoacoustic Emissions Recorded in Newborns using Two Calibration Methods
Nicholas Portugal; Laura Dreisbach Hawe, PhD, San Diego State Univesity, San Diego, CA
Eliza Aguilar, BA, San Diego State University/University of California San Diego, San Diego, CA

Distortion-product otoacoustic emissions (DPOAEs) elicited with high-frequency (HF; >8 kHz) stimuli are measurable and repeatable in normal-hearing adults and children, a patient population and are sensitive to insults caused by ototoxic exposures in adults. Further, the development and implementation of objective tests for monitoring basal cochlear function in those that are too young to respond subjectively are needed. While a large body of research exists for DPOAEs recorded at lower frequencies (<8 kHz), HF DPOAE data does not exist for newborns. The goal of the current study is to determine if HF DPOAEs are measurable and repeatable in newborns. DPOAEs were measured from 2-16 kHz (f2/f1 of 1.22; L1/L2 = 65/55 dB SPL, 62/52 dB FPL) using two different calibration methods (in-the-ear and forward pressure level) in 29 newborns. Probe reinsertion is the single greatest source of variability in OAE measures, thus to assess repeatability the probe was removed then re-inserted for a second round of testing. Spontaneous otoacoustic emissions (SOAEs) were also recorded. Preliminary results indicate that HF DPOAEs are present and repeatable in newborns and SOAEs are present in approximately 75% of newborns and are recorded at frequencies >4 kHz.

Poster # 80

Measuring Hearing in Toddlers and Preschoolers with an Observer-Based Method
Angela Yarnell Bonino, PhD; Emily Nightengale, BA; Elizabeth Pancoast, BA; Senia Romero, BA, University of Colorado Boulder, Boulder, CO

In order to address our knowledge gap of how auditory development unfolds during early childhood, it is critical to develop a reliable behavioral method for measuring hearing in toddlers and preschoolers. One method that appears to be promising involves an experimenter judging children's behavior using a two-interval, two-alternative testing paradigm (Bonino and Leibold, 2017). In order to evaluate the reliability of this method, this study measured detection of a 1000-Hz warble tone for 2- to 7-year-old children (n=17). For the first visit, the signal was presented at 30 dB SPL for up to 100 trials to measure upper asymptotic performance. For the second visit, a modified method of constant stimuli was used to sample intensity levels along the underlying psychometric function. Video recordings of test sessions were coded by two offline observers. Most children were able to perform 100 trials during a single test session. At supra-threshold signal levels, hit rate and observer confidence scores were high (>90%) and stable across the test session. Inter-rater reliability of this method appears to be high. We will discuss how inter-rater reliability is affected by signal level and the type of auditory behavior provided by the child.

Poster # 81

Factors Affecting Parental Beliefs, Child Hearing Device Usage, & Language Outcomes
Alexandra Reanae Mai, BA, Purdue University, West Lafayette, IN
Sophie Ambrose, PhD; Margo Appenzellar, PhD, Boys Town National Research Hospital, Omaha, NE

It is understood that the amount of time children wear their hearing devices and the amount of parent involvement is associated with language outcomes for children. However, device use and parent involvement are highly variable. Additionally, it is known that parents' beliefs affect parenting actions and a child's early cognitive development (Keels 2009). The Scale of Parental Involvement and Self-Efficacy- Revised (SPISE-R) queries parents' beliefs, knowledge, confidence, and actions as well as their child's device use The purpose of this study was to see what percent of parents held concerning beliefs, examine how children and family factors (i.e. parental education level, child's current age, age at confirmation of the hearing loss, degree of hearing loss, and hearing device type) affected parent beliefs, and determine if a parent holding a concerning belief was associated with differences in their child's device use or language development. This was done via an online survey made up of a demographic questionnaire, the SPISE-R, the Developmental Profile- 3 communication subscale (DP-3), and the Parenting Sense of Confidence self-efficacy subscale. Parents were also asked to submit their child's most recent audiological results.

Poster # 82

Emotion Identification by Pediatric Cochlear Implant Recipients: Longitudinal Results and Comparison to Children with Normal Hearing
Kasia Baginski, BS; Lisa Davidson, PhD; Rosalie Uchanski, PhD, Washington University in St Louis School of Medicine, St. Louis, MO

The ability to identify emotions (angry, happy, sad, scared) is examined for a large number (N=117) of pediatric cochlear implant (CI) recipients between the ages of 5 to 9 years old. Two years later, these same children (N=104) were evaluated again for their emotion identification accuracy. Compared to age-matched peers with normal hearing (NH), their emotion identification performance is significantly poorer. Across the four emotions, all children (with CIs and NH) identified 'scared' stimuli more poorly

than stimuli with the other three emotions. The longitudinal results show improvement in emotion perception for all children, though children with CIs still perform more poorly than those with NH. Audiologic and demographic factors associated with emotion perception will be examined and presented.

Poster # 83

Early Intervention: Ten Years of Advancements in a University Clinic
Lata A Krishnan, PhD, Purdue University, West Lafayette, IN

The state of Indiana passed legislation regarding universal newborn hearing screening in 2000, and shortly thereafter, the Purdue University Audiology Clinic became a referral site for comprehensive assessment of newborns who did not pass their hospital screening. The Clinic remains the only facility available for newborn hearing assessment in nine surrounding counties. With faculty interest in early intervention, the transition to the AuD program, and the requirement for students to complete capstone projects, several projects have been completed that have led to changes and improvements in clinical protocols and outcomes over the past decade. This talk will focus on five projects involving two clinical faculty and two prior AuD students that have addressed issues related to 1. loss to follow-up of infants before and after state policy changes in referral procedures; 2. hospital referral procedures and state brochure language across 50 states; 3. information included in state brochures across 50 states; 4. parental anxiety and satisfaction with the newborn hearing screening process; 5. effects of early maternal education on satisfaction with the newborn screening process.

Poster # 84

Acupuncture to Induce Sleep for BAER in Pediatric Patients
Nicole Holmer, MS; Elizabeth Artola; Erin Christianson, PhD; Katarina Kunz, BS; Susan Norton, PhD, Seattle Children's Hospital, Everett, WA
Anne Lynn, MD, University of Washington, Seattle, WA

Purpose: Phase I of this study demonstrated that acupuncture treatment contributed to sleep state to complete brainstem auditory evoked response (BAER) testing for medically-complex children. This is a report of the results from Phase II of this study that focused on non-medically complex patients. Main aims of this study were 1) evaluate feasibility and effectiveness of acupuncture to achieve a sleep state to perform BAER in non-medically complex children, and 2) assess provider and parent acceptability of acupuncture for this procedure. Method: Patients received acupuncture treatment to induce sleep to perform BAER testing. Data included the number of BAER thresholds, sleep indicators, and acceptability of this procedure. Results: A total of 12 patients were tested (mean age = 35 months) and 67% fell asleep with treatment. An average of 6 of 10 BAER thresholds were obtained per patient. There were no adverse safety events. Audiologists and parents reported high satisfaction on post-testing surveys. Conclusion: Acupuncture is an effective and safe treatment that contributes to sleep state to perform BAER in non-medically complex pediatric patients. These results are in general agreement with Phase I results.

Poster # 85

Confidence in Assessing Children with Hearing Loss and Other Disabilities
Monica P. Muncy, BS; Sarah Yoho, PhD; Maryellen McClain, PhD, Utah State University, Logan, UT

In this study, the confidence of speech-language pathologists (SLP) and school psychologists (SP) in working with children with hearing loss (HL) and other co-occurring disabilities was assessed via a survey distributed nationwide. Professionals' opinions on barriers to and the importance of interdisciplinary collaboration were also explored. Results indicate that many school-based SLPs and SPs have insufficient training or experience in working with students who have HL and other co-occurring disabilities. Specific areas of weakness include troubleshooting hearing aids and familiarity with FM devices. Results from a multiple linear regression revealed that the number of students the professional had worked with who have HL and amount of related training in graduate school as significant predictors of confidence. Limited training and experience with this unique population among practitioners has the potential to affect the quality of services provided to these students and thus should be addressed within the school system and the fields of school psychology and speech-language pathology.

SPEECH PERCEPTION

Poster # 86

Maintaining Postural Control While Listening: Effects of Age and Task Difficulty
Karen S. Helfer, PhD; Richard Freyman, PhD; Michael Clauss, PhD; Lincoln Dunn, University of Massachusetts, Amherst Department of Communication Disorders, Amherst, MA
Richard van Emmerik, PhD; Jacob Banks, University of Massachusetts-Amherst Department of Kinesiology, Amherst, MA

Increased listening effort may help explain why some middle-aged adults report difficulty in adverse listening situations even when they can understand speech with high levels of accuracy. In the present study we measured listening effort in younger and middle-aged adults using a dual-task paradigm that measured subjects' ability to maintain their balance while listening in adverse acoustical conditions. Participants stood on a force platform that measured their postural control (quantified by the amount of sway) while they listened to sentences in both speech and noise maskers in co-located and spatial conditions at two different SNRs. Overall, postural control was poorer when the masker was competing speech (vs. steady-state noise). Differences in speech recognition ability between middle-aged and younger participants were largest when the masker and target were spatially separated and when postural control was made more difficult by having participants use a tandem stance (with one foot in front of the other). Our results suggest that postural control may be challenged during effortful listening and that speech perception by middle-aged adults in adverse acoustical conditions may be compromised when balance is challenged (work supported by NIDCD 012057).

Poster # 87

Effects of Audibility and Context on Word and Sentence Recognition
Jenna Marie Browning, AuD; Lori Leibold, PhD, Boys Town National Research Hospital, Omaha, NE
Lauren Calandruccio, PhD, Case Western Reserve University, Cleveland, OH
Emily Buss, PhD, The University of North Carolina at Chapel Hill, Chapel Hill, NC

Closed-set speech perception testing has some practical advantages; however, it is unclear how performance on closed-set word recognition tasks relates to performance in more natural contexts, such as sentence recognition. The goal of this study was to examine the relationship between closed-set recognition of monosyllabic words, where word discrimination relied either on vowels or consonants, and sentence recognition, where semantic context was either low or high. Whereas high-context sentences may be recognized based on vowels, consonants play a larger role in low-context sentence recognition. Speech recognition thresholds were estimated in a speech-shaped noise masker. Thirty-three adults with normal hearing were tested; for 12, a high frequency hearing loss was simulated by low-pass filtering the stimuli. In the full bandwidth condition, performance was slightly better (less than 2 dB) for the high-context sentences and vowel-dominant words when compared to low-context sentences and consonant-dominant words, respectively. Simulated high-frequency hearing loss had a more negative impact on closed-set discrimination relying on consonants and low-context sentence recognition. These results demonstrate that the relationship between closed-set word recognition and open-set sentence recognition tasks depends upon audibility as well as the stimulus context (i.e., whether the task relies on vowel or consonant identification).

Poster # 88

An Open-Source, Automated Tool for Scoring Transcriptions of Speech
Stephanie A. Borrie, PhD; Sarah Yoho, PhD; Tyson Barrett, PhD, Utah State University, Logan, UT

Studies in speech perception often rely on trained research assistants to score orthographic listener transcripts for words correctly identified. Although the accuracy of this type of human scoring has been validated with strong intra- and inter-judge reliability, the process of hand-scoring the transcripts is time-consuming and resource intensive. To circumvent these limitations, an open-source, computer-based tool for automated scoring of listener transcripts, Autoscore, was created and validated on two different human-scored data sets. Results show that not only is Autoscore highly accurate, achieving approximately 99% accuracy, but is also extremely efficient, considerably reducing the time it takes to score transcripts. Thus, Autoscore affords a practical tool for scoring listener intelligibility of speech. Several potential applications of this freely available tool, both research and clinical, will be presented.

Poster # 89

Masking Effect of Perceptual Cues on Hearing-Impaired Ears
Siyan Guo, MS; Jont Allen, PhD; Cliston Cole, PhD, University of Illinois, Urbana-Champaign, Urbana, IL

Objectives: Current hearing-aids mainly work by improving audibility. However the most common complaint is "I can hear the speech but I can't understand it.'' This has led us to investigate the strategy of the hearing-impaired (HI) ear in listening to speech. In this study, effects of the masking of primary cues in HI ears are analyzed, with and without the presence of conflicting cues (Li and Allen 2011). Using an error pattern analysis, the results provide insights into the HI ear's listening strategy. Design: Two consonant-vowel (CV) identification experiments were conducted on five normal-hearing (NH) and ten HI subjects. Four plosive consonants (tokens) /t,k,d,g/ paired with vowel /a/, in CV context, were used as target stimuli. The CVs were presented at signal-to-noise ratios (SNRs) of 0, 9, and 18 dB. In experiment

one the primary cue for each CV was modified in 3 ways: removed, attenuated, and amplified. Experiment two was similar to experiment one except the conflicting cues were removed. Subjects' responses were analyzed based on consonant errors. Results: The results for both NH and HI groups show a large increase in probability of error in all SNR levels when the primary cue got removed from the first experiment. The results for experiment two display more variability over different group of subjects. The HI subjects were divided into three groups, based on their average error: 1) a low error group (LEG) which contains four subjects (eight ears), 2) a medium error group (MEG) with three subjects (four ears) and 3) a high error group (HEG) with three subjects (five ears). HEG shows more reliability on the presence of conflicting cues, while other HI subjects and NH subjects have less dependency on conflicting cues. Conclusion: The analysis shows that HI listeners are using the same primary cue as NH ears. The strength of the primary cue is a critical quality for low-error HI speech perception, especially in the presence of noise. Overall, the LEG showed results similar to the average normal hearing (ANH) group, for both experiments, but with higher error. However, the subjects in MEG and HEG exhibit sensitive reaction towards the presence of conflicting cues. The experimental removal of the conflicting cues demonstrates that some HI ears are using not only the primary cue, but also conflicting cues for correct speech perception. Our results suggest that the LEG are more likely to benefit from hearing-aids. Thus it would be clinically useful to classify subjects in this way to predict success with their aided condition, as well as to improve the fitting algorithm.

TINNITUS

Poster # 90

Effects of Tinnitus Relief Using Broadband Noise and Notched Sound
Seungyeop Jeong, BS; Hongyeop Oh, BS; Jeeun Yoo, BS; In-Ki Jin, PhD, Hallym University, Gangwon-do, Korea

Background: Counseling and/or sound therapy are common tinnitus rehabilitation options. Traditional sound therapy is generally performed using Broadband Noise (BBN), but recent studies using notched sound showed significant tinnitus improvement. Although the effects of sound therapy using BBN or notched sound were individually tested on tinnitus improvement, the effect of BBN versus notched sound on rehabilitation has not been compared. Purpose: The purpose of this study was to compare the effect of tinnitus improvement on sound therapy between BBN and notched BBN sound. Research design: Ten subjects with chronic tinnitus participated in this study. All subjects were randomly grouped into either a BBN sound therapy group or a notched BBN sound therapy group, and performed sound therapy with a directive counselling for 3 months. Data collection and analysis: Score changes between pre- and post-treatment sessions for the Korean-Tinnitus Primary Function Questionnaire (K-TPFQ) and Visual Analysis Score (VAS) of loudness and awareness time for tinnitus were measured. Results: There were no statistically significant differences between the two groups for K-TPFQ and VAS. However, both groups showed significant tinnitus improvement. Conclusions: Although further studies are required, notched sounds may be a viable option for sound therapy in the treatment of tinnitus.

