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POSTER ABSTRACTS

Topic areas, poster numbers, and abstract codes:

ANATOMY / PHYSIOLOGY OF AUDITORY & VESTIBULAR SYSTEMS

Poster # 1

The Association of Recreational Noise Exposure on Acoustic Reflexes

Shaina Jones; Nicolette Dome; Amanda Kaae, BA; Carlee Michaelson; John Parsons; Shannon O'Donnell; Peter Torre III, PhD, San Diego State University, San Diego, CA

Acoustic reflexes have an important role in protecting the cochlea against noise exposure. The purpose of this study was to compare self reported volume use of a personal music system with earphones and preferred listening level and acoustic reflex thresholds. Ninety-seven undergraduate students (80 women

and 17 men) participated. Otoscopy, tympanometry and acoustic reflex thresholds a 1 kHz were obtained in each ear. Pure-tone thresholds from 0.25 to 8 kHz, and 3 and 6 kHz, confirmed normal hearing in all participants. Self reported volume use was collected during a questionnaire; participants were categorized into Can Hear or Cannot Hear people (i.e., Hear variable) while wearing earphones. Preferred listening level data was collected using a probe and equivalent continuous sound level, A-weighted, (LAeq) was obtained. There was a significant Sex-by-Hear interaction such that men who reported difficulty hearing others had significantly higher acoustic reflex thresholds compared to other groups. The main effect for Sex was not significant whereas the main effect for Hear was significant. Preferred listening level, in LAeq, was not significantly associated with acoustic reflex thresholds. The significant interaction should be interpreted cautiously because of the small sample of men in this study.

Poster # 2

Clinical Use of Head-Shake Static Posturography

Ewa Zamyslowska-Szmytke, MD; Mariola Sliwinska-kowalska, MD, Clinic Of Audiology And Phoniatrics, Nofer Institute Of Occupational Medicine, Lodz, Poland

Objective: to analyze whether the implementation of head shake (HS) to conventional static posturography may increase the value of this test in differential diagnostics of vestibular pathologies. Methods: The study comprised a total of 169 subjects including healthy individuals, patients with benign paroxysmal positional vertigo, with unilateral uncompensated and compensated canal paresis and with vestibular migraine. No significant age difference between groups was found. Static posturography was performed as a standard four conditions test and then repeated with head movements controlled by metronome set at 1 kHz. Results: We found statistically significant increase in mean velocity of body movements in HS posturography as compared to standard posturography in all patient groups, but the control group. The results of HS posturography differed also in patient groups in comparison to controls while such differences were not found in standard examination (ANCOVA). The group of patients with uncompensated canal paresis was the only one for which the average body movements were significantly increased in all four HS posturographic conditions. Conclusion. The inclusion of head movements to standard static posturography can increase its sensitivity in the diagnosis of vestibular disorders. Acknowledgment. Supported by the National Centre for Research and Development project No 2/266299/19NCBR/2016 (INNOREH).

Poster # 3

Reductions in cVEMP Amplitude Variability Using a Commercial Dynamometer

Stephanie Palazzolo; Lauren Kassa; Anthony Cacace, Wayne State University, Detroit, MI

Cervical vestibular evoked myogenic potentials (cVEMPs) are gaining increased interest as a metric of otolith/saccular function. However, amplitude values of this metric are notoriously variable. We set out to determine if using a dynamometer to quantify input force levels of sternocleidomastoid muscle tension would decrease measurement variability. In 25 normal hearing adult volunteers, age range 18 to 60 years, single channel cVEMP recordings were acquired over a 50 ms recording epoch. Keeping input sound pressure level constant and using a Blackman windowed 750 Hz tone burst as the activation stimulus, four experimental conditions were used to assess P1 and N1 latencies/amplitudes: Condition 1,

head turned to the left with no explicit muscle tension applied (control), Conditions 2-4 head turned to the left with 2, 4, and 6 lbs/force applied to a dynamometer force plate situated between the chin and shoulder with numerical feedback values displayed on a digital screen. Based upon the coefficient-of-variation (CV), cVEMP P1 and N1 latencies remained constant across all conditions. However, CV amplitude values increased slightly from control (80% CV) and decreased below 60% CV at 6 lbs/force. Quantifying force levels of muscle tension using a commercial dynamometer helped to reduce amplitude variability in cVEMP measurements.

Poster # 4

Vestibular Evoked Myogenic Potential (VEMP) Test-Retest Reliability in Children

Elizabeth Marler, BA, Purdue University, Springfield, MO
Amanda I. Rodriguez, PhD; Tom Cruetz, PhD; Denis Fitzpatrick, PhD; Kristen L. Janky, PhD, Boys Town National Research Hospital, Omaha, NE
Megan La Thomas, AuD, Richland County School District 1, Columbia, SC

Vestibular evoked myogenic potentials (VEMPs) are short-latency muscle potentials measured from the neck (cervical, cVEMP) or under the eyes (ocular, oVEMP), which provide information regarding function of the the saccule and utricle, respectively. VEMPs are reliably performed in adults; however, research has not been done to assess whether VEMPs are reliable in children. Therefore, the purpose of the study was to determine the test-retest reliability of c- and oVEMP testing in children. C- and oVEMP testing were completed across two test sessions in response to air conduction and reflex hammer stimuli. Additionally, oVEMP was completed in eyes open and eyes closed conditions. Results suggest that when using air conduction stimuli, c- and oVEMP amplitudes are reliable across test sessions in both children and adults. With reflex hammer stimuli, cVEMP amplitudes showed high reliability; however, oVEMP amplitudes showed low reliability in both conditions (eyes open and closed). Comparison between oVEMP conditions revealed shorter latencies and higher peak-to-peak amplitudes in the eyes open condition. In conclusion, cVEMPs are reliable in children using air conduction and reflex hammer stimuli; oVEMPs are reliable using air conduction stimuli in the eyes open condition.

Poster # 5

Control of Dynamic Balance During Gait: A Pilot Study

Paige Heeke, BS, East Carolina University, Greenville, NC
Robert Peterka, PhD, Va Portland Health Care System, National Center For Rehabilitative Auditory Research, Portland, OR

Normal gait is a series of rhythmical, alternating movements of the trunk and limbs which result in the forward progression of the body. With each successive footfall, the body's center of mass oscillates side-to-side in the mediolateral (ML) plane. Previous research focused on three mechanisms (step-width adjustments, ankle torque, and reactive torque from trunk motion) for controlling ML dynamic balance to maintain a stable ML oscillation. Step-width control is usually considered to be the primary mechanism used by humans. A less studied mechanism is step-timing regulation. In the current study, step-width regulation and step-timing regulation were measured in both stepping-in-place (SiP) tasks and natural walking gait tasks using galvanic vestibular stimulation to induce ML body tilt. It was hypothesized that

both step-width and step-timing mechanisms contribute to dynamic balance control. Results show that in SiP tasks, step timing contributes to ML dynamic balance control and step width does not. In walking gait tasks, both step timing and step width appear to contribute. While step-width regulation has been found to contribute in walking gait, previous research has not evaluated the contribution of step-timing regulation. These preliminary results suggest that dynamic balance control may be different between SiP and walking gait.

AUDIOLOGY / OTOLOGY

Poster # 6

Auditory Midbrain Contribution to the Pathophysiology of Self-Perceived Speech-in-Noise Problems

Ariel Cohen; Jason Sanchez, PhD, Northwestern University, Evanston, IL

Research suggests that wave I of the auditory brainstem response (ABR) can be a valuable clinical tool in validating hidden hearing loss in humans, suggesting its pathophysiology is associated with a peripheral auditory deficit. However, there is no evidence to support the hypothesis that the central auditory pathway also contributes to its clinical symptoms. The objective of the current proposal was to determine the relative contribution of the auditory midbrain in the pathophysiology of hidden hearing loss in humans. We analyzed data from 2 groups of normal hearing adults (n = 32), 17 of which self-reported speech in noise difficulties. Scores from participants' speech-in-noise test (performance measure) and self-reported speech-in-noise survey (perceptual measure) were evaluated with the peak-to-trough amplitude of wave V of the ABR (objective measure). Our data shows that there was no difference in wave V amplitude for both groups and relationships between performance, perceptual and objective measurements were not apparent. These results suggest several possibilities. First, the auditory midbrain does not contribute to symptoms of hidden hearing loss. Second, wave V of the ABR is not a good predictor of speech-in-noise performance and perception and third, speech-in-noise deficits are likely due to a peripheral auditory phenomenon.

Poster # 7

Recreational Noise Exposure and Audiogram Noise Notches in Young Adults

Nicolette Dome; Shaina Jones; Amanda Kaae, BA; Carlee Michaelson; Shannon O'Donnell; John Parsons; Peter Torre III, PhD, San Diego State University, San Diego, CA

A notch (10 dB or greater) or unequivocal notch (15 dB or greater) present in an audiogram is typically associated with noise-induced hearing loss. The purpose of this study was to evaluate the association between self-reported volume use and preferred listening levels and the presence of noise notches in younger adults. One hundred, ninety-one undergraduate students, 52 men and 139 women participated. Otoscopy, tympanometry, and audiometry (0.25-8 kHz, including 3 and 6 kHz) were completed as part of a larger research protocol. A probe microphone was placed in the ear canal during one hour of music exposure to measure equivalent continuous sound pressure level, A-weighted, in the ear canal. A small notch was defined as a 10 dB threshold elevation in either ear between 3 and 6 kHz compared to adjacent frequencies. A large notch was defined in the same way but with a -15 dB threshold elevation. Overall,

there were a higher percentage of both small and large notches in the right ear. There were a higher percentage of large notches in either for both women and men. Self-reported volume use and preferred listening levels were not significantly associated with notches.