Poster # 91

Clinical Algorithm to Promote Standardization of Evidence-Based Tinnitus Services
Candice Manning, PhD, National Center for Rehabilitative Auditory Research (NCRAR), Portland, OR

Purpose: Clinical services for tinnitus are needed by millions of people annually. These services have not been standardized, and patients are vulnerable to receiving services that may appear legitimate but are not evidence-based. Method: The American Academy of Otolaryngology-Head and Neck Surgery Foundation (AAO-HNSF) published their Clinical Practice Guideline: Tinnitus in 2014, which is the first evidence-based guideline for the management of tinnitus. The proposed clinical algorithm is based on the AAO-HNSF guidelines and on research conducted at the National Center for Rehabilitative Auditory Research (NCRAR). Discussion will focus on two randomized controlled trials (RCTs) completed at the NCRAR that showed efficacy of an audiologic protocol. Results: The AAO-HNSF guidelines are summarized and include the discussion of assessment, intervention/management, and patient education. The two NCRAR RCTs revealed significant reduction of tinnitus functional effects for both hearing aids and 'combination instruments,' although there were no significant differences between devices. Conclusion: A defined clinical protocol is proposed for audiologists, which includes a case history, appropriate referral, audiologic assessment, validated questionnaires, brief tinnitus counseling, hearing aids/combination instruments as warranted, and follow-up assessment. Use of this algorithmic protocol can help to promote standardization of tinnitus practice by audiologists.

Poster # 92

Tinnitus Rehabilitation Effects Using Partial Masking with Nature Sounds
Jeeun Yoo, BS; Sohee Heo, BS; Inki Jin, PhD, Division of Speech Pathology and Audiology, Hallym University, Chuncheon, South Korea

Background: Sound therapy using masking is one method used for tinnitus rehabilitation. Although broadband noise is used as stimuli for the sound therapy, several studies have suggested nature sounds, like wave sounds, as a stimulus. However, it is unclear whether the effects of tinnitus rehabilitation using nature sounds are more effective than rehabilitation using broadband noise. Purpose: The purpose of the current study was to identify tinnitus rehabilitation effects using partial masking with nature sounds. Research design: The twenty-four chronic tinnitus subjects were randomly divided into two groups: the nature sound group and the broadband noise group. The partial masking was applied in both groups. The rehabilitation period was three months. Data collection and analysis: A comparison between pre- and post-treatment score changes of the Tinnitus Handicap Index(THI) was conducted. Results: In terms of the THI score change between pre- and post-treatment sessions, the nature sound therapy group showed 15.92% improvement but the broadband noise group showed 8.43% improvement. Statistical significance was observed only in the nature sound group ($p<.05$). Conclusions: The result of the current study indicates that sound therapy using nature sounds was more effective than sound therapy using broadband noise during a short period of tinnitus rehabilitation.

ANATOMY and PHYSIOLOGY

Poster # 93

Mouse Strain-Dependence in the Effects of Moderate Noise on the Cochlea
Haley Lanoue, BS; Kevin Ohlemiller, PhD, Washington University School of Medicine, St. Louis, MO

Recent work (Ohlemiller et al., 2018) indicates that moderate noise exposure (>90 dB SPL, 2 hr) forms holes or tears in the reticular lamina of young adult mice (6-7 weeks old). Endocochlear potential (EP) measures show a significant drop immediately after the same noise exposures, potentially reflecting 'shorting out,' of the EP from uncontrolled ion leakage. This injury appears strain- (genetically-) dependent, such that young CBA/J and BALB/cJ (BALB) mice are affected, but not C57BL/6J (B6) mice. The order of vulnerability to opening of the lamina corresponds to the relative vulnerability to noise-induced permanent threshold shift (PTS) in young adult mice of these strains. Together, evidence to date suggests that cochlear lateral wall dysfunction in young mice promotes outer hair cell loss and PTS. The current work seeks to confirm the formation of openings in cochlear reticular lamina immediately after noise in young CBA/J, BALB, and B6. Sectioned, plastic embedded cochleae from acutely noise-exposed mice at 6-7 wks (n = 8/group, both sexes) will be blindly scored for holes/tears by light microscopy after various durations of noise exposure at 104 dB SPL. Ohlemiller, K. K., Kaur, T., Warchol, M. E., & Withnell, R. H. (2018). The endocochlear potential as an indicator of reticular lamina integrity after noise exposure in mice. Hearing research, 361, 138-151.

Poster # 94

Establishing Visual Guidelines for the Locus of Human Auditory Cortex

Aaron Whiteley, BS; Bryan Wong, BS; Barrett St. George, BA; Maggie Schefer, BS; Jillian Bushor, BS; Carrie Clancy, BA; Frank Musiek, PhD, University of Arizona, Tucson, AZ

Given the variability of human brain anatomy, there is a need to form a guideline for visually identifying important auditory structures. Traditionally, visual guidelines have been taught in order to help clinicians quickly and reliably identify central auditory structures in the brain. However, the reliability of some of these guidelines have been accepted but not necessarily studied extensively. This study examines the location of Heschl's gyrus along the superior temporal plane and the consistency of the 'two-thirds rule' - a rule that states that Heschl's gyrus appears in the most posterior third of the superior temporal plane. Heschl's gyrus and intra-hemipsheric and inter-hemispheric measures of neighboring structures along the superior temporal plane are examined, and new data is reported. The relationship between the two-thirds rule and other variables such as: the angle of Heschl's gyrus, the size and shape of planum temporale and Heschl's gyrus, and the type of ascending ramus were observed. This new data obtained from the current study should allow a more accurate interpretation and application of the two-thirds rule. In addition, morphometric information regarding the auditory cortex and its location and morphometry has also been obtained.

Poster # 95

Assessing the Osteolytic and Osteoblastic Responses to Virotherapy for Cholesteatoma

Brian R. Earl, PhD; Ravi N. Samy, MD; Ivy Schweinzger, BS; Noga Lipschitz, MD; Joseph Pinkl, AuD, University of Cincinnati, Cincinnati, OH

Background: Surgery has been the standard of care for cholesteatoma (CHST) for over 100 years, although the recurrence rate is as high as 70%. Recent in vitro and in vivo research in a gerbil model has shown that virotherapy with an oncolytic herpes simplex virus (oHSV) could be effective in eradicating CHST cells. This study aimed to characterize bony erosion (osteolysis) and bony growth (osteoblastosis)

within the middle ear (bulla) over the course of oHSV treatment. Methods: CHSTs were induced in 10 Mongolian gerbils (n=20 ears) using a double ear canal ligation approach. The animals received either one, two, or three intra-bullar oHSV injections beginning 2-4 weeks post-CHST induction. Osteolytic and osteoblastic changes within the bullae were assessed with high-resolution micro-CT scans obtained pre- and post-treatment. Results: Osteolytic changes were observed in the bullae of the majority of ears prior to oHSV treatment. Following either one, two, or three oHSV treatments, the majority of ears exhibited osteoblastic changes including thickening of the bullar bone and, in some cases, closing of pre-treatment voids in the bullar bone. Conclusion: Virotherapy with oHSV appears to induce an osteoblastic response within the middle ear cavity which can partially reverse CHST-induced osteolysis.

Poster # 96

Towards a Clinical Test of the Auditory Efferent System

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Hilary MacCrae, BS; Sumitrajit Dhar, PhD, Northwestern University, Evanston, IL

The auditory efferent system, especially the medial olivocochlear reflex (MOCR), is implicated in both typical auditory processing and in auditory disorders. However, the clinical applicability of the MOCR is underutilized. This is, in part, because the repeatability of conventional MOCR tests is rather low. Conventional tests employ broadband noise in one ear while monitoring change in otoacoustic emissions (OAEs) in the other ear to index efferent activity. These assays, (1) are limited in their ability to assay only the contralateral MOCR pathway, (2) risk activating the middle ear muscle reflex (MEMR), and (3) are unable to extract the kinetics of the reflexes. We have developed a method that repurposes the same OAE-evoking click train to also concurrently elicit the MOCR bilaterally. Data from click-train presentation at 80 dB peSPL in 15 young normal-hearing adults demonstrate the feasibility of our method. Mean MOCR magnitude (~2 dB) and activation time-constant (150-200 ms) corroborate prior MOCR reports. The data also suggest several advantages of the novel method including, (1) the ability to monitor MEMR, (2) obtain both magnitude and kinetics of the MOCR (time constants), and (3) a potential reduction in test-time based on the application of statistical stopping rules.

Poster # 97

Acoustic Reflexes in Chinchillas with Selective Inner Hair Cell Loss

Hannah Swanner, BS; Monica Trevino, BA; Eliza Granade, BA; Christina Campbell, BA; Edward Lobarinas, PhD, University of Texas at Dallas, Dallas, TX

The acoustic reflex is an involuntary response of the middle ear stapedius muscle to moderately loud sound. This response results in a measurable decrease in the admittance of the ossicular chain, reducing acoustic input to the inner ear. Diagnostically, the acoustic reflex (AR) threshold and amplitude are widely used in comprehensive hearing assessments. Approximately 65% of Audiologists in the US include the AR as part of their standard hearing test battery to evaluate retrocochlear pathways, corroborate hearing thresholds, and detect nonorganic hearing loss. Robust reflexes can be obtained in patients with mild to moderate sensorineural hearing losses associated with loss of outer hair cells (OHC) but are substantially diminished or abolished by severe to profound hearing loss. Remarkably, the relationship between the AR and inner hair cells (IHC), the primary conduits of acoustic information, is unknown. To

answer this important question, we assessed the presence and amplitude of the AR in chinchillas before and after carboplatin treatment that reliably and selectively destroys IHC. We hypothesized that a substantial IHC loss would result in a significant reduction of the acoustic reflex amplitude or abolish the response.

Poster # 98

Large-scale Examination of Spontaneous and Evoked Reflection Otoacoustic Emissions (OAEs)
Uzma S. Wilson, AuD; Courtney Glavin, AuD; Sumitrajit Dhar, PhD, Northwestern University, Evanston, IL

Various psychoacoustic and otoacoustic phenomena (i.e. threshold microstructure and spontaneous otoacoustic emissions [SOAEs]) are theorized to originate from the same mechanical properties of the cochlea. SOAEs are a result of multiple internal reflections that become locally amplified and self-sustained due to the impedances encountered at the middle ear boundary. Likewise, the reflection component of distortion product otoacoustic emissions (DPOAEs) is thought to be a sum of reflected energy arising from randomly distributed irregularities from the 2f1-f2 characteristic place. A theoretical relationship between the phase slope of reflection emissions and basilar membrane/neural tuning has been proposed and examined, as has the relationship between reflection OAE phase slope and the spacing of SOAEs. However, only a few studies in humans with small sample sizes have examined this relationship between spontaneous and evoked reflection emissions, both supposedly arising from the same generation mechanism. Using a large dataset, we test the hypothesis that SOAEs and the reflection component of DPOAEs have a common generation mechanism. If true, the phase slope of the reflection component of DPOAEs and the normalized spacing of adjacent SOAEs will be related and can be used to better understand the relationships between spontaneous and evoked reflection emissions.

Poster # 99

Examining Involvement of Olivocochlear Efferents for Frequency Discrimination
Kristin M. Johnson, BA; Ian Mertes, PhD, University of Illinois at Urbana-Champaign, Champaign, IL

The olivocochlear efferent system improves sound detection in noise by modifying the motility of the outer hair cells. However, past speech-in-noise task studies using complex speech and comparing those results to efferent activity have yielded conflicting results. Of note, the underlying mechanism in which the efferent system aids speech-in-noise detection is not yet known. Complex speech contains multiple variables making it challenging to isolate potential cues the efferent system may take advantage of (e.g., frequency resolution, gap detection, intensity discrimination, etc.). Therefore, an examination of individual speech components may provide insight regarding previous contradictory results. We are currently examining frequency discrimination in isolation, based on animal work by Hienz et al. (1998). The protocol consists of measuring olivocochlear strength in normal-hearing humans utilizing contralateral suppression of otoacoustic emissions, then comparing these results to an adaptive vowel formant discrimination task. The task is performed at three signal-to-noise ratios. We hypothesize that those who show stronger olivocochlear activity will also show better frequency discrimination skills. This research may aid in the creation of auditory training programs, as well as contribute to development of a clinically-feasible test of efferent contributions to speech perception. Further results will be discussed at the meeting.

AUDIOLOGY / OTOLOGY

Poster # 100

Hearing Tests on Mobile Devices: Pitfalls when Interpreting the Results
Marcin Masalski, PhD; Krzysztof Morawski, PhD, Wroclaw Medical University, Warsaw, Poland

Monitoring and diagnosis of hearing are especially important in preventing and treatment of hearing loss. Hearing screening tests on mobile devices can be conducted at a low cost on a large scale, however, their interpretation requires consideration of factors specific to this type of examination that may affect the test results. The purpose of the study is to identify and analyze the factors specific to mobile-based hearing test. The research was based on over 500,000 tests conducted in uncontrolled conditions in the years 2016-2018. Each test was carried out using bundled headphones and consisted of self-identification of the quietest audible sound by manual adjusting its intensity. The device was previously calibrated by a group of normal-hearing app users. The factors that may affect the mobile-based hearing test results were identified and analyzed: test time, the presence of contralateral masking noise, heuristic parameters of background noise and the number of calibrations used to determine the calibration factors. Basing on the analyses, the thresholds of critical parameters determining the correct results were identified. A modification of the procedure was proposed to improve the accuracy.

Poster # 101

"5-Minute Hearing Screening" in Adults with and without Alzheimer's Disease
Jasmin Lucia Martinez, BA, University of Cincinnati, Washington University School of Medicine, St. Louis, Cincinnati, OH
Kate McClannahan, PhD; Dennis Barbour, PhD; Jonathan Peelle, PhD, Washington University in St. Louis, Saint Louis, MO

Hearing and cognitive function decline with age. Previous studies report a small but significant relationship between declines in cognitive function and declines in hearing (Lin, 2011; Lin et al., 2013). Early identification and treatment of hearing impairment in individuals with AD would improve communication between the patient and their providers and caregivers. While pure-tone threshold testing is the standard for evaluating hearing loss, it is typically only administered by audiologists in the context of hearing related appointments. This study sought to determine the validity and reliability of an abbreviated protocol designed for clinicians to administer in the context of non-audiological clinical situations. This '5 Minute Hearing Screening' included an adaptive computerized audiometric screening tool, the Machine Learning Audiogram (MLAG; Song et al., 2015) paired with the Hearing Handicap Inventory for the Elderly screening questionnaire (HHIE-S; Ventry & Weinstein, 1982). Older adults participated in 2 sessions which each included a comprehensive audiometric test, MLAG, and HHIE-S. We hypothesized that the '5-minute Hearing Screening' would show good test-retest reliability and accurately predict hearing acuity in older adults with and without symptomatic AD. Preliminary findings suggest that the abbreviated protocol is a reliable measure of objective and subjective hearing status in this population. Funded by NIH T35 DC008765 and R01 DC014281.

Poster # 102

Clinical Trial of an Automated Hearing Screening and Education System

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Our research team developed a computer-based, automated hearing screening and education system to motivate individuals with hearing loss to enter the hearing healthcare system. A clinical trial was conducted at four study sites (Portland, OR; Minneapolis, MN; Columbus, OH; and Bay Pines, FL). Participants were randomized into one of four study arms: 1) Control, no hearing test, questionnaires only; 2) 5-frequency pure-tone threshold test (PTT); 3) four-frequency pure-tone screening (PTS); and 4) digits-in-noise test (DIN). Screenings took place in several communities to allow an evaluation of the application of these screening methods for various populations (e.g., Veteran and non-Veteran, region of the country). Follow-up interviews were conducted 6-8 months after the hearing screenings to determine if participants did or did not pursue additional hearing healthcare evaluations. Results: 1,667 individuals participated, 1,012 of whom provided follow-up data. 467 of 762 participants (61.3%) with follow-up data failed one of the three hearing screening tests. The percentage of participants who failed the screening and pursued hearing healthcare during the follow-up period were: PTT - 25.7%; PTS - 31.7%; DIN - 23.3%. These compared to 16.8% of Controls who pursued hearing health care. The effect of including an educational module on screening outcome will be discussed.