Poster # 8

Quality Metrics for Thévenin-Equivalent Acoustic Source Parameters
Kren Rahbek Noergaard, MS, Technical University Of Denmark, Kongens Lyngby
Stephen T. Neely, PhD; Daniel M. Rasetshwane, PhD, Boys Town National Research Hospital, Omaha, NE

The measurement of ear-canal impedance and reflectance requires determination of the Thvenin-equivalent acoustic source parameters of the ear probe. A widely used existing calibration method is unable to reveal undesired parallel components in the source parameters, such as a leak in the ear tip or improperly accounting for evanescent modes. Such parallel components can introduce errors into subsequent measurements of ear-canal impedance and reflectance. A set of alternative error metrics are proposed that are capable of accurately identifying undesired parallel components. This is achieved by studying the causality of the source admittance using the Hilbert transform and by examining the source pressure and source flow in the time domain. The proposed and existing error metrics are compared in cases where undesirable parallel components have been deliberately introduced, employing two existing calibration methods. The results demonstrate the ability of the proposed error metrics to identify various undesired effects in the source parameters that would otherwise go undetected. Implementing the proposed error metrics as part of a Thvenin calibration procedure could thus increase the validity and accuracy of ear-canal impedance and reflectance measurements.

Poster # 9

Characterization and Serial Measurement of Ototoxicity in Pediatric Cancer Treatments
Kelsey Dumanch, MA; Matthew Schuelke; Amulya A. Nageswara Rao, MD; Gayla Poling, PhD, Mayo Clinic, Rochester, MN

Current ototoxicity monitoring (OM) guidelines recommend serial measurement of behavioral hearing thresholds to identify earliest changes in auditory function. This can be difficult to obtain from young children and/or patients unable to respond during treatments. Guidelines suggest incorporating higher frequencies and supplementing with objective measures. DPOAEs offer a noninvasive, objective measure of cochlear dysfunction and are more sensitive to subtle ototoxic changes than thresholds. Outcomes using DPOAEs in pediatric OM are not well quantified in terms of impacts of treatment parameters and significant change criteria are unestablished. This study analyzed retrospective data for 351 patients (age<18 years) undergoing brain cancer treatments. The primary objective was to characterize ototoxic changes and establish the time course of clinically-significant ototoxic change. Seventy-two percent of patients undergoing OM experienced an ASHA (1994) significant threshold shift in at least one ear while 44% experienced a NCI CTCAE grade shift highlighting the added value of including higher frequencies for early detection. Initial ototoxic changes were observed up to 10 years after treatment. Serial DPOAEs (n=27) were reviewed and various significant change criteria applied. Tumor type and cumulative chemotherapy dosage placed children at highest risk. Results including significant change criteria, risk, and auditory outcomes will be discussed.

COCHLEAR IMPLANTS

Poster # 10

Interaural Mismatches Result in Uncorrelated Signals, Causing Degraded Binaural Abilities
Justin Aronoff, PhD; Daniel Lee; Abbigail Buente, Hannah Staisloff, University Of Illinois At Urbana-champaign, Champaign, IL

Despite the advancement in cochlear implant (CI) strategies, the binaural benefits that bilateral CI users obtain are considerably less than those obtained by normal hearing listeners. This is due, in part, to the effects of interaural mismatches caused by differences in electrode array insertion depth and neuronal cell survival between the two ears. However, CI processors assign frequency regions to individual electrodes based on electrode numbering (i.e. the distance, in electrodes, from one end of the electrode array). This suggests that interaural mismatches will result in matched bilateral electrode pairs encoding different frequency regions in each ear, resulting in decreased interaural correlation. This could potentially decreased binaural abilities. To test whether pairing electrodes that encode different frequency regions would degrade binaural abilities, three experiments were conducted. The first experiment measured changes in binaural abilities when interaural mismatches result in uncorrelated pulse timing. The second experiment tested single-channel binaural abilities, when interaural mismatches result in uncorrelated envelopes. The third experiment tested multi-channel binaural abilities, when interaural mismatches result in uncorrelated envelopes. The results suggest that decreased correlation resulting from interaural mismatches detrimentally affects binaural abilities for CI users above and beyond the detrimental effects of interaural mismatches alone.

Poster # 11

Impact of Recording Electrode on Electrocochleography in Hybrid CI Users
Rachael Owen, BS, University Of Iowa, Iowa City, IA

Shorter electrode arrays and soft surgical techniques allow for preservation of low-frequency acoustic hearing in the implanted ear of some cochlear implant (CI) users. Recently, we have begun using the telemetry system of the CI to record neural responses from the cochlea that are evoked using an acoustic stimulus (Abbas et al., 2017). The response we record include the cochlear microphonic, generated by the cochlear hair cells, and the auditory nerve neurophonic. This report describes the technique we use to record these responses and focuses on how the choice of intracochlear recording electrode impacts these recordings. To date, seven Nucleus Hybrid CI users have participated. If we use a 500 Hz tone burst to evoke the response, CM and ANN amplitudes decrease as the recording electrode is moved toward the base of the cochlea. If we use the most apical electrode in the array as the recording electrode and lower the frequency of the tone burst, CM and ANN amplitudes tend to increase in amplitude. Our assumption is that trend reflects the fact that most subjects have sloping audiograms.

Poster # 12

Evaluation of Cochlear Implant Mapping Parameters in Older Adults: Rate of Stimulation
Meredith Rooth, AuD; Margaret Dillon, AuD, University Of North Carolina At Chapel Hill, Chapel Hill, NC
Andrea Bucker, AuD; English King, AuD, UNC Health Care, Chapel Hill, NC

Multiple variables may contribute independently and in combination to the growth of initial speech perception for cochlear implant (CI) recipients. Age at implantation has been shown to influence initial speech perception, with younger adults achieving higher performance than older adults. Attempts to improve the speech perception growth of older adult CI recipients include the assessment of different mapping parameters. Rate of stimulation may contribute to speech perception outcomes; however, some researchers have demonstrated a positive effect with a faster rate while others with a slower rate. The present report compared the speech perception of older adult CI recipients mapped with different stimulation rates to determine whether this mapping parameter influences initial speech perception. Fifteen CI recipients participated in this twelve-month prospective evaluation. Speech perception was assessed postoperatively; subjects were grouped at the six-month interval based on their CNC word score and a randomization algorithm to determine the assigned rate of stimulation for the remainder of the study. Manipulation of stimulation rate at the six-month interval did not result in a difference in speech perception at the 12-month interval. Individual differences within the older adult population should be considered and mapping parameters altered on a case-by-case basis.

Poster # 13

Ongoing Vocal Corrections to Brief Loudness Shifts: Voice Stabilization Mechanisms
Abbigail Buente, BS; Justin Aronoff, PhD, University Of Illinois At Urbana Champaign, Champaign, IL
Melanie Samuels, BA, Northwestern University, Evanston, IL
Torrey Loucks, PhD, University of Alberta, Edmonton, Canada

Intensity is an important prosodic cue for speech understanding, conveying emotional information and emphasis in speech. However, vocal intensity control is needed in order to convey these prosodic cues. Cochlear implant (CI) users have difficulty controlling their vocal intensity. Vocal intensity is normally controlled by a perception-production loop, and CI users may have difficulty using this loop. To investigate this seven CI users and 10 normal hearing (NH) listeners were tested. Vocalizations were recorded while a brief perturbation in intensity was introduced into the feedback that was provided back to the participant. The CI users showed significantly fewer responses to the perturbations overall. However, both groups showed a tendency to compensate for the perturbation, changing the intensity of their voice in the opposite direction as the perturbation. These results suggest that the perception production loop is at least partially intact for CI users. One possible explanation for the decreased number of total responses of the CI users compared to the normal hearing subjects, may be that CI users do not have reliable auditory feedback. Another possibility is that they have difficulty using that auditory feedback, or it could be a combination of both possibilities.

Poster # 14

Binaural Beats Assess Binaural Interactions in Single-Sided-Deafness Cochlear-Implant Patients
Coral Dirks; Peggy Nelson; Andrew Oxenham, University Of Minnesota, Minneapolis, MN

Patients with single-sided deafness (SSD) report significant difficulty understanding speech and localizing sound, especially when sounds originate on the deaf side. Some SSD patients receive a cochlear implant (CI) in their deaf ear and the CI is typically fit to maximize speech perception through the CI alone. Here we evaluate a novel method of fitting the CI to maximize binaural interactions and frequency match between the ears. Binaural temporal-envelope beat sensitivity was measured in three SSD+CI patients, using biphasic pulses presented to one electrode in the CI and bandpass-filtered acoustic pulse trains in the hearing ear. The results were compared with those from normal-hearing (NH) listeners using bandpass-filtered pulse trains presented to both ears. Maximum sensitivity to binaural beats in NH listeners occurred when place of stimulation is matched across ears. Similar tuning was observed in the SSD+CI patients. The results will be used to adjust the frequency allocation map for the CI. The outcomes of the study will provide new information on binaural interactions in SSD+CI patients, and may provide a new approach to fitting a CI in cases where considerable residual hearing exists in the contralateral ear.

Poster # 15

Effects of Aging on Vocal Emotion Recognition with Spectrally-Degraded Speech
Shauntelle Cannon, AuD; Monita Chatterjee, PhD, Boys Town National Research Hospital, Omaha , NE

Vocal emotion recognition declines with age, even in normally hearing (NH) adults. Recent studies have investigated vocal emotion recognition using CI-simulated speech in children and young adults with NH; however, little is known about the effects of aging on vocal emotion recognition in CI adults or in NH adults attending to spectrally-degraded stimuli. The current study focused on these effects. Participants included 17 NH adults and 8 adult CI users. Stimuli were audio-only emotion-neutral sentences spoken by a male and female talker in 5 emotions (happy, sad, scared, angry, neutral). NH participants listened to unprocessed speech and different degrees of degraded speech, while CI users only heard unprocessed speech. Participants were asked to choose which emotion they thought the talker was conveying in a forced-choice procedure. Preliminary results show age-related declines for unprocessed speech and all spectrally degraded conditions for NH adults. Performance of CI users with unprocessed speech is similar to that of older NH adults with CI simulated speech. Results have implications for aging adults with NH, hearing loss, and CI users as deficits in vocal emotion recognition have been shown to negatively impact social interactions and social cognition, leading to decreased quality of life.