Poster # 103

Air-Bone Gaps Measured Using Frequency-Limited Environmental Sounds and Spondee Words

Sarah F Poissant, PhD; Briana Deslauriers, BA; Richard Freyman, PhD, University of Massachusetts Amherst, Amherst, MA

In order to extend useful audiometric test time for young children or other difficult-to-test patients, we have developed two sets of stimuli that are likely more engaging than tones: half-octave wide environmental sounds and octave wide spondee words. These stimuli have been shown to be valid and reliable in measuring sound field auditory thresholds in young adults with normal hearing who listened both with and without simulated hearing loss and in a small set of adults with sloping hearing losses. In the present investigation, we extend this work to the measurement of bone conduction thresholds with the goal of being able to identify air-bone gaps. Subjects were 14 young adults with normal hearing whose warble tone thresholds were compared to narrowband environmental sound and spondee thresholds measured via both air and bone conduction. During the measurement of air conduction thresholds, subjects wore a foam earplug to simulate a conductive hearing loss. Results suggest that, similar to warble tones, these narrowband environmental and spondee stimuli are capable of identifying and quantifying air-bone gaps. This finding has important implications for the application of these stimuli

to the assessment of very young children, a clinical population that often presents with middle ear effusion.

Poster # 104

Characterizing SNHL in Peroxisome Biogenesis Disorders in the Zellweger Spectrum
John Lee, AuD, Harvard University - Speech and Hearing Bioscience & Technology Program, Cambridge, MA
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Peroxisome Biogenesis Disorders in the Zellweger Spectrum (PBD-ZSD) are autosomal recessive disorders that affect formation of functional peroxisomes. These disorders are characterized by sensorineural hearing loss, retinal degeneration, and multiple organ dysfunction. Mutations in any of 14 PEX genes have been found to cause PBD-ZSD. PEX1 mutations are the most common and are found in nearly 70% of affected individuals. Currently, there are no targeted therapies for PBD-ZSD and management is supportive only. PBD-ZSD patients suffer from moderately-severe to profound sensorineural hearing loss that has not been well characterized in regards to natural history and pathophysiology. We reviewed audiologic records from 70 patients with PEX1 mutations. Initial analyses confirm the hearing phenotype associated with these mutations. When patients were stratified by genotype, a correlation with severity was found. Patients who possess the G843D mutation in one PEX1 allele and a null allele in trans (G843D/null) suffer from severe to profound hearing losses. Patients with PEX1 homozygous mutations (G843D/G843D) suffer from moderate to profound hearing losses. Additional analyses will be done to better characterize age-related changes and amplification-based outcomes in these patients with PEX1 mutations. This information will help to improve management options and assist in future therapeutic developments.

Poster # 105

Synchronized Spontaneous Otoacoustic Emissions in a Hearing Test Battery
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Angie Garinis, Oregon Health and Science University, Portland, OR

Otoacoustic emissions (OAE) are generated by active cochlear mechanisms in response to sound. The specific underlying mechanism that generates OAEs varies depending upon the type of stimulus used to elicit the response and the analysis method used to extract the emission. Spontaneous synchronized OAEs (SSOAEs) elicited with clicks are delayed relative to shorter duration click-evoked OAES (CEOAEs), measured during the silent interval after the offset of the stimulus, and generated by multiple internal reflections. SSOAEs and CEOAEs were obtained in 83 adults (20 to 72 years of age) with normal hearing and in 61 adults (35 to 79 years of age) with mild to moderate sensorineural hearing loss. SSOAEs were recorded in half-octaves centered around 710 to 4000 Hz. SSOAEs were recorded in 42.3% of ears with normal hearing and 5% ears with sensorineural hearing loss. The highest incidence of SSOAEs in ears

with normal hearing was at 1410 Hz (25.8%). Chirp-evoked OAEs had 2-3 dB better signal-to-noise ratio at 1000, 2000, and 4000 Hz in ears with SSOAEs in comparison to ears without SSOAEs. SSOAEs may not have sufficient prevalence for inclusion in a hearing test battery. However, they do appear to provide a boost in SNR of CEOAEs.

Poster # 106

Short-term Reliability of Contralateral Suppression of Transiently Evoked Otoacoustic Emissions
W. Wiktor Jedrzejczak, PhD; Edyta Pilka, MS; Krzysztof Kochanek, PhD; Henryk Skarzynski, PhD, Institute of Physiology and Pathology of Hearing, Warsaw, Poland

The effect of suppression of otoacoustic emissions (OAE) by contralateral acoustic stimulation (CAS) is very faint, on the level of 1,Äì2 dB. At the same time OAEs are known to have quite high variability across subjects and some fluctuation of the signal between measurements is also present. The purpose of the present study was to investigate short-term reliability of contralateral suppression of transiently evoked OAEs (TEOAEs). TEOAEs were recorded in a group of adults with normal hearing. TEOAEs were recorded using the linear protocol (all stimuli at the same level and polarity); stimulus levels were kept at 65 dB peSPL; and a 60 dB SPL broadband noise was delivered to the contralateral ear as suppressor. Multiple measurements were conducted for each patient consisting of recordings with different number of averages, and with and without refitting of the probe. Synchronized spontaneous OAEs (SSOAEs) were also measured. Broadband and half-octave values of TEOAE response levels and suppression were investigated. As could be expected the reliability of suppression effect was higher with higher number of averages and with higher signal to noise ratio. Additionally the effect of suppression tended to be more reliable in ears with detected SSOAEs.

Poster # 107

Wideband Tympanometry: Contralateral Acoustic Reflexes and Normative Data
Zoe A. Dinger, BS; Ian Mertes, PhD, University of Illinois at Urbana-Champaign, Champaign, IL

Wideband tympanometry (WT) is a measure of the middle ear's absorbance across a range of frequencies and pressures. This study used a clinical device to examine WT in adults with normal hearing and middle ear functioning to obtain normative data, analyze test-retest reliability, and examine growth and frequency effects of the acoustic reflex. Two WT measurements were obtained in each participant's right ear to determine test-retest reliability. Then, wideband absorbance was measured while broadband pulsed noise was presented from 50-80 dB SPL to the contralateral ear to activate the acoustic reflex. Preliminary results have shown that there is a greater reduction in absorbance from 500-1000 Hz relative to 250-500 Hz, even at the lowest elicitor level. Acoustic reflex growth was also less compressive in the 500-1000 Hz frequency range as compared to 250-500 Hz. Initial results suggest that 226 Hz may not be the ideal probe tone to measure acoustic reflexes in clinical populations, consistent with previous work using research equipment. This study will improve our basic understanding of middle ear mechanics across a broad frequency range, may lead to the ability to identify acoustic reflexes in more individuals, and may allow for measurements at a more comfortable listening level.

Poster # 108

Characteristics of Transient Evoked Otoacoustic Emissions With Different Time Windows
Devon Pacheco, BS; Beth Prieve, PhD, Syracuse University, Syracuse, NY

Transient evoked otoacoustic emissions (TEOAEs) are a non-invasive measure of cochlear function and are composed of short-latency (SL) and long-latency (LL) components. The SL components originate from multiple places on the BM and grow linearly, and LL components originate from the peak of the traveling wave and grow compressively as stimulus level increase. The purpose of this study was to isolate the LL components and compare their characteristics to TEOAEs that have a mixture of SL and LL components. TEOAE input/output functions for 2 kHz tonebursts were measured between 4 and 20 ms in 7 normally hearing adults. Offline, TEOAEs were analyzed using starting time windows that increased in 1 ms steps, from 4 to 9 ms. The slopes of TEOAE input-output functions were increasingly lower as starting time window increased. Gain functions were constructed by normalizing TEOAE level relative to stimulus level for each starting time window. The slopes of the gain functions were higher for the 4 ms starting window than for the 6 ms starting window, suggesting differences between TEOAEs dominated by LL components and those that contain both SL and LL components. [Funded by Gerber Auditory Research Grant]

Poster # 109

Calibration of Target Word Level Embedded in a Carrier Phrase
Emily M. Chu; Robert Schlauch, PhD, University of Minnesota, Minneapolis, MN

Scientists disagree over the approach for calibrating word level in standardized recordings of speech tests. The same concern applies to monitored-live-voice presentations of speech in clinical settings. One approach is to have the talker produce calibrated levels (peaking at 0 dB VU) for words in a carrier phrase (e.g., "Please select the word") and to let the target word fall naturally. The justification for this approach is that word level varies naturally and predictably depending on phonetic context. Another approach is to equate each target word for its root-mean-square (rms) level, which controls for idiosyncratic differences in production levels. To assess this issue, rms levels for words and carrier phrases from an online source for the Modified Rhyme Test (Institute for Telecommunication Sciences) were analyzed for 9 talkers. The entire utterance (carrier phrase plus target word) had equal rms levels (within 1 dB). A detailed analysis of a sample of target words revealed significant inter-talker level differences that are larger than within-talker differences based on speech acoustics (e.g., open vowels in voiced consonant environments vs closed vowels in voiceless consonant environments). The strengths and limitations of each approach for setting the level of the target word will be discussed.

AUDITORY PROCESSING

Poster # 110

Effects of Age, Cognition, and Neural Encoding on Speech Perception
Lindsey Susan Roque, BS; Samira Anderson, PhD, University of Maryland, College Park, College Park, MD

Older adults, even those with normal hearing, experience increased speech perception difficulties compared to younger adults. Age-related cognitive decline and reduced auditory temporal processing may contribute to reduced speech perception. The present study investigates the interplay between cognition, perception, and neural processing of temporal speech cues to gain a better understanding of the communication difficulties often experienced by older adults. To assess cognition, younger and older adults completed three measures of cognitive functioning: working memory, processing speed, and inhibitory control. To assess perception, identification functions were obtained for the 9-step continuum of vowel duration observed in the contrasting word pair WHEAT (93 ms) and WEED (155 ms). To assess neural representation, frequency-following responses and cortical auditory-evoked potentials were recorded to the two endpoints of the WHEAT-WEED continuum. Younger adults demonstrated higher cognitive scores, clearer distinction between WHEAT and WEED, and better neural processing compared to older adults. Results of multiple linear regression analyses suggest that different mechanisms contribute to the perception of vowel duration cues in older versus younger adults, which may underlie older adults' speech recognition difficulties.

Poster # 111

Speech Intelligibility Benefit for Korean Clear Speech

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Background: Clear Speech is one of the speaker-centered communication strategies that can improve speech intelligibility. English-based Clear Speech is known as an effective communication strategy that helps improve speech intelligibility for children, adults, people with hearing loss, and non-native speakers. Purpose: The purpose of this study was to investigate the speech intelligibility benefit for Korean clear speech compared to conversational speech. Data collection and analysis: Speech intelligibility performances (keyword percent correct) between clear speech and conversational speech were measured with young adults with normal hearing (50), older adults with normal hearing (30), and older adults with hearing loss (50) in five signal-to-noise ratios. The intensity of the stimulus was presented at 70dB SPL, and the number of sentences per condition was 20. Results: Speech intelligibility performance, according to the production method, showed significantly higher speech intelligibility when presented with clear speech in most SNR conditions and all groups. Conclusions: The results of this study showed that the Korean-based Clear Speech may be an effective method of improving communication for people with hearing loss.

Poster # 112

Association Between Hearing Loss, Cognitive Impairment and Amplification Use

Dave Andrew Harris, PhD; Andrew Nash, BS; William-Maurice Redden, MD, Saint Louis University School of Medicine, St. Louis, MO

Hearing loss, in addition to being one of the most reported occupationally induced hazard, it is also associated with aging and affects 5.3% of the global population (Stevens et. Al 2013). Coincidentally, dementia is the leading cause of disability worldwide and affects approximately 6.5% of the population over the age of 65 (CP Ferri et. al 2005., YT Wu. et al. 2017). This preliminary study will summarize

recent findings in literature and compare to our current patient population. We will examine medical records of all patients over the age of 65 with hearing loss. We will examine the age at which hearing loss is diagnosis, whether cognitive impairment is diagnosed or not, age at diagnosis of cognitive impairment (including Dementia and Alzheimer's), use of amplification, and duration of amplification use.

Poster # 113

Recognition Performance and Error Patterns of Consonants Spoken at Conversational Rate
Sandeep A. Phatak, PhD; Ken Grant, PhD, Walter Reed National Military Medical Center, Bethesda, MD

Consonant recognition is frequently measured using nonsense syllables spoken in isolation. However, the production, and therefore the perception of consonants in isolated syllables may not generalize to consonant recognition in conversational speech. The primary goal of the current study was to measure consonant recognition when presented in phrases produced at conversational rates, and to compare it with consonant perception in isolated syllables. A second goal of the study was to measure the effect of hearing loss on consonant perception with and without (a) gain, and (b) visual speech cues. A modified 1-up/1-down tracking method was used to estimate the SNR for 70% recognition performance and the slope of the performance function around this point. The effects of consonant position were minimized using a level-matched modulated noise masker. As expected, hearing loss degraded the recognition of consonants and visual speech cues yielded improvement, especially in hearing-impaired listeners, while gain did not have a significant effect. A comparison with isolated syllable data [Grant & Walden,1996] revealed that consonant recognition at conversational rates is relatively more difficult. The contribution of visual cues to the intelligibility of different consonant features also appears to be different in isolated syllables than in conversational speech.

Poster # 114

Frequency and Temporal Resolutions Characteristics of Single-Sided Deafness
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Jihyeon Lee, MS; Youngjoon Seo, MD; Taehoon Kong, MD, Department of Otorhinolaryngology, Yonsei University Wonju College of Medicine, Wonju, Republic of Korea

Many studies have reported no benefit of sound localization, but improved speech understanding in noise after treating patients with single-sided deafness (SSD). Furthermore, their performances provided a large individual difference. The present study aimed to measure the ability of frequency and temporal resolution for the SSD patients to better understand their hearing nature. Nine SSD patients with different onset and period of hearing deprivation and 20 young adults with normal hearing (NHL) and simulated conductive hearing loss (UHL) as the control groups participated. To evaluate the frequency and temporal resolutions, speech perception in noise (SPIN) with the +5 and -5 dB signal-to-noise ratio conditions and gap-in-noise (GIN) tests were applied, respectively. Compared to the groups with NHL and UHL, the SSD group showed much poor performance in both SPIN and GIN tests while supporting central auditory plasticity of the SSD patients. Rather than a longer period of deafness, interestingly the large individual variance indicated that the congenital SSD patients showed better performance than the

acquired SSD patients in two measurements. The results suggested that central assessments should be implemented before any treatment of the SSD patient considering their onset time and etiology.

Poster # 115

Effects of Perceptual Load and Task Expectations on Distractor Interference
Erin Elizabeth Lynch, MS, Ohio University, Athens, OH
Jeffrey DiGiovanni, PhD, University of Cincinnati, Cincinnati, OH

Individuals with auditory disorders express difficulty separating target speech from background noise and find such noise distracting. Studies investigating distractibility primarily employ cross-modal paradigms and separately assess the contributions of executive functions, task load and motivation. Results from previous literature demonstrate that superior executive functions, namely working memory (WM), and tasks high in perceptual load allow for greater task engagement and reduced distractor interference. Similarly, when instructions prime expectations of a task as 'difficult' participants exhibit increased effort and improved performance; however, the influence of instruction bias on distractibility has not been evaluated. The intent of the current study was to determine if the manipulation of motivation via instruction bias effects distractor interference similarly to perceptual load across WM capacities, specific to the auditory domain. Normal hearing and cognitively functioning adults ages 18 to 30 years were recruited for participation. Four conditions of a dichotic-listening sustained attention (SA) task were developed to address the primary research question: 1) neutral instruction - high perceptual load, 2) neutral instruction - low perceptual load, 3) primed 'difficult' - low perceptual load and 4) primed 'easy' - high perceptual load. Findings from this study provide insight about the patterns of distractibility under various perceptual loads and biased expectations.