Poster # 16

Acoustic Analysis of Singing Proficiency in Children with Cochlear Implants
Emily Hahn, BS; Li Xu, PhD, Ohio University, Athens, OH
Rosalie Uchanski, PhD; Lisa Davidson, PhD, Washington University School of Medicine, St. Louis, MO

This study compared the vocal singing abilities of children with cochlear implants (CI) to normal-hearing (NH) children. Fifty-four children with CIs (18 bimodal; 36 bilateral CI) and 34 NH children were recruited. All CI children were between the ages of 6.75 and 11 years old and all NH children were between the ages of 3.25 and 11 years old. The children sang a song most familiar to them. The fundamental frequency of each sung note was extracted. The original song and the sung version by each child were compared using four different metrics including (1) contour direction, (2) compression ratio, (3) mean note deviation, and (4) mean interval deviation. Results from this study showed that there were

significant differences in the singing proficiency between the CI and NH groups. No significant differences were found between bimodal and bilateral CI users. While several CI children sang with similar proficiency to that of the NH children, many of them produced pitch in a more or less random fashion. These results indicate that current CI technology provides limited pitch information to the users which in turn hinders singing development in children with CIs.

Poster # 17

Real-Time Spoken Word Recognition in Sentences by Cochlear Implant Users

Kelsey Klein, BA; Bob Mcmurray, PhD, University Of Iowa, Iowa City, IA
Ashley Farris-Trimble, PhD, Simon Fraser University, Burnaby, British Columbia

For typical listeners, word recognition is a process of dynamic competition between potential interpretations of the input. Little is known about how cochlear implant (CI) users adapt these dynamics to cope with uncertainty. With isolated words, CI users are slower (~80ms) than normal hearing (NH) listeners to commit to the target and do not fully suppress phonological competitors. We examined how these atypical word recognition dynamics manifest in sentences. Sixteen adult CI users and 16 NH adults participated in a visual world paradigm task. Listeners heard a target word in a neutral carrier phrase and selected its referent from a screen containing a picture of the target, a phonological competitor, and two unrelated items. Eye movements were monitored as a measure of how strongly each candidate was considered. CI users were slower than NH listeners to activate the target (108ms; $p<.001$). They also showed reduced peak competition from cohorts ($p=.061$) but did not suppress cohorts as much as NH listeners ($p=.020$). Even when the sentence does not provide semantic information, it can alter the dynamics of word recognition. This has implications for speech perception measures that rely on isolated words, which may underestimate processing load experienced in running speech.

Poster # 18

Cochlear Implant Performance in Reverberation and Noise: Implications for Telepractice

Tia McDonald, BA, University Of Arkansas For Medical Sciences, Little Rock, AR
Joshua Sevier, AuD; Michelle Hughes, PhD, Boys Town National Reseach Hospital, Omaha, NE

Recent research has examined the potential use of telepractice for delivery of cochlear-implant (CI) services. Programming levels have been shown to be similar for remote and in-person mapping, yet speech-perception scores are poorer when performed outside of a sound booth in remote conditions. The purpose of this study was to measure speech perception in varying reverberation times (RTs) and signal-to-noise ratios (SNRs) using direct audio input (DAI) to evaluate CI recipient performance in simulated acoustical environments typical of potential remote locations used for telepractice. To date, 17 CI recipients have been tested using clinical speech-perception tests (CNC words and phonemes, HINT sentences, and AZBio sentences). Preliminary findings show that recipients exhibit poorer performance for longer RTs and more challenging SNRs, as expected. Results from this study will be used to develop correction factors that can be applied to equate sound-booth performance in the clinic to performance measured remotely at sites that lack a sound booth.

Poster # 19

Hearing Related Quality of Life for Children with Cochlear Implants
Deepa Suneel, BS, University Of Texas At Austin, Austin, TX
Lisa Davidson, PhD; Judith Lieu, MD; Chris Brenner, MS, Washington University School Of Medicine In St. Louis, St. Louis, MO

This study examined self-reported hearing quality of life (HQoL) for pediatric cochlear implant (CI) recipients, 7-10 years of age, through three questions: 1) Does HQoL of children with CIs differ from that of age-mates with less severe hearing loss (HL)? 2) Does HQoL of children with CIs depend on device configuration (simultaneously- implanted CIs, sequentially implanted CIs, bimodal device)? 3) Are any audiological, demographic and/or spoken-language factors of these children with CIs related to their HQoL? Nineteen children with simultaneously implanted CIs, 57 with sequentially implanted CIs, and 28 with bimodal devices (CI and HA) participated. Children responded themselves to all items on The Hearing Environments and Reflection of Quality of Life (HEAR-QL) questionnaire, and were given a receptive language and speech perception test battery (word recognition in noise, talker discrimination and emotion identification). For these participants, HEAR-QL scores did not differ from those of children with less severe HL, nor did scores differ significantly across device configuration. None of the audiological, demographic or spoken-language factors were associated with Hear-QL scores, with the exception of emotion identification. Factors typically associated with better-spoken communication, for pediatric CI recipients, were not associated with HQoL.