Poster # 116

The Relation Between Auditory and Visual Selective Attention in Children
Kristi Ward, MA; Tina Grieco-Calub, PhD, Northwestern University, Evanston, IL

Previous research has demonstrated that auditory selective attention develops with age during childhood. This development has potential implications for children's ability to understand speech in complex acoustic environments, such as a classroom, that require children to selectively attend to the target auditory stream as it unfolds over time. It remains unknown, however, whether the observed age-related changes in selective attention are specific to the auditory domain, or whether they reflect domain-general development in attentional control. The purpose of the present study is to investigate whether visual selective attention relates to auditory selective attention in children between 5-12 years of age. Auditory and visual selective attention were measured using behavioral change detection tasks comprised of target and distractor streams of words (auditory) or pictures (visual) with randomly presented deviant stimuli. Auditory and visual selective attention were quantified by children's rate of responses to deviants in the target stream (hits) and distractor stream (false alarms), as well as the reaction time of these responses during each task. Results will be discussed within the context of how selective attention - as a domain-specific and domain-general cognitive process - underlies children's ability to navigate real-world complex acoustic environments in order to understand speech.

Poster # 117

Intrusion of Task-irrelevant Information in the Older-adult Selective Auditory Attention

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Owing to selective auditory-attention deficits, older adults have difficulty separating perceptually task-relevant from irrelevant sounds; research is needed to determine how the task-irrelevant information intrudes in the processing of the relevant one. Here, effects of irrelevant duration or level differences on discrimination thresholds of target frequency (FDTs) were studied in healthy, normal hearing young (YA) and older adults (OA). Targets (T) occurred in isolation or followed by a distracter tone (D) after a 90 or 350s silent interval (ITI); both T and D were 1000 Hz, 80 ms, and 70-dB SPL. Irrelevant differences occurred simultaneously with T frequency differences or sequentially in D. In all conditions, FDTs were larger in OAs than in YAs, the effect decreasing with ITI. In OAs, FDT elevations were large with irrelevant differences in level but not in duration; in YAs, all elevations were small. In OAs, interference obtained only when the target and the irrelevant stimulus differences had features in common (e.g., pitch and loudness) that were close in time. As a result, OAs tended to use the irrelevant differences as a reference against which to discern relevant differences; without features in common (e.g., pitch and duration) irrelevant differences did not hinder frequency discrimination in OAs.

Poster # 118

Language Processing and Working-Memory in Blast-Exposed Veterans

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Lindsey Jorgensen; Michelle Novak, BS, Sioux Falls VA Healthcare System; University of South Dakota, Sioux Falls; Vermillion, SD

Some Veterans with histories of blast-exposure and presumed mild traumatic brain injury (mTBI) complain of hearing impairment despite normal standard audiometric test performance. Many of these Veterans also exhibit Post-Traumatic Stress Disorder (PTSD). Along with hypersensitivity, these individuals may have poor processing skills and reduced access to cognitive resources. As a result, they are at-risk for poor performance on tests of language processing and executive function. Veterans with normal or near-normal pure-tone thresholds were enrolled into one of four groups based on blast exposure, self-perceived hearing impairment, and PTSD: mTBI-only, PTSD-only, PTSD+mTBI, and a non-blast-exposed control group. They completed the Computerized Revised Token Test battery evaluating nonlinguistic timing processing, the Stroop interference effect, and reading- and auditory-language processing in quiet and in speech babble. They also completed visual and auditory short-term and working-memory digit span tests, and the Trail-Making Test. All groups performed similarly on tests of language processing across noise conditions, and nonlinguistic processing. Stroop interference was similar across groups but appeared to persist longer for those with PTSD-only. Working-memory performance was largely similar across groups, but auditory-backward digits recall accuracy was higher

for mTBI-only than for PTSD+mTBI groups. Increasing sample size may further reveal cognitive differences between groups.

COCHLEAR IMPLANTS

Poster # 119

Measuring Pitch Matching for Cochlear Implant Patients using Acoustic Stimuli
Justin Aronoff, PhD; Hannah Staisloff, BS; Abbigail Kirchner, BS, University of Illinois at Urbana-Champaign, Champaign, IL

Bilateral cochlear implant (CI) users will often indicate that they have a rumbly ear and a squeaky ear. Helping CI users hear similar sounds in the two ears requires first determining the relationship between pitches heard in the two ears. Although we have previously shown that pitch matches can be acquired quickly, our pitch matching paradigm, like those from other labs, requires specialized equipment for direct control of stimulation found only in laboratories. The goal of this study was to determine if it is possible to derive the same pitch matches while using acoustic stimuli instead of direct control of stimulation. Acoustic stimuli were designed based on the frequency allocation for a 15 channel current steered strategy, reflecting the strategy used in the processors for this experiment. Stimulus amplitude was adjusted based on frequency to counteract the effects of pre-emphasis. Two bilateral CI users completed a pitch matching task for 31 reference stimulation locations using direct control of stimulation and using pure tones. The results indicated that the pitch matches obtained with the two methods were similar. This suggests it is possible to design an acoustic pitch matching paradigm to accurately measure the relationship between pitches in the two ears.

Poster # 120

Forward Masking Recovery for Poor Electrode-Neuron Interfaces in Older Listeners
Kelly Nicole Jahn, AuD; Julie Arenberg, PhD, University of Washington, Seattle, WA
Lindsay DeVries, PhD, University of Maryland, College Park, MD

Age-related changes in temporal processing can alter auditory perception in older adults with cochlear implants (CIs). Temporal processing difficulties might be further exacerbated by poor interfaces between CI electrodes and their target auditory neurons or by long periods of deafness prior to implantation. The aim of this study was to evaluate potential interactions between chronological age, duration of deafness, and the estimated quality of the electrode-neuron interface (ENI) to psychophysical forward masking recovery. Twelve CI listeners (age 15 to 88 years) with Advanced Bionics devices participated. To estimate the quality of the ENI, behavioral thresholds were measured on electrodes 2-15 using a spatially-focused electrode configuration. Forward-masked thresholds were measured on the highest and lowest threshold channels in each listener for eight masker-probe delays. Results showed that older listeners require significantly longer masker-probe delays than younger listeners to fully recover from forward masking, irrespective of duration of deafness. This age-related difference in forward masking recovery was more pronounced on high threshold channels, which are thought to indicate a poor ENI. Peripheral factors that influence the quality of the ENI might be particularly detrimental to temporal processing in older CI listeners, which may influence detection of fast changes in a speech signal.

Poster # 121

CI Compression Optimization for Musical Sound Quality in MED-EL Users
Melanie Lucile Gilbert, AuD; Patpong Jiradejvong, MS; Charles J. Limb, MD, Otolaryngology-Head & Neck Surgery, University of California, San Francisco, San Francisco, CA

This study aimed to identify optimum processor settings, specifically Maplaw and Automatic Gain Control (AGC), to improve music sound quality for MED-EL cochlear implant (CI) users. Based on prior normal hearing (NH) and CI research showing that additional compression applied to commercially-recorded music was rated poorer in sound quality, it was predicted that CI users would prefer lower compression levels for music listening. A modified CI-MUSHRA (MUltiple Stimulus with Hidden Reference and Anchor) software application allowed participants to compare and rate the sound quality of various CI settings while listening to 25 real-world music clips. Maplaw is a setting that informs audibility and compression of soft sounds (options: 500, 1000, 2000), whereas AGC applies compression to loud sounds (options: 2.5:1, 3:1, 3.5:1). Adult CI participants were all postlingually deafened with little-to-no formal music training (Maplaw study: n=14; AGC study: n=10). MED-EL users reported improvements in music sound quality with higher Maplaw settings, but no significant difference between AGC settings. Thus, participants preferred higher compression for music listening, with results having clinical implications for improving music perception in CI users.

Poster # 122

Context Reduces CI Listening Effort, but Benefit is Fragile
Matthew Winn, PhD, University of Minnesota, Minneapolis, MN
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Listeners with hearing impairment are thought to rely on context more heavily than their normal-hearing peers. However, it is not clear whether individuals with hearing impairment use context predictively (as do people with normal hearing), or retroactively, to correct mistakes after hearing later-occurring information. This difference could have important implications for a person's readiness to hear an upcoming sentence, as time spent mulling over the last utterance could conflict with ongoing listening. In previous work, the benefit of context to reduce listener effort was smaller and later in people with cochlear implants (CIs), suggesting that they were likely engaging in retroactive corrective behavior. In this study we measured the reduction of listening effort afforded by the presence of semantic contextual cues in sentences heard by listeners with normal hearing and with CIs. For isolated sentences, pupil dilation was reduced when there was context. However, that reduction of pupil size was extinguished when the sentence was followed by another utterance that the listener attended. These results suggest that testing one utterance at a time could underestimate a listener’s ability to use context in a way that would survive the rapid pace of everyday conversation.

Poster # 123

Mechanisms and Speed of Adjusting to Voices of Different Talkers

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There is a large amount of variability in the acoustics of voices between different talkers - particularly between women and men, which include differences in pitch, formant frequencies, and other properties. Although listeners can typically make adjustments without much effort, little is known about how it is accomplished. In this study we examined mechanisms and speed of adjusting to voices of women and men using a phonetic labeling paradigm with listeners with normal hearing (NH) and with cochlear implants (CIs). A continuum of fricative phonemes -sh- and -s- was preappended to vowels whose acoustic parameters were manipulated by various properties ranging from typically feminine to masculine; the canonical female-male shift in phonetic category boundary was evidence of sensitivity to the parameters of interest. NH listeners relied primarily on perceived vocal tract length (talker size), and mostly neglected pitch information. Listeners with CIs used a variety of strategies, including proxy cues such as visual information and rate pitch. Systematic truncation of the vowel context revealed that NH listeners needed only 30ms to initiate an adjustment, while CI listeners' data were much more variable. Results highlight the variety of listening strategies taken in situation where ultimate intelligibility results reveal no remarkable differences.

Poster # 124

Audiovisual Speech Speeds Lexical Access in Children with Cochlear Implants
Tina M. Grieco-Calub, PhD; Katherine Simeon, MS, Northwestern University, Evanston, IL
Bob McMurray, PhD, University of Iowa, IA

The aim of this study was to determine whether congruent audiovisual speech promotes lexical access during real-time spoken language processing in children with or without hearing loss. Using integrated eye-tracking and touch-screen technology, we tested children's spoken word recognition. Two groups of children who are 5-to-9 years old were tested: children with normal hearing children and children with bilateral sensorineural hearing loss who used cochlear implants (CIs). On each trial, children viewed a still or dynamic female talker as she spoke a sentence with a target word, resulting in auditory-only or audiovisual speech cues, respectively. Following the sentence, children were shown three images of objects and selected the image that matched the target word. Children's eye gaze was video-recorded throughout the task and quantified offline by trained coders. Touchscreen responses show that children in both groups recognized words at >90% accuracy. However, both the time course of visual fixations to the target image and the response times for image selection showed group differences. Specifically, children with CIs were faster in the audiovisual conditions when compared to auditory-only conditions. The results will highlight the advantages of quantifying real-time processing of spoken language in children with hearing loss.

Poster # 125

The Contribution of Voice Pitch Contour for Vocal Emotion Recognition
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Anna Tinnemore, AuD, University of Maryland, College Park, MD

Device limitations of cochlear implants result in deficits of vocal emotion identification by their users. Difficulty identifying vocal emotions has been linked to depression and lower reported quality of life. Understanding emotion identification in normal-hearing (NH) listeners may yield insight to improve cochlear implants. Previous studies have attempted to examine in NH individuals the contribution of prosodic cues in speech to emotion recognition using low-pass filtered speech. The current study digitally isolated select prosodic cues without use of low-pass filtering, preventing loss of F0 or inclusion of F1 information in the processed stimuli. These stimuli are referred to as "hum" stimuli. In this study NH listeners were presented semantically-neutral sentences spoken with several vocal emotions (Angry, Happy, Neutral, Sad, or Scared) and tasked with identifying the emotion. Stimuli from four Talkers (1 adult-directed female, 1 adult-directed male, 1 child-directed female, and 1 child-directed male) were presented in both an unmodified format and as a "hum" stimulus Type. Significant main effects for emotion recognition were observed for Talker and stimulus Type , as well as a significant interaction between Type x Talker ($p < 0.01$). Overall results suggest that the pitch contour conveys substantial emotion information, modified by individual talkers/speaking styles.

Poster # 126

Hybrid Cochlear Implant Users' Speech Recognition After Post-Implant Hearing Loss
Eileen Lancaster, BA; Viral Tejani, PhD; Camille Dunn, PhD; Carolyn Brown, PhD, University of Iowa, Iowa City, IA

Shorter electrode arrays and soft surgical techniques potentially allow for preservation of low-frequency acoustic hearing in the implanted ear of cochlear implant (CI) users. However, some patients still lose acoustic hearing following surgery. This preliminary retrospective review compares two groups of patients who received Nucleus Hybrid L24 CIs, designed to preserve acoustic hearing, at the University of Iowa Hospitals and Clinics between 2011 and 2015. A group (n=10) of patients who experienced delayed-onset loss of acoustic hearing are compared to another group (n=11) that maintained stable acoustic hearing post-surgery. CNC word recognition scores in quiet and AzBio sentence recognition scores in noise were compared between the groups. For the group that lost acoustic hearing post-surgery, we looked at performance at several timepoints and at their 'best performance' score. Preliminary within-group analysis for the group of users that lost acoustic hearing suggested that their CNC scores post-hearing loss are significantly worse than their pre-loss scores. Their post-loss CNC scores were also lower than patients who kept residual hearing, though this was not statistically significant. Case studies for trends in AzBio scores between and within groups will also be presented. The importance of maintaining residual hearing will also be discussed.

Poster # 127

Effects of Bimodal Hearing on Vowel Production and Perception
Angie Nguyen; Kathryn Pulling; Ayoub Daliri, PhD; Xin Luo, PhD, College of Health Solutions, Arizona State University, Tempe, AZ

Cochlear implant (CI) has both long- and short-term effects on speech production of individuals with post-lingual hearing loss, suggesting that the brain continuously monitors speech output to ensure

intelligible and accurate speech production. It has been shown that bimodal hearing-concurrent use of a CI and a contralateral hearing aid (HA)-improves speech perception of CI users by providing low-frequency acoustic cues. However, it is unclear whether bimodal hearing also improves speech production of CI users. In four hearing conditions (unaided, CI alone, HA alone, and CI+HA), we examined vowel production of post-lingually deafened adults with bimodal hearing. Additionally, categorical perception of vowel continua (i-…™ and Œµ-o) generated from each subject's own production was tested with CI alone, HA alone, and CI+HA. Preliminary results showed that relative to unaided hearing, HA alone lowered the first formants of high vowels, CI alone reduced the trial-to-trial formant variabilities, and CI+HA expanded the vowel space. Consistent with the improvement in vowel production, vowel categorical perception was better with CI+HA than with CI or HA alone. Overall, these preliminary results suggest that, in addition to vowel perception, bimodal hearing may also improve vowel production of CI users, and thus, warrant further investigation.