Poster # 20

The Effects of Bilateral Low Frequency Hearing on Music Perception
Max Gilbane, BA; Rene Gifford, PhD, Vanderbilt University, Nashville, TN

The purpose of this study was to investigate what benefits bilateral access to low-frequency acoustic hearing provides to music perception and appreciation in cochlear implant (CI) users with preserved acoustic hearing in the CI ear. 10 CI users with bilateral acoustic hearing and 6 normal-hearing controls completed sound quality judgements in response to music played from loudspeakers at 45 in a soundproof booth. Two listening conditions were tested including best-aided EAS (CI + bilateral hearing aids) and bimodal (CI + contralateral hearing aid). Subjects also completed a music perception test battery: a beat-alignment task, chord discrimination, a test spectral modulation detection, and stereophonic perception. While no significant differences were found at a group level for any of the music tasks, 5 out of 10 CI users reported considerably higher ratings of perceived audio quality for best-aided EAS versus bimodal hearing. Subjective ratings of sound quality did not correlate with audiometric thresholds in the CI ear or performance on any of the music perception tasks. These data suggest that bilateral acoustic hearing may not add significant benefit to music perception for all EAS users, though some individuals will report and experience benefit. Supported by NIH-NIDCD T35DC008763

ELECTROPHYSIOLOGIC RESPONSES

Poster # 21

Tone-Evoked Acoustic Change Complex (ACC) in an Animal Model
Alessandro Presacco, PhD; John Middlebrooks, PhD, University Of California, Irvine, Irvine, CA

Introduction: The Auditory Change Complex (ACC) is a cortical evoked potential complex generated in response to changes (e.g. frequency) within an auditory stimulus. The ACC has been recorded in both normal-hearing human subjects and in cochlear implant users, suggesting that the ACC would be useful in clinical applications. Here we investigate the feasibility of recording ACC in response to frequency and level discrimination tasks in sedated cats. Methods: Five purpose-bred domestic shorthaired cats were anesthetized and used in this studied. Continuous tones alternated between high and low frequencies or levels in 500-ms blocks. Frequency and level steps were varied parametrically. Scalp potentials were recorded with needle electrodes (two active electrodes = one on each hemisphere, reference: mastoid, ground = back of the cat). Results: ACC was successfully elicited in all cats by both frequency and level steps. The ACC showed a clear asymmetry, in that amplitudes were greater for increasing than for decreasing or frequency or level steps. Interestingly, the detection thresholds measured were in good agreement with previous behavioral studies in which cats where trained to perform similar discriminations. Conclusions: Responses bore several similarities to human studies, making this animal model a good candidate for use in clinically-relevant applications.

Poster # 22

Auditory Brainstem Response to CHIRP-LS Stimulus in Patients with Vestibular Schwannoma
Diane Catalano, AuD; David Kaylie, MD, Duke University Hospital, Durham, NC
Rebecca Kane, AuD, Duke Otolaryngology Of Durham, Durham, NC

A chirp stimulus, based on the derived-band model, may overcome current limitations of traditional ABR recordings in vestibular schwannoma patients. Standard recordings for retrocochlear ABR utilize a click stimulus to stimulate the basilar membrane from base to apex. Due to the traveling wave effect generated by the click stimulus, low frequency input is delayed and canceled out of the click stimulus resulting in the majority of energy centered in the mid- to high-frequency range (2000-4000 Hz). The chirp stimulus is able overcome the traveling wave effect by delaying high frequency input resulting in greater low frequency input in the ABR recording. The CHIRP-LS (level specific) attempts to compensate for the traveling wave effect as well as frequency specific input. Previous studies indicate that CHIRP-LS produces larger ABR amplitudes in normal hearing individuals. As click ABR recordings are negatively affected by presence of vestibular schwannoma, enhancing ABR recordings with CHIRP-LS may serve in better medical management for this patient population both pre and intraoperatively. Twenty-four subjects with vestibular schwannoma underwent ABR testing with click and CHIRP-LS stimulus. Subjects had varying tumor sizes and severity of hearing loss. Primary outcome measures were amplitude and latency measurements. Findings will be discussed in detail.

Poster # 23

Effects of Personal Music System Listening Level on the Cochlea
Amanda Kaae, BA; Carlee Michaelson; John Parsons; Shannon O'Donnell; Shaina Jones; Nicolette Dome; Peter Torre III, PhD, San Diego State University, San Diego, CA

Both inner and outer hair cells within the cochlea are vulnerable, especially to noise exposure. The purpose of this study was to measure changes within the cochlea after listening to a personal music system with earphones. Two men and 16 women (mean age=21.5 yrs; SD=3.4 years) participated. Distortion product otoacoustic emissions (DPOAEs) and electrocochleography (ECochG) were measured before and after one hour of music exposure. DPOAEs were collected at 1, 1.5, 2, 3, 4, and 5 kHz. ECochG data were obtained using 90 dB HL clicks and at a rate of 7.1/sec. Summating potential (SP) and action potential (AP) were determined and SP/AP ratios, AP latency, and AP amplitude were calculated. A probe tube was placed in the ear canal to measure equivalent continuous sound level (LAeq) of one hour of music. The median preferred listening level was 76.1 dBA and participants were stratified based on this. With the exception of 4 kHz, participants that listened above this level had a greater mean decrease in DPOAEs after music. There were no differences in ECochG data for preferred listening level groups. In this small sample of young adults, there was more change DPOAEs than ECochG measures.