Poster # 128

Aging Affects Complex Speech Perception in Cochlear Implant Listeners
Kara C. Schvartz-Leyzac, PhD; Teresa Zwolan, Ph; Bryan Pfingst, PhD D, University of Michigan, Ann Arbor, MI

Cochlear implant (CIs) are highly successful at restoring hearing and communication abilities in all adults of all ages. However, there is evidence that aging influences the ability to discriminate voice-gender using CI simulations and how voice-pitch cues are used in more complex listening environments. This study examines how adult CI recipients perceive voice-pitch in simple and complex tasks, at various points in time following cochlear implantation. Adult CI recipients (>18 years of age) were evaluated on their ability to identify voice gender and sentences in varying types of background noise. For the voice-gender identification task, stimuli were manipulated as to vary in fundamental frequency (f0). Sentence recognition performance was measured using a target sentence (male) in the presence of steady-state noise, modulated noise, or a female voice. Cognitive assessments (NIH Toolbox) were also administered. Results indicate that voice gender identification is worse soon after implantation, compared to pre-operative scores. Pre-operative performance was not related to the age of the listener, however it was observed that voice-gender identification becomes increasingly dependent on age with more CI listening experience. Sentence-in-noise recognition performance was also significantly correlated with age of the CI listener. Additional data will be presented on how cognition affects performance.

ELECTROPHYSIOLOGIC RESPONSES

Poster # 129

Neural Pitch Coding in Multi-lingual Population
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Previous studies have shown that adults who speak tonal languages show stronger neural pitch coding ability, while some behavioral studies have suggested that multi-lingual adults could process certain auditory features better. Whether it is the multilingualism or certain language that (re)shapes the

auditory brainstem remains unanswered. The purpose of this study was to examine the effect of multilingualism on adults' pitch processing ability. Three language groups were recruited: monolingual (English), bilingual (English and a tonal language) and bilingual (English and a non-tonal language). Two speech syllables with different fundamental frequency pitch contours were used. Fundamental frequencies of both the stimulus and the responses were extracted and compared. FFR was found to be stronger in bilingual tonal language speakers, compared to both monolingual speakers and bilingual non-tonal language speakers. However, there was no statistically significant difference between the monolingual group and bilingual non-tonal group. Results demonstrated that pitch processing ability may primarily be influenced by specific auditory features in the language, not the number of languages. Furthermore, comparable FFR results obtained from both mono-lingual and non-tonal bilingual speakers group suggest that although behaviorally multilingualism could show some differences in certain assessment, they likely do not affect speakers' pitch processing mechanism.

Poster # 130

Cortical Evoked Potentials to Speech in Adults with Normal Hearing
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Raphael Delgado, PhD, Intelligent Hearing Systems, Miami, FL
John D. Durrant, PhD, University of Pittsburgh, Pittsburgh, PA

Current clinical applications of auditory evoked potentials focus on subcortical auditory pathway responses, using the auditory brainstem response (ABR) and auditory steady state response (ASSR) to assess neural integrity and provide estimates of hearing thresholds. A limitation of these measures is the lack of information provided related to cortical portions of the auditory pathway. Cortical responses can be obtained using an ASSR paradigm, which has potential to add objectivity in analysis of late latency responses (LLR). The aim of the current study was to assess cortical auditory evoked potentials, measured in the context of an ASSR paradigm (termed Long Latency Auditory Steady State Responses, LLASSR), and compare these responses to standard LLR and behavioral thresholds. Physiologic responses were obtained from 15 adults with normal hearing who were awake and sitting quietly during testing. The speech stimuli used were the syllables /ba/ and /da/, presented at a repetition rate of .781 Hz using a two-channel vertex to earlobe electrode montage. Results showed that LLASSR and LLR thresholds for both speech stimuli were within 10 dB of behavioral thresholds for all subjects, with closer agreement for responses obtained with the LLASSR paradigm. [Supported by NIH-NIDCD T35DC008763 and R44DC015920.]

Poster # 131

Hearing Beyond the ABR: Cortical Responses to Speech Stimuli
Caitlin D. Dold, BA; Alexandra Key, PhD; Linda Hood, PhD, Vanderbilt University School of Medicine, Nashville, TN

The goal of the study was to examine auditory learning and memory using event-related potentials (ERPs). Two passive listening paradigms examined language processing at the level of the auditory cortex. The Consonant Differentiation paradigm examined the physical characteristics of the obligatory responses to natural speech stimuli; here the P1-N1-P2 waveforms showed evidence of differentiation,

suggesting that the physical features of form and transition are reflected in the early time window of the cortical responses. For the Incidental Memory paradigm, fifty-one nonsense words were presented, and one of the nonsense words was randomly repeated to examine if repetition of information without semantic meaning or previous exposure would result in an 'Old/New' memory trace that would differ from the non-repeat memory trace. The analysis of a later time window indicated a larger amplitude to the repeated stimuli which suggests modality independent memory in the area related to attention, memory, and recall. Cortical auditory responses can detect physical stimulus differences and track higher order processing. These results are consistent with previous work in infants, children, and adults. [Supported by NIH NIDCD T35-DC008763.]

Poster # 132

Characteristics and Relationships Between Suprathreshold Physiologic Measures

Jeffrey W. Wise, BA; Jordan Racca, AuD; Linda Hood, PhD, Vanderbilt University, Nashville, TN

The proliferation of research concerning sub-clinical changes in hearing highlights the importance of defining characteristics of and relationships between physiologic measures, even within populations defined as having 'normal' auditory function. Recently, we reported that high-frequency ipsilateral middle ear muscle reflex (MEMR) threshold is significantly related to auditory brainstem response (ABR) Wave I amplitude in a well-defined group of adults with normal pure-tone thresholds. As MEMR threshold increases, ABR Wave I amplitude decreases. The present study considered the effect of age on this relationship. We found that mean Wave I amplitude did not significantly differ between the middle (25-36-years old) and oldest (37-79-years old) groups, though the youngest group (12-24-years old) significantly differed from the other two groups. Moreover, individuals with the highest MEMR thresholds and lowest Wave I amplitudes tended to belong to the youngest and middle group. This study reveals relationships between some suprathreshold physiologic measures and age effects that vary across assays. However, the associations between measures do not appear to be driven by age. These associations may be valuable in understanding the role of various auditory processes and in designing and interpreting research and clinical protocols. [Supported by NIH NIDCD T35-DC008763]

Poster # 133

Short-Term Context Effects of Vowel-Evoked Envelope Following Responses

Emily M. Wilson, BS; Maddie Salutz; Cynthia Fowler, PhD; Sriram Boothalingam, PhD; Viji Easwar, PhD, University of Wisconsin - Madison, Madison, WI

Vowel-evoked envelope following responses (EFRs) are an objective index of speech encoding. However, it is unknown whether acoustic contexts in naturally-spoken speech influence vowel-evoked EFRs. This study aimed to quantify the effect of level and spectra of preceding context on vowel-evoked EFRs in young adults with normal hearing. The EFR elicitor was a naturally spoken /i/, which was modified to elicit two independent EFRs: one from the low-frequency first formant (F1) and another from the higher formants (F2+). The /i/, presented at 65 dB SPL, was preceded by three phoneme contexts that varied in level and spectral overlap relative to the stimulus, /i/. The three context phonemes were / É/, /m/, and /i/, each presented +15 dB relative to the level of /i/. A control condition without a preceding context was included for comparison. Preliminary data (n=8) suggests that the EFRs elicited by the F1 and F2+ of

/i/ are most attenuated when preceded by a context that is spectrally-close to the stimulus. Further, EFRs tended to be attenuated when preceded by higher level context phonemes, particularly for F2+. Findings with additional data will help conclude the degree of context effects and therefore the need for context-based interpretation on vowel-evoked EFRs.

Poster # 134

Relating Auditory Brainstem Response Latency to Loudness Growth

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Auditory brainstem response (ABR) latency is known to decrease with increasing stimulus level (e.g. Gorga et al., 1988). However, the physiological mechanisms that underlie this phenomenon are uncertain. One interpretation is that the level-dependent component of ABR latency arises from cochlear mechanics. Rasetshwane at el. (2013a) demonstrated significant correlations between distortion product otoacoustic emission (DPOAE) input-output functions and loudness growth, which is consistent with the view that cochlear mechanics may play a role in mediating loudness growth. The goal of the present study was to examine the relationship between ABR latency decrease with level and loudness growth. A significant correlation between the two measures would support the existence of a common underlying mechanism. ABR data and loudness growth functions were obtained from 20 adult subjects with normal hearing using 1000 and 4000 Hz toneburst stimuli. The linear relationship between loudness growth function slope and the level-dependent component of ABR wave latency change with level was assessed using standard major axis regression. Results show significant correlations between wave V latency and loudness growth for 4000 Hz stimuli and support the role of cochlear mechanics as an underlying mechanism. [Work Supported by the NIH].

Poster # 135

Wideband Acoustic Immittance in Children with Enlarged Vestibular Aqueduct

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Enlarged Vestibular Aqueduct (EVA) is the most common inner ear malformation associated with early-onset sensorineural hearing loss, usually affecting children within the first few years of life. However, due to the progressive nature of hearing loss, children with EVA may pass their newborn hearing screenings, leading to delayed diagnosis of EVA. Previous literature has suggested that wideband acoustic immittance (WAI) could potentially be utilized as an effective screening tool for patients with EVA; in certain cases, this may lead to earlier identification of EVA, thus allowing professionals to more effectively track for progression of hearing loss and provide appropriate recommendations. Pediatric subjects diagnosed with EVA (n=13) and age-matched control subjects with SNHL (n=12) participated in this study. WAI measures were analyzed with a notch-detection algorithm developed by Merchant et al. (2015), altering parameters to maximize sensitivity and specificity. Results showed a sensitivity of 64% and a specificity

of 75% under optimal parameters; in subjects with bilateral EVA (n=9), results showed a sensitivity of 78% and a specificity of 75%. Overall, WAI may be a promising measure to screen for EVA; future directions should include further subject recruitment and normalization of data with a larger subset of pediatric WAI data.

HEARING LOSS / REHABILITATION

Poster # 136

Audiologic and Amplification Characteristics of Children with UHL
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Academic, behavioral, and speech/ language deficits for pediatric patients with unilateral hearing loss (UHL) have been well documented. With the advent of universal newborn hearing screening, children are being diagnosed with hearing loss at an earlier age, yet much uncertainty exists as to how to manage children with UHL, audiologically. This study addressed the following questions: At what age are children with UHL first fit with devices compared to those with BHL? Do device recommendations for children with UHL vary with audiometric profiles? Do children with UHL have similar device wear times, verified with data logging, compared to children with BHL? What are the factors related to wear time for children with UHL (i.e., SES, degree of loss, type of device, etc.) A chart review was undertaken at a pediatric clinic within a private oral school for the deaf, covering a 5 year period (August 2011- February 2017). A total of 76 children with UHL were compared to 252 children with bilateral hearing loss (BHL). The children's ages range from 6 months to 13 years old. Results will be summarized and clinical implications for device recommendations and counseling will be discussed.

Poster # 137

Maternal Sensitivity, Inhibitory Control, and Language: DHH and Hearing Children
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Communicative and affective components of the parent-child relationship are hypothesized to affect children's emerging inhibitory control and language development. Variability in maternal sensitivity (appropriate, well-timed, child-centered behavior) is one such factor identified in the literature. Child language comprehension and inhibitory control, as well as parental sensitivity during a dyadic play interaction, were evaluated in 56 3- to 8-year-old normal-hearing (NH) and 50 deaf/hard-of-hearing children (DHH) with hearing aids and cochlear implants inside families' homes. Two multiple linear regressions (controlling for age) were carried out to preliminarily evaluate significant contributors to language and inhibitory control separately; In the NH group, maternal education ($p=0.033$), inhibitory control ($p<0.001$), and parental sensitivity ($p=0.05$) were significant predictors of language comprehension, $R2=0.828$. Further, maternal education level ($p=0.017$), language comprehension ($p=0.017$), and parental sensitivity ($p<0.001$) were significant predictors of inhibitory control, $R2=0.859$. Once parental sensitivity coding is complete, these analyses will be repeated in the DHH group and

comparisons will be made between the groups. These preliminary results support our hypothesis that parental sensitivity influences inhibitory control and language comprehension. For children with delays in inhibitory control and language skills, including DHH children, family factors such as maternal sensitivity may be potential targets for intervention.

Poster # 138

Screening for Childhood Hearing Loss in High-Risk Populations

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Globally, indigenous children are at a disproportionately high risk of developing hearing loss secondary to otitis media. Despite the need for early intervention in this group, little is known about hearing screening programs for high-risk children. We assessed existing literature on hearing screening strategies for children at high risk. A comprehensive database and gray literature search was undertaken. Of 637 articles screened, 11 were included. Pure-tone audiometry was the primary screening tool in the majority (n=8) of studies. Half (n=4) of these tested frequencies of 500, 1000 and 2000 Hz, with pass/refer criteria for screening audiometry ranging from 15-45 dBHL. Tympanometry (n=5) and otoscopy (n=6) were the most commonly used adjunct tests. One study evaluated the use of otoacoustic emissions as a standalone screening instrument. Screening was administered primarily by community health workers, and recent studies used telemedicine to connect children to care. Proportion referred ranged from 15-68%; loss to follow-up ranged from 31-62% with limitations in transportation identified as a significant barrier. While this review demonstrates that effective screening programs for high-risk pediatric populations are feasible, more robust studies evaluating screening methods and the use of telemedicine are needed to ensure that high-risk populations can reliably access specialty care.

Poster # 139

Inhibitory Control and Word Learning in Children with Hearing Loss

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Children with hearing loss (HL) show poorer word learning abilities than children with normal hearing. Children with HL may show word learning difficulties that are not fully explained by degree of HL, but also by executive function capacity (i.e., inhibitory control). This study tested the hypothesis that if word learning is facilitated by inhibitory control, then children with higher inhibitory control should learn more words than children with lower inhibitory control. We assessed vocabulary size, word-learning and retention, and inhibitory control (flanker task) in 38 children (20 with normal hearing and 18 with HL). Hierarchical linear regression revealed that inhibitory control predicted 50% of the variance in vocabulary size, controlling for age and degree of HL ($F [4, 33] = 10.36$, $p < .001$, $R2 = .50$). Word learning and retention measures were not correlated nor predicted by age, vocabulary size, degree of HL, or inhibitory control. Children with normal hearing were more accurate in the flanker task than children with HL ($t[36] = -2.17$, $p < .05$), but they did not differ in any other measure. This suggests that inhibitory

control abilities predict vocabulary size, but they are not predictive of word learning as conceptualized in this study.

Poster # 140

Relations Between Parental Stress and At-Risk Pediatric Hearing Loss Outcomes
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David Pisoni, PhD, Indiana University, Bloomington, IN
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Parental stress is associated with poorer spoken language and behavioral outcomes in children with hearing loss (HL). However, the effect of parental stress on neurocognitive abilities has not been investigated. Mechanistic relations plausibly exist wherein increased parental stress hinders spoken language abilities which, in turn, adversely impact closely-related neurocognitive skills like inhibitory control. Parental self-efficacy for promoting language development might protect language comprehension skills against negative effects of parental stress. We studied 80 children (41 normal-hearing (NH), 39 with HL) and their families. Children completed the CELF-2-Concepts and Following Directions subtest and the Flanker Test of Attention and Inhibitory Control. Parents completed the Parenting Stress Index-Short Form and the Scale of Parental Involvement and Self-Efficacy. Although stress levels did not differ significantly between parents of children with HL and NH, regression analyses revealed that parental stress accounted for a significant proportion of the variability in language comprehension and inhibitory control skills in children with HL. Language comprehension indirectly accounted for stress-inhibitory control relations. Parental self-efficacy for language development did not significantly moderate the relation of stress on language. Language comprehension and inhibitory control abilities of children with HL are associated with parental stress, and self-efficacy may not affect this association.

Poster # 141

Assessment of Sensorineural Hearing Loss Using a Wideband Test Battery
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Douglas H. Keefe, PhD; Denis Fitzpatrick, PhD, Boys Town National Research Hospital, Omaha, NE
Angela Garinis, PhD, Oregon Health and Science University, Portland, OR

A wideband physiological test battery including acoustic reflex thresholds (ARTs) and transient otoacoustic emissions (TEOAE) and was compared with a clinical physiological battery of 226 Hz tympanometry and acoustic reflex thresholds in the assessment of mild and moderate sensorineural hearing loss (SNHL). Results were compared in a group of 76 adults with normal hearing (NH) and 55 subjects with symmetrical mild or moderate SNHL. A receiver operating curve analysis showed that the area under the curve (AUC), which quantifies the accuracy of a test to classify ears in the NH or SNHL group, revealed better performance for the wideband ART test with an AUC of 0.83 for a broadband noise activator (BBN) at tympanometric peak pressure (TPP) compared to 0.68 for the BBN activator for the clinical test. Performance was better for the wideband TEOAE test averaging 0.93 across frequency from

0.71 kHz to 8.0 kHz for subjects with mild SNHL and 0.96 for moderate SNHL. Results suggest that the detection of SNHL is improved over the standard clinical battery by including a wideband ART test and by adding TEOAEs.

Poster # 142

The Effect of Test Administration Methods on Cognitive Screening Results of Older Individuals with Hearing Loss

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Hearing loss and mild cognitive impairment are two health conditions that are prevalent in the aging cohort. While hearing loss is associated with cognitive decline, the impact of hearing loss on older individuals' cognitive screening results may contribute to an inflated failure rate on cognitive screening instruments. Previous studies have shown no change in cognitive screening outcomes under aided versus unaided administration. The result, however, may be partially due to the variability in sound level and quality as introduced by individual amplification device. The current study aims to determine whether a more controlled amplification method or a non-auditory administration has an effect on cognitive screening outcomes of older individuals with hearing loss. Twenty-four older individuals with mild-to-moderate sensorineural hearing loss participated in the study. The tests included Montreal Cognitive Assessment (MoCA), a working memory test of word recognition and recall, a reading span test, and two speech recognition tests. Results to date indicate no significant effect of test administration methods on the MoCA total score, as the impact is limited to the speech recognition items (e.g., sentence repetition). Amplified, as compared to unamplified testing, significantly improves word recall in the working memory test, as well as speech recognition performance. [Work supported by NIH]

Poster # 143

Hearing Loss, Amplification, and Falls: Analyses of NHANES Data

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There are recent data that suggests older adults have higher odds of falling if they also have hearing loss, particularly if the hearing loss is moderate or greater in severity. In addition, there seems to be a dose effect associated with hearing loss severity and increased falls risk such that there are greater odds of falling with increasing degrees of hearing loss. The data are limited and results are mixed, however, in regards to whether or not hearing aids might mitigate falls risk in older individuals with hearing loss. This study explores the association between hearing loss and falls and to determine if hearing aid use affects falls risk. The data were extracted from the National Health and Nutrition Examination Survey (NHANES) database from survey years 2001-2002 and 2003-2004. In particular, results from survey questions focusing on falls/balance, hearing, and hearing aid use, along with audiometric data were obtained. Demographic, cardiovascular, metabolic, and mental health variables were also obtained from the datasets and used as covariates in the analyses. The results from statistical modeling will be reported.

Poster # 144

Subjective Hearing Difficulty and Risk of Falls in Audiology Patients
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Hearing loss often results in communication difficulties, stress, fatigue, and depression (Preminger & Meeks, 2010; Kramer et al., 1997). It is also linked to another common aging problem,Äîfalls (Viljanen et al., 2009; Lin & Ferrucci, 2012). We investigated the association between perceived hearing difficulty and fall risk measures in 58 community-dwelling audiology patients (n=29 hearing aid users) aged 60 years and older. Hearing Handicap Inventory for the Elderly (unaided; Ventry & Weinstein, 1982) scores were significantly positively correlated with number of falls within the last year (r = .287, p = .031). Participants without hearing aids fell more often and exhibited slower Timed Up and Go test (TUG, Podsiadlo & Richardson, 1991) times than participants with hearing aids. Moreover, significant correlations were noted with unaided HHIE scores and other measures of balance and fall risk, such as the Dizziness Handicap Inventory (DHI, Jacobson & Newman, 1990). Overall, a trend was noticed such that for increasing HHIE score categories (i.e., mild, moderate, or severe), fall risk increased. Significant relationships differed between participants with and without hearing aids. The potential effects of hearing aids on fall risk and differences in fall risk between hearing aid users and non-users will be discussed.

Poster # 145

Hearing Loss and the Healthcare System
Nicholas Salvatore Reed, AuD; Amber Willink, PhD; Jennifer Deal, PhD; Frank Lin, MD, Johns Hopkins University, Baltimore, MD

Hearing loss impacts patient-provider communication which may affect satisfaction with care which is linked to Medicare hospital reimbursement rates under the Affordable Care Act. The Atherosclerosis Risk in Communities Study (ARIC, prospective observational cohort with objective pure-tone audiometry, n=250) and the Medicare Current Beneficiaries Survey (MCBS, a national survey of Medicare Beneficiaries with self-report hearing difficulties, n=12, 311) collect hearing and self-report satisfaction (4-point Likert scale) with care information. Associations were explored with ordinal logistic regression and generalized additive models, adjusted for demographic and health-related confounders. In ARIC, there was a significant (p=.033) interaction between hearing loss and age such that hearing loss had greater impact on satisfaction in older adults. For every 10 dB increase in hearing loss, the odds of being less satisfied with care increased .94 (95% Confidence Interval [CI]:0.74-1.20) in a 75-year-old participant but 1.33 (95% CI:0.96-1.83) in an 85-year old participant. In the MCBS cohort, compared to participants with no reported hearing trouble, those with a little and those with a lot of trouble had 1.5 (Odds Ratio [OR] = 1.468; 95% CI = 1.060-2.029; P=0.021) and 1.7 times the odds (OR = 1.737; 95% CI = 1.150-2.623; P=0.009) of being dissatisfied with care.

HEARING SCIENCE / PSYCHOACOUSTICS

Poster # 146

Estimating Spectral Ripple Resolution in Children and Adults
Stacey L.G. Kane, AuD; Emily Buss, PhD, University of North Carolina at Chapel Hill, Chapel Hill, NC

Frequency resolution is a basic auditory ability that is important for speech perception in both children and adults. Psychophysical detection of changes in the spectral ripple profile of a sound based on pitch is one approach for evaluating frequency resolution. Previous data indicate that the child-adult difference is smaller for frequency modulation detection than for across-interval pitch discrimination. This could reflect children's reduced ability to compare cues across intervals than within intervals due to immature auditory memory. This study evaluated two psychophysical tests,Äîspectral ripple phase reversal and the SMRT,Äîto explore how the provision of dynamic within-interval cues versus static across-interval cues effects estimates of frequency resolution. Thresholds were measured using 2AFC, cued-2AFC, and 3AFC procedures. The prediction was that the dynamic cue (SMRT) would result in better performance than a static cue for both groups tested in the 2AFC, and that provision of three intervals (cued-2AFC and 3AFC) would improve performance, particularly for the static cue. Preliminary results indicate improvement in performance as a function of age, no benefit of the dynamic cue, and a trend for a smaller child-adult difference in the 3AFC procedure.

Poster # 147

Effects of Personalizing Hearing-Aid Gain using a Machine-Learning Approach
Laura Winther Balling, PhD; Niels Sogaard Jensen, MS; Jens Brehm Bagger Nielsen, PhD, Widex, Lynge, Denmark
Wendy Switalski, AuD, Widex USA, Happauge, NY

In most hearing-aid fittings, gain is prescribed by a fitting rationale that uses the audiogram as the main input. While this approach may work well in some situations, it falls short in situations where the user's listening intention deviates from that assumed by the rationale. This shortcoming was the motivation for a new commercially available method to self-adjust hearing-aid parameters while in a situation. The method is based on use of machine-learning algorithms that utilize input from the user to determine a sequence of parameter settings to be assessed in paired comparisons and to estimate the setting that optimizes user satisfaction. We present results from a study where 20 participants with hearing loss used the method to adjust hearing-aid gain in 12 different sound scenarios. In a double-blind comparison, the participants rated recordings of the adjusted settings compared with two prescribed settings with respect to three different perceptual sound attributes. The results showed a significant benefit of the method on basic audio quality ratings. A large spread in the gain adjustments were observed, suggesting a need for individual adjustments of hearing aids. Data from real-life use of the same method will be included in a discussion of the clinical implications.

Poster # 148

Preferred Listening Levels of Mobile Phone in Subway Commuter Noise
Sunghwa You, BS; Woojae Han, PhD; Chanbeom Kwak, BS, Department of Speech Pathology and Audiology, Graduated School, Hallym University, Chyncheon, Republic of Korea

Today people listen to music louder using personal listening devices. As considering 'double noise exposures' such as environmental noise plus recreational noise, the present study measured preferred listening levels of a mobile phone program with subway interior noise for 893 normal hearing participants in five age groups (20s to 60s). The speakers presented the subway interior noise at 73.45 dB, while each subject listened to three application programs (e.g., DMB, music, a game) for 30 minutes using a tablet PC with an earphone. Participant earphone volume levels were analyzed via a sound level meter and 2cc coupler. Overall results showed that those in their 20s listened to the three programs significantly louder with DMB set at significantly higher volume levels than for the other programs. Higher volume levels were needed for middle frequency, compared to the lower and higher frequencies. We concluded that although the volume level was not high enough to produce temporary hearing threshold shifts, the potential risk of noise-induced hearing loss for mobile phone users should be communicated when users listen routinely. When considering individual's listening habits on mobile phones, further study to predict total accumulated environmental noise is still needed.

Poster # 149

Acceptable Noise and Preferred Listening Levels for Speech and Music

Donguk Lee, MS; James Lewis, PhD; Patti M. Johnstone, PhD; Patrick Plyler, PhD, University of Tennessee Health Science Center, Knoxville, TN

Purpose: This study measured acceptable noise levels (ANL) and preferred listing levels (PLL) when listening to speech and music in noise backgrounds. Research questions included: (1) Does the amount of noise tolerated by a listener depend on the target? (2) In high-level noise, does the PLL of a listener depend on the target? (3) Does ANL predict PLL? Method: Participants included 99 normal-hearing, Native-English speakers. Each participant's ANL was measured in 12-talker babble for three targets: speech, music with lyrics, and music without lyrics. The PLL was then measured for each target in 75-dBA 12-talker babble. Results: The ANLs for the different target stimuli were all significantly different from each other. The average ANL for speech, music with lyrics and music without lyrics was 7.2, 6.1 and 2.5 dB, respectively. The PLLs for the different target stimuli were also all significantly different. The average signal-to-noise ratios (SNR) at the PLLs of speech, music with lyrics, and music without lyrics were 1.2, 2.3, and -0.1 dB, respectively. There was no significant relationship between ANL and the PLL SNRs. Conclusions: Findings suggest that a listener's preference when listening in noise depends on the target and the noise level.

Poster # 150

Musician Advantage on Speech Perception in Noise for Children

Yingjiu Nie, PhD; Victoria Andre, BS; Victoria Whitney, BS, James Madison University, Harrisonburg, VA

Musician advantage on speech perception in noise has been reported for children. This particular study aimed to examine the effects of some neurocognitive factors, including auditory short-term memory, nonverbal intelligence, and receptive vocabulary, on this advantage. Using the sung speech corpus consisting of naturally- and unnaturally-intonated sentences of five words in a closed-set task, speech perception in steady-state noise was measured at 3- and 0-dB signal-to-noise ratios (SNR) in thirty-one school-aged children (16 and 15 respectively classified as musicians and nonmusicians) with normal

hearing. Speech perception scores were assessed for the effects of between-subject factor (Listener Group) and within-subject factors including place in sentences (i.e., first, second, third, fourth, and fifth word), sentence intonation, and SNR. Preliminary data showed no age difference between the two listener groups, higher speech-perception scores for musicians than nonmusicians, significance of all three within-subject effects, and no interactions between Listener Group and any of the within-subject factors. In addition, auditory short-term memory was found to positively correlate with speech perception, although the two listener groups did not score differently in any of the aforementioned three neurocognitive areas. The effects of socioeconomic status and pitch contour identification on the musician advantage will also be discussed.

Poster # 151

Effect of Talker Orientation on Speech Perception in Spatially-Separated Speech
Nicole E. Corbin, AuD; Emily Buss, PhD, The University of North Carolina at Chapel Hill, Chapel Hill, NC
Brian B. Monson, PhD, University of Illinois at Urbana-Champaign, Champaign, IL

The majority of data on masked speech recognition are obtained with speech materials that are recorded with the microphone placed at 0¬∞ azimuth relative to the talker, capturing the stimulus available when a talker is directly facing the listener. However, in the real world background speech is often produced by talkers facing other directions, and talker head orientation affects the high-frequency content of speech. This study investigated the effect of talker orientation on spatial release from masking (SRM), which is the advantage observed when the target and masker are spatially separated on the horizontal plane. Adults with bilaterally normal hearing completed a masked speech recognition task in three spatial conditions and two talker orientation conditions. Target speech always originated from the front of the listener (0¬∞ azimuth) and was recorded from a microphone at 0¬∞ azimuth. Masker speech was either co-located with the target or spatially separated to one or both sides of the listener (+ or ¬±52¬∞ azimuth), and was recorded from a microphone placed at either 0¬∞ or 60¬∞ azimuth relative to the talker. Results are consistent with greater SRM for masker talker orientation of 0¬∞ than 60¬∞. Data collection for young school-age children is ongoing.

Poster # 152

Does the Speech Cue Profile Affect Response to Temporal Distortion?
Pamela Souza, PhD; Kendra Marks, AuD; Patrick Zacher, BS, Northwestern University, Evanston, IL
Richard Wright, PhD, University of Washington, Seattle, WA
Frederick Gallun, PhD, National Center for Rehabilitative Auditory Research and Oregon Health and Sciences University, Portland, OR

Previous work demonstrated that listeners with similar amounts of sensorineural hearing loss utilize different acoustic cues to identify stimuli; specifically, the extent of reliance upon spectral (or temporal) information for identification. Although some researchers have proposed that listeners who rely on temporal information may be detrimentally affected by temporal distortion, this has not been directly tested. We measured speech cue profiles in older adults with sensorineural hearing loss using a synthetic speech task in which spectral and temporal dimensions (formant frequencies, formant transition time, envelope rise time) were manipulated along continua. Discriminant feature analysis was used to

determine the degree to which each listener used spectral and temporal information in stimulus identification. The same listeners were presented with low-context sentences in which envelope was distorted via a range of clinically-representative amplitude compression parameters combined with varying amounts of time compression. Results indicate that susceptibility to the envelope distortions varies across individuals. The degree of susceptibility is analyzed relative to listener characteristics, including the cue profile. We also consider the extent to which these differences may have consequences for treatment, such as the need to preserve fidelity of temporal envelope information for listeners who rely on those cues. [Supported by NIH]

Poster # 153

Effects of Low Frequency Thresholds in Listeners with Asymmetric Hearing

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Rixon Rouse, BA, The University of Texas at Austin, Austin, TX

Individuals with asymmetric hearing have difficulty understanding speech in noise and localizing sound due to disrupted binaural processing, even when one ear has normal hearing. Residual low frequency hearing in the poor ear may preserve interaural time differences and mitigate impairment. This study examined the relationship between residual low frequency hearing in the poor ear and speech in noise and localization performance in individuals with one normal hearing ear and one ear with moderate hearing loss. The amount of low frequency asymmetry between ears was also examined as a possible outcome factor. Participants completed localization tests in quiet and noise, adaptive and spatially roving speech in noise tests, and the Speech, Spatial, and Qualities (SSQ) of Hearing questionnaire. Results found poor-ear low frequency hearing correlated with localization but not speech understanding in noise. Low frequency hearing asymmetry was related to localization and speech in noise performance. SSQ ratings were poor for spatial hearing and speech understanding in noise but did not correlate with amount of poor ear low frequency hearing. Findings suggest that both amount of low frequency hearing in the poor ear and low frequency hearing asymmetry impacts binaural abilities such as sound localization and speech understanding in noise.