Poster # 24

Search for Electrophysiological Indices of Hidden Hearing Loss

Chandan Suresh, MS; Ananthanarayan Krishnan, PhD, Purdue University, West Lafayette, IN

Recent studies in animals suggest that even moderate levels of noise exposure can damage synaptic ribbons without affecting audiometric thresholds, giving rise to the use of the term 'hidden hearing loss' (HHL). Research employed to characterize HHL in humans have yielded confounding results. The objective of the project is to develop sensitive clinical electrophysiologic measures for early detection of HHL. We utilized specific stimulus manipulations that will likely produce a greater degradation of responses (recorded from different levels-inner ear, auditory nerve, and brainstem) in individuals at high-risk for HHL compared to low-risk, due to loss of synapses and/or neurons. The specific stimulus manipulations include response measures across sound levels, response measure in noise, two different adaptation paradigm (stimulus rate neural adaptation and adaptation recovery for click train paradigm), and changes in rate of frequency sweep. Consistent with previous studies, there were no differences between the low- and high-risk groups in audiometric thresholds or DPOAE amplitude. The high-risk group had significantly lower Wave I amplitude at high sound levels only; different pattern of amplitude recovery from adaptation; and greater disruption in encoding of rapid frequency change. These results suggest certain stimulus manipulations could potentially isolate individuals at risk for HHL.

Poster # 25

Recreational Noise Exposure Effects on ECochG in Young Adults

Shannon O'Donnell; Nicolette Dome; Shaina Jones; Amanda Kaae; Carlee Michaelson; John Parsons; Peter Torre III, PhD, San Diego State University, San Diego, CA

Electrocochleography (ECochG) can be used to evaluate the effects of noise exposure on the cochlea. The purpose of this study was to evaluate how self-reported volume use with personal music (PM) systems and preferred listening level in quiet is associated with the ECochG. Nineteen undergraduate students, 17 women and 2 men (mean age=21.4 years; SD=3.3 years) with normal hearing participated. Survey data included self-reported PM use and preferred volume use. Pure tone thresholds were used to confirm normal hearing. ECochG data were obtained using clicks presented at 90 dB HL and at a rate of 7.1/sec.

The summating potential (SP) and action potential (AP) were determined. Participants were categorized as Non-Loud (low or medium volume use) or Loud (loud or very loud) PM users. The SP/AP ratio, AP latency, and AP amplitude were analyzed. The median preferred listening level was 76.1 dBA; participants were stratified across this level. There were no significant differences for SP/AP ratio or AP latency for either self-reported volume use or preferred listening level. Those who reported Loud volume use had significantly lower AP amplitude compared to those who reported Non-Loud volume. There was no significant difference in AP amplitude for preferred listening level.

Poster # 26

Peripheral Role in Temporal Processing Deficits

Alanna Schloss, BA; Veronica Yevsukov; Samira Anderson, PhD, University Of Maryland, College Park, College Park, MD

Older adults often report that speech is audible but unclear, and this lack of clarity may result from age-related degradation in temporal processing. Temporal processing deficits may arise from age-related cochlear synaptopathy. The present study investigates the role of peripheral auditory function in the perception of vowel duration differences ('wheat' vs. 'weed') in normal-hearing younger and older adults. The vowel duration in 'weed' was progressively shorted to obtain a 9-step continuum from 155 ms ('weed') to 93 ms ('wheat'), and a perceptual identification function was obtained using this 9-step continuum. Cochlear hair cell and lower-level neural function were assessed using distortion product otoacoustic emissions (DPOAEs) and auditory brainstem responses to clicks in quiet and noise. Behavioral performance did not differ between the groups, but performance was variable across participants. DPOAE thresholds above 1 kHz were lower in older than in younger adults. Wave I amplitude was also lower in older adults than in younger adults, but the Wave V/I ratio and Wave V latency quiet-to-noise slope were equivalent between groups. DPOAE and ABR measures did not predict variance in perceptual performance; therefore, central or cognitive factors may play a role in performance on temporal processing tasks.

Poster # 27

Neural Representation of Speech in Individuals with Different Noise Tolerances

Meredith Klinker, BS; Lata Krishnan, PhD; Ananthanarayan Krishnan, PhD, Purdue University, West Lafayette, IN

Individuals with better tolerance to noise, as indicated by their Acceptable Noise Level (ANL) score, are more likely to be successful hearing aid users. ANL scores vary greatly among individuals and are unrelated to age, gender, and hearing levels; however, little is known regarding the sources of this variability. Here we examine neural encoding of the envelope and temporal fine structure (TFS) of a speech stimulus using frequency following responses (FFR) to determine if differences in encoding may account for the variability in ANL. FFRs were elicited using a speech stimulus presented in quiet and noise (+10 and +5 SNR) in normal hearing young adults with low and high ANL scores. Results indicate that TFS encoding was more robust for the low ANL group, suggesting that the improved neural representation of TFS may predict better hearing aid performance. In contrast, envelope encoding was poorer in noise for the low ANL group, suggesting differential susceptibility to noise between the two

groups. Overall, FFR measures of envelope and TFS may provide insight into the sources of variability related to noise tolerance and hearing aid performance.