Poster # 154

Equivalence of English and Mandarin Chinese AzBio and HINT Sentences

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Xin Xi, PhD, Department of Otolaryngology - Head & Neck Surgery, Chinese PLA General Hospital, Beijing, People's Republic of China

The aim of this study was to evaluate the cross-language equivalence (i.e., English and Mandarin Chinese) in level of difficulty of two commonly used sentence-recognition materials (AzBio and HINT). Sixty normal hearing, native English-speaking and sixty normal hearing, native Chinese-speaking young adults were recruited to participate in three experiments. During each experiment, subjects were tested in their native language. In Experiments I and II, noise and tone vocoders were used to process the AzBio and HINT sentences, respectively. The number of channels varied from 1 to 9. In experiment III, English AzBio and Mandarin HINT sentences were tested in speech-shaped noise at various signal-to-noise ratios (i.e., -

20, -15, -10, -5, and 0 dB). Results of Experiments I and II using vocoder processing indicated that English and Mandarin Chinese versions of AzBio and HINT sentences were not equivalent in level of difficulty. However, Mandarin HINT sentences and English AzBio sentences were close in level of difficulty. Such equivalence was further confirmed in Experiment III under noise conditions. Therefore, in cross-language comparative research, Mandarin HINT sentences and English AzBio sentences should be chosen for the respective language as the target materials.

HEARING TECHNOLOGY / AMPLIFICATION

Poster # 155

Can Auditory Processing Tests Predict Hearing Aid Satisfaction in Adults?
Alyssa Everett, AuD; Bryan Wong, BS; Frank Musiek, PhD; Nicole Marrone, PhD, The University of Arizona, Tucson, AZ

Background: The large variability of hearing aid satisfaction is a widely unexplained outcome in hearing impaired adults,Äîwith the most common complaint being understanding speech-in-noise. Traditional pure-tone threshold testing and word recognition in quiet are sub-optimal predictors of hearing aid satisfaction. This necessitates evaluation of other auditory processes. Current literature suggests mechanisms of auditory processing are related to understanding speech-in-noise, making tests of central auditory processing ability important to consider in hearing aid pre-fitting evaluations. In a first step towards addressing this issue, a systematic review was conducted to answer, "Does behavioral central auditory processing testing in adults predict hearing aid satisfaction?" Methods: A systematic review of the literature was performed and a total of 7 articles met specific pre-defined criteria were included. Results: Three of these articles demonstrated significant correlations when the Dichotic Digits, the Synthetic Sentence Identification test, and the Performance-Perceptual test were evaluated. Pure-tone averages were not a significant predictor of hearing aid satisfaction. Conclusions: Central tests of auditory processing may be better predictors of hearing aid satisfaction due to central auditory processing and psychoacoustic mechanisms that underlie speech-in-noise processing.

Poster # 156

Hearing Loss, Hearing Aids and the Emotional Perception of Sound
Maureen Louise Virts, BA; Benjamin Hornsby, PhD; Todd Ricketts, PhD; Erin Picou, PhD, Vanderbilt University, Nashville, TN

Hearing loss has been shown to have many negative psychosocial and emotional consequences which may be affected by reduced emotional responses to acoustic stimuli. The purpose of this project was to examine the effects of congenital hearing loss and various hearing aid frequency responses on emotional responses to sounds. In the current study, young adults with pre-lingual, and older adults with post-lingual hearing loss were fit with hearing aids to prescriptive targets. Participants self-adjusted the hearing aids and then rated non-speech sounds in terms of valence and arousal in three conditions: 1) unaided, 2) with a hearing aid fit to prescriptive targets, and 3) a self-adjustment of the hearing aid to make them feel happier. Younger listeners showed a reduced range of emotional responses compared to the older group and a wider range of emotional responses using a self-adjustment program. Older adult

listeners did not reliably self-adjust and their hearing aid programs did not affect their emotional ratings of sound. These results demonstrate that congenital hearing loss might have a larger effect on emotion perception than acquired loss and that younger patients might be able to self-adjust hearing aids to improve their range of emotional responses to non-speech sounds.

Poster # 157

How do Patient Characteristics Contribute to Hearing Aid Self-Efficacy?
Lipika Sarangi, MS, PhD; Jani Johnson, PhD, University of Memphis, Memphis, TN

Hearing aid self-efficacy (HASE) refers to an individual's confidence in their ability to use a hearing aid. Studies have shown that HASE is a factor that influences older adults' decisions to seek treatment for hearing loss, obtain hearing aids, and have successful hearing aid outcomes. Other factors that predict success with hearing aids are cognition, personality, and hearing aid experience. Although all of these have been associated with hearing aid outcomes, it is not clear how they are related to each other. Differences in outcomes appearing to result from one of these variables might be conflated with one or more of the other variables. This study explored the relationships between these variables with the ultimate aim to clarify their different contributions to hearing aid outcomes. Adults aged 45 and older, with at least mild hearing loss in one ear, participated in this study. Working memory, personality, and hearing aid experience, self-efficacy, and skills were assessed. Cognition and HASE were moderately positively correlated and were distinct from personality and hearing aid experience. No variables were demonstrated to predict hearing aid skills. Consideration of how these findings might be used to improve hearing aid outcomes for individuals with varying cognition are discussed.

Poster # 158

Efficacy of Non-Invasive Treatment Options for Single-Sided Deafness
Yeonkyoung Park, MA; Suyeon Park, MA, Hearing Research Laboratory, Samsung Medical Center, Seoul, Korea
Sung Hwa Hong, MD; Yang Sun Cho, MD; Il Joon Moon, MD, Department of Otorhinolaryngology-Head and Neck Surgery, Sungkyunkwan University School of Medicine, Samsung Medical Center, Seoul, Korea

The aim of this study was to examine the efficacy of the currently available non-invasive hearing devices for patients with single-sided deafness (SSD): a contralateral routing of signal (CROS, Phonak) hearing aid and two different types of bone-conduction hearing aids (ADHEAR, Medel; SoundArc, Cochlear). Twenty patients with SSD were enrolled. The test battery for unaided and aided conditions (CROS, ADHEAR, and SoundArc) included Hearing In Noise Test (HINT) and Sound Localization Test (SLT). HINT was performed in order to investigate the three effects of binaural hearing, including head-shadow (HS), binaural squelch (SQ) and binaural summation (SU). SLT was measured with 13 speakers placed at 15¬∞ intervals. Patient satisfaction questionnaires were administered after the test battery of each condition. Pseudo-binaural benefits were obtained with all aided conditions except the condition with CROS in SQ. Regarding pseudo HS effect, CROS was most beneficial. Sound localization ability was not improved with all three devices. CROS was the most favored device by patients, followed by ADHEAR, and SoundArc. Despite the lack of device acclimatization on a long-term outcome, the results can provide clinical

counseling information for patients with unilateral SNHL and SSD.

Poster # 159

Hearing-aid Research with Open-source Software and Off-the-shelf Ear-level Transducers
Harinath Garudadri, PhD; Dhiman Sengupta; Tamara Zubatiy; Arunkumar Ravichandran, UC San Diego, La Jolla, CA
Arthur Boothroyd, PhD, San Diego State University, San Diego, CA

The NIDCD open-source initiative, designed to promote hearing-aid research, has resulted in several viable systems. To apply these in hearing-aid research, however, requires attention to two issues. One is the addition of suitable ear-level transducer assemblies. The other is the development of interfaces to give researchers, without advanced programming skills, control of processing parameters. This presentation describes the UCSD open-source software for processing and control together with an example of its use with an inexpensive, off-the shelf, supra-aural transducer assembly. This assembly includes the necessary analog-to-digital and digital-to-analog circuitry along with an USB interface to a laptop and suitable for many lab-based investigations. Electroacoustic assessment using a real-ear probe microphone shows stable gains of up to at least 20 dB at 2 and 4 kHz and saturation pure-tone outputs up to at least 110 dB SPL. Control software gives the hearing-aid researcher six-band control of gain and maximum output plus the ratio, onset point, attack time, and release time of compression. Control of the parameters of feedback and noise management is also provided. The open-source processing software includes control via an embedded webserver which the researcher can access from the browser of any computer, tablet, or smart phone.

Poster # 160

Spectral Modulation Detection and Bimodal Benefit in a Clinical Sample
David Kessler, BA; Rene Gifford, PhD, Vanderbilt University Medical Center, Department of Hearing and Speech Sciences, Nashville, TN

Purpose: To investigate the relationship between speech recognition benefit derived from the addition of a hearing aid (HA) to the non-implanted ear (i.e., bimodal benefit) and quick spectral modulation detection (QSMD) in the non-implanted ear in a large clinical sample. Method: Participants included 311 unilateral cochlear implant (CI) users who wore a hearing aid in the non-implanted ear. Participants completed speech recognition testing in quiet and in noise with the CI-alone and in the bimodal condition (i.e., CI and contralateral HA), QSMD in the non-implanted ear, and a cognitive screener. Results: QSMD performance in the non-implanted ear was significantly correlated with bimodal benefit in quiet and in noise. However, this relationship was weaker than previous reports with smaller samples. QSMD, low frequency PTA of the non-implanted ear from 125-750 Hz, and age at implantation together accounted for, at most, 30.6% of the variance in bimodal benefit. Cognition was not significantly related to bimodal benefit. Conclusions: Taken together, QSMD, low frequency PTA, and age at implantation account for the greatest amount of variance in bimodal benefit than each variable alone. A large portion of variance (~70%) in bimodal benefit is not explained by these variables. [Supported by NIH-NIDCD T35-DC008763 and R01-DC13117.]

Poster # 161

Considerations in Developing a Clinical Speech Quality Metric
James M. Kates; Kathryn Arehart, PhD, University of Colorado, Boulder, CO

Metrics have been developed over the last several years to predict speech intelligibility and speech quality for hearing-impaired listeners using hearing aids. These metrics have proven successful under laboratory conditions, but there are challenges in translating them to the clinic. Metrics such as the Hearing-Aid Speech Quality Index (HASQI) measure the change in the signal envelope modulation over the entire signal dynamic range, and accurate predictions of quality require signal-to-noise ratios (SNRs) of about 40 dB. The SNR in a clinic may be much lower, which means that the background interference in the clinic could cause a reduction in the predicted quality even if there is minimal nonlinear distortion in the hearing aid. An approach to resolving this issue would be to predict the speech quality using only the high-intensity segments of the speech, based on the assumption that these segments have a greater immunity to the effects of the background noise. In this study, the accuracy of HASQI computed using only the high-level speech segments in background noise is compared to the values obtained using the entire signal in quiet. The benefits and limitations of using the high-level segments are identified and avenues for future research are discussed.

Poster # 162

Toward a New Evidence-Based Fitting Paradigm for OTC Hearing Aids
Dana Patton Urbanski, AuD; Yu-Hsiang Wu, PhD, Department of Communication Sciences and Disorders, the University of Iowa, Iowa City, IA
Helin Hernandez, BS; Jacob Oleson, PhD, Department of Biostatistics, the University of Iowa, Iowa City, IA

We conducted a two-part study to develop an evidence-based fitting paradigm for over-the-counter (OTC) hearing aids. In the previous study, we used audiometric data from an epidemiology database to develop a set of four gain-frequency responses (‚Äúpresets‚Äù) that can fit 70% of older adults with mild-to-moderate presbycusis. The purpose of this study is twofold: 1) to test the efficacy of our four presets relative to best-practice verification methods; 2) to determine the best method(s) for older adults to select presets. Thirty-seven older adults with bilateral mild-to-moderate sensorineural hearing loss used five selection methods to select presets stored in the program memories of basic-level hearing aids. The selection methods were select-by-audiogram (presets assigned using audiometric thresholds), select-by-self-test (presets assigned using predicted thresholds from an online self-hearing test), select-by-trying (subjects selected presets by listening to them), select-by-questionnaire (presets assigned using a self-assessment), and random assignment. Speech recognition scores and sound quality judgments were compared across selection methods and devices custom-matched to NAL-NL2 real-ear aided response (REAR) targets. Linear mixed-effects modeling showed that the outcomes of select-by-audiogram, select-by-self-test, and select-by-trying were not statistically different from the NAL-NL2 condition. The data suggest that an OTC fitting paradigm may provide benefit comparable to best-practice verification.

Poster # 163

Functional Near-Infrared Spectroscopy (fNIRS) for Studying Aided Listening Effort
Kristi Oeding, AuD, University of Minnesota - Twin Cities, Saint Louis Park, MN
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Functional near-infrared spectroscopy (fNIRS) is an optical imaging tool that can be used to probe biophysical correlates of aided auditory perception. Hearing instruments are difficult to study with electromagnetic methods because of artifact, a problem that disappears when optically measuring changes in blood oxygenation. This study uses a spatial attention paradigm to investigate listening effort in older adults with hearing loss (HL) and young adults with normal hearing (NH). All hearing aid fits (personalized for HL and uniform, low amplification for NH) were programmed with asymmetric beamforming. NH participants completed the study with both occluding and open domes. All spatial attention trials included target digits from 0¬∞ azimuth, masking digits at ¬±90¬∞, and a non-speech cat meow masker at 135¬∞ (behind the participant). In each trial, attention was visually cued either toward the target digits or the cat meows, and one of five trials was silent as a control condition. Two levels of reverberation modulated difficulty. Results are evaluated to demonstrate differences in the hemodynamic response activation in different regions of interest when directing attention toward speech and non-speech stimuli. Additional comparisons are made between high and low reverberation, NH and HL groups, and occluded and unoccluded fits (NH).

Poster # 164

Investigating Short-term Benefits of OSN in Pediatric Hearing Aid Users
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Hannah Stewart, PhD; Tommy Evans, AuD; Tim Nejman, AuD; Jeanie Hamilton, AuD; Jill Huizenga, AuD; Erin Stewart, AuD, Cincinnati Children's Hospital, Cincinnati, OH

Pediatric hearing aid programming favors omni-directional microphones, as equal polar patterns promote incidental learning. Unfortunately impaired speech understanding in noise, a common outcome of SNHL, is unaccounted for when using this setup. This may limit a child's potential in academia and language/vocabulary development. OpenSound Navigator (OSN) by Oticon,Ñ¢, is an algorithm that uses a spatial-microphone noise estimator. This theoretically enhances speech from all celestial angles while reducing background noise, potentially solving this dilemma. In this preliminary study, we investigated the short term benefits of OSN in children. Participants (N=15) aged 6-12 years with mild/moderate symmetrical SNHL and previous hearing aid experience were fit with bilateral OSN-enabled hearing aids. Outcome measure testing was completed within a week of initial fit and after 2 months of hearing aid use. Measures included speech understanding in noise (SNR threshold measurements using monosyllabic words in three sound field conditions) and in quiet (sentence repetition), language learning (nonsense word repetition), and validation (Speech, Spatial and Qualities of Hearing Scale-SSQ). Findings included significant improvement of speech in noise (2/3 conditions) and SSQ scores, suggesting functional and perceptual benefit. We are now extending into a double-blind, clinical RCT of longer-term (6-8 months) OSN benefit.

Poster # 165

Effect of Directionality, Compression, and Working Memory on Speech Recognition
Varsha Hariram Rallapalli, PhD; Gregory Ellis, PhD; Pamela Souza, PhD, Northwestern University, Evanston, IL

Previous research has shown that benefit with amplitude compression in hearing aids depends on individual differences in working memory (WM). The relationship strengthens as signal fidelity degrades (e.g., acoustically challenging conditions). To date, studies have assumed omnidirectional microphone settings, whereas most modern hearing aids provide directional microphones, shown to improve the signal-to-noise ratio (SNR), and consequently signal fidelity. The purpose of this study is to determine the effect of microphone directionality on the relationship between compression speed and WM. Participants are older hearing-impaired listeners with mild to moderately-severe sensorineural hearing loss. Sentence recognition in spatially separated multi-talker babble is measured at different SNRs in a virtual sound room. Listeners are fit with real hearing aids and signal processing is varied in two dimensions: i) Directionality (omni versus fixed), ii) Compression speed (fast versus slow). Signal fidelity metrics are used to quantify acoustic changes in the processed signal across conditions. Results-to-date indicate an improvement in sentence recognition with fixed directionality and increasing SNR, and differences in performance between compression speeds. These changes in performance will be examined with regard to individual WM ability. This research informs clinical decision-making regarding the selection of compression speed and directionality settings for individual listeners. [NIH-funded].

Poster # 166

The Impact of Virtual Space on Speech Understanding in Noise
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Il Joon Moon, MD, Department of Otolaryngology-Head & Neck Surgery, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Korea
Sung Hwa Hong, MD, Department of Otolaryngology-Head & Neck Surgery, Sungkyunkwan University School of Medicine, Samsung Changwon Hospital, Seoul, Korea

This study investigated the impact of virtual space(VS) on speech understanding in noise(SIN) in hearing aid(HA) users and normal hearing(NH) individuals. As communication entails auditory and visual cues, we created a VS(caf√©) and displayed it on a PC(VSPC) and head-mounted display(VSHMD) to investigate its effect on participants' SIN performance. Two NH individuals and HA users participated in this study and completed the Korean version of the Hearing in Noise Test(K-HINT) at -10, -5, 0, and +5 dB signal-to-noise ratios(SNRs) in conventional K-HINT, VSPC, and VSHMD conditions. HA users completed K-HINT with and without their HAs. All participants completed a questionnaire regarding the quality of the VS and their preferred test method. Results revealed that for the NH group, VS and SNRs did not have a great impact on their SIN. The HA users' K-HINT scores improved with the VS; their aided scores were better than their unaided scores except in VSHMD -10dB SNR condition. Questionnaire results showed that 50% preferred to complete the conventional K-HINT and 50% preferred to complete the K-HINT with VSHMD for the NH group. All HA users chose K-HINT with VSHMD as their most preferred test method. Further data collection is ongoing and will be presented.

PEDIATRIC AUDIOLOGY / OTOLOGY

Poster # 167

Wideband Acoustic Immittance Testing in Newborns: Effect of Measurement System
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Assessment of auditory conductive pathways of newborns at birth may improve the timeliness of diagnosis/ intervention for newborns with permanent congenital hearing loss. Before large-scale studies are performed to determine whether WAI is beneficial to early hearing detection and intervention programs, it must be determined whether absorbance measurements are different between WAI measurement systems. The objectives of this project were to 1) compare WAI measurements using two commercially available systems, 2) determine whether absorbance differences between systems were greater than test-retest differences, and 3) assess the influence of probe-tip insertion depth between systems. Seventy-five newborn ears that passed a TEOAE hearing screening underwent WAI testing using the HearID [Mimosa Acoustics Inc.] and Titan [Interacoustics AS]. WAI was measured several times in order to determine test-retest. Significant differences were found for absorbance from 1600-2500 Hz and low-frequency equivalent volume between systems (Titan-HearID). These differences were uncorrelated with each other, indicating no relationship between absorbance in the 1600-2500 Hz range and probe insertion depth. Despite their small magnitude, absorbance (Titan-HearID) differences were greater than test-retest differences. The observed differences may impact accuracy in the diagnostically important 1000-2000 Hz range. [Supported by Gerber Auditory Research Grant from Syracuse University].

Poster # 168

Feasibility of Tablet-based Audiometry and Speech-in-Noise Tests in Pediatric Participants
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The Creare Wireless Automated Hearing-Test System (WAHTS) provides passive acoustic isolation across a broad frequency range to allow testing outside the sound-booth in low to moderate ambient noise. WAHTS interfaces with an open-source control application on a tablet (TabSINT) to allow automated self-administration of speech-in-noise and pure-tone audiometry. Studies in adults have shown comparable performance between the WAHTS audiometric thresholds and those obtained in a sound-booth. Feasibility of the WAHTS automated audiometry and speech-in-noise tests in children (<18 yrs of age) have yet to be reported. Typically developing children (N=20, 10-18 yrs) were recruited from website advertisements. Clinical test procedures included pure-tone audiometry (0.25-16 kHz), and the Bamford-Kowal-Bench Speech-in-Noise test. WAHTS tests included audiometry (0.25-16 kHz) with retest, Fixed Level Frequency Test (> 8 kHz), Triple Digits Test (positive and negative phase Schroeder masking), Binaural Masking Level Difference (with and without interaural phase differences) and the Modified Rhyme Speech Test (two spatial conditions and two signal-to-noise ratio conditions). Performance on speech-in-noise tests will be reported in relation to high-frequency thresholds. A portable and reliable

automated self-administered audiometric test battery would be extremely useful especially for children unable to travel to a sound-booth due to illness.

Poster # 169

Children's Ability to Benefit from Target/Masker Differences in F0-Contour
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This study investigates the extent to which children (ages 5-17 yrs) can take advantage of differences in fundamental frequency (F0) contours to improve speech-in-speech understanding. F0 contour refers to the natural variation, or rise and fall, of F0 within an utterance. While talker differences in mean F0 can improve speech-in-speech recognition for adults, children's ability to use mean F0 differences remains immature into adolescence (Flaherty et al. 2018). One explanation for this age effect is that children rely more than adults on dynamic, time-varying acoustic cues that contain redundant information (Nittrouer 2004; Flaherty et al. 2017). Examining F0 benefit in children, Flaherty et al. (2017, 2018) carefully controlled voice characteristics to isolate effects of mean F0, leaving F0 contours of the utterances unaltered. In natural speech, F0 co-varies with duration and intensity. Children's ability to segregate target from masker speech is expected to improve as a function of the magnitude of time-varying differences in F0. In the present study, sentence recognition was measured adaptively in a two-female-talker speech masker with a neutral F0 contour. Female target sentences were recorded with either neutral, flat, or exaggerated F0 contours. Results will be examined for effects of age and F0 contour differences.

Poster # 170

Home Acoustic Environment of Children with Hearing Loss
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Children with hearing loss (CHL) require better signal-to-noise ratios (SNRs) than children with no hearing loss to understand speech in background noise. Homes have been traditionally considered quiet environments, where access to speech is guaranteed for children. This is important given young CHL spend the bulk of their day in a home setting. However, studies examining the acoustics of adult home environments have found that SNRs are poorer than recommended for optimal speech understanding. The purpose of this study was to expand on these findings in adults by describing the acoustic characteristics of the home environment of young CHL. Nine families who have CHL between 2 and 5 years of age participated in the study. Children's home acoustic environments were recorded and analyzed using Language ENvironmental Analysis (LENA,Ñ¢) recorders. Results showed the average SNR encountered by CHL was +12 dB. Importantly, 80% of the SNRs experienced by CHL in their homes were poorer than the +15 dB recommended in ANSI standards. Listening under these sub-optimal conditions throughout the day could negatively affect learning opportunities for these young CHL- suggesting interventions are needed to improve the SNRs in their home environments.

Poster # 171

Children's Speech Recognition in Noise: Relationship with Language and Cognition
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Children learn in noisy environments where there are competing sounds to instruction, such as papers rustling, HVAC systems, and other children talking. In order for children to comprehend what the teacher is saying, they have to be able to recognize and attend to the teacher's voice amidst varying types of background noise and then remember what was said to interpret the meaning. Previous studies show mixed results on the contribution of linguistic and cognitive factors on children's ability to recognize speech in background noise. Corbin et al (2015) found age-related improvements in speech recognition in the presence of steady state noise and with a two-talker speech masker. However, performance in the two-talker condition had a more gradual improvement and reached adult-like performance by age 14. This study investigates whether children's language and cognitive skills, such as working memory and selective attention, relate to sentence recognition with varying maskers. Participants included 40 children with typical hearing between the ages of 6-12 years. Preliminary analyses found that those with stronger working memory, selective attention and inhibition skills had lower SNRs on the speech-in-noise task. The differences were more easily seen in the multi-talker babble condition, but were also present in the steady state noise condition. It was also found that those with stronger language skills had lower SNRs on the speech-in-noise task.

Poster # 172

Reliability of Bone Conduction Vestibular Evoked Myogenic Potentials in Children
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Recent research has supported the use of Vestibular Evoked Myogenic Potential (VEMP) for assessing vestibular function in children. Bone conduction vibration (BCV) stimuli for VEMP testing are clinically desirable for multiple reasons. However, no accepted standard exists for stimulus type and the reliability of BCV devices has not been investigated in children. The objective of the current study was to determine (a) the optimal BCV VEMP method by measuring response rates and reliability in a group of 22 adolescents and children and (b) if estimations of bone density predict the efficiency of BCV stimulation of the otolith organs. When comparing the reliability of the B-71, reflex hammer, and Mini-shaker, analyses indicate that the optimal method varies by age and VEMP type. In addition, wrist circumference and BMI were negatively correlated with both cervical VEMP and ocular VEMP amplitudes in response to all BCV methods within the child, adolescent, and adult groups, suggesting estimations of bone density

can be used to predict BCV efficiency. Further research is needed to determine the appropriate role for predictors of bone density in determining VEMP stimulus level and BCV stimulation type.

Poster # 173

Improving the Differential Diagnosis of Otitis Media

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Otitis media (OM) is the most common cause of conductive hearing loss (CHL) in children and the leading cause of pediatric office visits, prescription antibiotic use, and surgery. OM can vary in a given patient in a number of ways, including whether infection is present or absent, whether and how much CHL is present, and, if effusion is present, the volume and viscosity of that effusion. These variations can impact the management of OM and drive what treatment is indicated, yet there is no non-invasive and objective method to determine and differentiate many of these variables. Our goal is to improve the differential diagnosis of OM by (1) developing methods to objectively and non-invasively determine characteristics of an episode of OM and (2) determine how variations in OM characteristics influence CHL. Specifically, we investigate whether wideband acoustic immittance can be used to distinguish two common types of OM, (1) Acute Otitis Media and (2) Otitis Media with Effusion, as well as detect differences in effusion characteristics such as volume, viscosity, and purulence. Effusion is collected during ear-tube placement and its characteristics are individually quantified. We investigate relationships between OM effusion characteristics and degree of CHL.

SPEECH PERCEPTION

Poster # 174

Phonetic Processing is the Problem in Children with Reading Disabilities

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Objectives: Reading disability (RD) is widely accepted as a key obstacle in the development of literacy. Studies show that 15-20% of grade-school students are RD. Many quit high-school and go to jail. Design: We shall show that RD for 8-12 yrs is related to inadequate phonetic identification ability, rooted in pre-school language development. We used two tests (10 thousand responses/child): 1) A 3-interval forced choice procedure (Syllable Confusion Oddball Task: SCO). 2) A single CV/VC presentation task with oral response, to label CV/VC phones (Nonsense Syllable Confusion Matrix: NSCM). Results: The experimental results showed that for the SCO task the 10 RD cohort had, on average 5 times the error compared to the 6 RC reading control (RC) cohort. The errors were highly idiosyncratic, analyzed by logit. Conclusion: 1) RDs have significant speech perception problems, despite normal pure-tone hearing and language ability. 3) When comparing the SCO and NSCM results, our findings are consistent with a reduced ability to label CV/VC sounds presented in random temporal order. This seems consistent with phone memory dysfunction. 4) These conclusions are at odds with previous studies finding no indication of phone identification impairment.

Poster # 175

Informational Masking in Older Adults with Mild Cognitive Impairment
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Previous studies have suggested declines in auditory processing abilities in adults with mild cognitive impairment (MCI). The current study investigates speech understanding abilities of adults with MCI. Sentences are presented in the presence of a speech-envelope modulated noise or in the presence of a two-talker masker. The sentences are from the TVM corpus and comprised of 5 keys words in a syntactically correct but meaningless sentence. Adults with MCI are matched to cognitively healthy adults on the basis of age and hearing status. Results to date suggest poorer performance among participants with MCI across all conditions that is exacerbated by the informational masking effect of the two-talker background noise. Implications for optimizing communication in adults with MCI will be discussed.
(Work supported by NIH K23DC016855)

Poster # 176

Consistency of Talker Intelligibility Across Different Listening Environments
Nicole Thiede, BS; Sarah Yoho, PhD; Stephanie Borrie, PhD, Utah State University, Logan, UT

In recent years, increased emphasis has been placed on the replicability and reproducibility of scientific studies. However, an underappreciated variable in the study of speech perception is the impact a particular talker has on the observed pattern of results across different conditions. In the current study, the stability of ten talkers' intelligibility was observed across different listening environments. Specifically, sentence intelligibility in terms of percent words correct was measured in three different types of background noise (speech-shaped noise, babble, cafeteria) at two different signal-to-noise ratios (SNRs) for five male and five female talkers. Ten young, normal-hearing listeners were assigned to each of the six conditions for a total of 60 listener participants. An analysis via multilevel modelling found that the intelligibility of male talkers was more negatively impacted than the intelligibility of female talkers by less favorable SNRs across all types of noise. After this effect was accounted for, nearly 20% of the remaining variance in percent correct was attributable to talker-to-talker differences and less than 7% was attributed to listener-to-listener differences, indicating that the individual talker plays a large role in the pattern of results observed across noise types and SNRs.

TINNITUS

Poster # 177

Evaluation of the Tinnitus and Hearing Survey for Outcomes Assessment
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Individuals complaining of tinnitus often attribute hearing problems to the tinnitus. In such cases some (or all) of their reported 'tinnitus distress' may in fact be caused by trouble communicating due to hearing problems. We developed the Tinnitus and Hearing Survey (THS) as a tool to rapidly differentiate hearing problems from tinnitus problems. We have previously published data providing evidence that the THS is statistically validated and reliable for use in assisting patients and clinicians in quickly (and collaboratively) determining if intervention for tinnitus is appropriate. The present study involves a retrospective analysis of three randomized controlled trials conducted by our Center that used both the THS and the Tinnitus Functional Index (TFI) at all outcome points. Concurrent administration of these two instruments enabled an analysis of the THS as an outcome instrument relative to the TFI, which was the primary outcome instrument for each of the studies. Although the THS contains only four tinnitus-related items (compared to the 25-item TFI), the THS can be used to assess outcomes of tinnitus intervention, with the caveat that the THS does not have the same sensitivity for change that has been reported for the TFI.

Poster # 178

Evaluation of Cochlear Tuning in Adults With and Without Tinnitus

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The study quantified (1) sharpness of cochlear tinning and (2) the efferent induced changes in the sharpness of cochlear tuning estimates in normal hearing young adults with and without chronic tinnitus and with clinically normal hearing sensitivity. Click-evoked otoacoustic emissions (CEOAEs) with and without 60 dB SPL contralateral acoustic stimulation (CAS) were recorded from 15 young adults with no tinnitus and 12 with chronic tinnitus (i.e. bothersome tinnitus perception for •1 year). CEOAEs were measured using 75 ¬µs rectangular condensation clicks. Responses to 2048 clicks were time windowed between 2 and 20 ms. Time-frequency distributions of CEOAE were obtained via S-transform, and the CEOAEs latencies were used to estimate the sharpness of cochlear tuning. It was hypothesized that (1) individuals with chronic tinnitus would exhibit poorer cochlear tuning compared to individuals with no tinnitus, and (2) individuals with chronic tinnitus would exhibit increased medial olivocochlear reflex strength resulting to the significantly greater reduction in the sharpness of the cochlear tuning followed by CAS compared to the control group. The results of the study will be presented at the conference.