Poster # 28

Subcortical Frequency-Coding Errors are Linked to Speaker-Variability Intolerance in Normal-Hearing Adults

Breanna Hart, BS; Fun-cherng Jeng, PhD; Chao-yang Lee, PhD, Ohio University, Athens, OH

Processing speaker-specific information is an important task in daily communication. This study examined how fundamental frequency (F0) cues were encoded at the subcortical level, as reflected by scalp-recorded frequency-following responses, and their relationship with the listeners ability in processing speech stimuli produced by multiple speakers. By using Mandarin tones with distinctive F0 contours, the results indicated that subcortical frequency-coding errors were significantly correlated with the listeners speaker-variability intolerance for both percent correct and reaction time measures. These findings lay a foundation to help us better understand how speaker information is processed in individuals with normal and impaired auditory systems.

Poster # 29

Electrophysiologic Investigation of Spatial Release from Masking

Alireza Pourjavid, MS; Kailyn Mcfarland; Nicole Marrone, PhD; Barbara Cone, PhD, University Of Arizona, Tucson, AZ

The main aim of this study was to measure the key neurophysiologic markers of spatial-release-from-masking (SRM) in adults with normal hearing. We obtained CAEPs from 30 adults in response to consonant-vowel tokens (/ta/, /da/ and /di/) presented in the sound field. Tokens were first presented in quiet at 15, 30, 45 and 60 dB SL. Then a 10-talker-babble noise was presented in 3 different SNRs (10, 0, -5) at the same levels tested in quiet, either co-located, at 0 degrees azimuth or spatially-separated at 90 degrees. CAEP component latencies and amplitudes demonstrated systematic shifts as a function of SL, SNR, and noise location. Latencies decreased and amplitudes increased for the P1-N1-P2 response components as level increased. Latencies increased and amplitudes decreased as SNR was decreased. Latencies increased and amplitudes decreased in the co-located noise condition compared to quiet. When noise was spatially-separated there was a release from masking with latencies decreasing and amplitudes increasing significantly compared to co-located noise conditions. This suggests that the CAEP reflects how the central auditory system is able to squelch background noise via processing of binaural phase and level differences.

Poster # 30

Training Effects on Perception and Neural Representation of Temporal Cues

Eve Kronzek, BA; Jennifer Chisolm; Sandra Gordon-salant, PhD; Matthew Goupell, PhD; Samira Anderson, PhD, University Of Maryland, College Park, MD

Current treatment for mild-to-moderate sensorineural hearing loss focuses on increasing signal audibility with the use of hearing aids. This approach does not, however, address senescent changes in central auditory function, such as age-related declines in auditory temporal processing. The aim of this investigation was to determine if auditory training focusing on a discrete temporal cue, silence duration, improves the perception and neurophysiological representation of that temporal speech cue. Younger normal-hearing (YNH; <45) and older normal-hearing (ONH; 65-80) participants underwent identical pre and post behavioral and electrophysiologic test procedures. Perceptual identification functions were obtained for 'dish' versus 'ditch' on a seven-step continuum of silence duration. Frequency-following responses (FFRs) were recorded to 'ditch' stimulus-to-response (STR) correlations and phase-locking factors (PLF) were calculated to analyze the precision of temporal encoding. Behavioral testing revealed earlier identification crossover points in both YNH and ONH groups after training, with equivalent improvement between groups. FFR recordings revealed higher STR correlations and PLF after training in the ONH group only. These results show that nine sessions of perceptual training is sufficient to demonstrate behavioral improvement in both ONH and YNH groups, and improvement in the neural responses of the ONH group.

Poster # 31

Dissociable Mechanisms of Concurrent Speech Segregation in Noise at Subcortical Levels
Anusha Yellamsetty, MS; Gavin Bidelman, PhD, The University Of Memphis, Memphis, TN

Parsing simultaneous speech requires use pitch-guided (F0) segregation which can be hindered by the signal-to-noise ratio (SNR) in the auditory scene. The synergetic effects of spectral cues and noise interference on concurrent speech segregation and its underlying neural correlates are not well understood. Here, we assessed how pitch and noise impact the subcortical neural encoding of simultaneous speech sounds. We recorded brainstem frequency-following responses (FFRs) while listeners heard double vowels whose F0s differed by zero or four semitones presented in either clean or noise-degraded (+5dB SNR) conditions. Behaviorally, listeners were more accurate in identifying both vowels for larger pitch separations, but the F0-benefit interacted with noise. FFR F0 amplitudes to single-vowels were more robust and demonstrated a greater noise-related reduction than for double-vowels. F0 responses were elevated for double-vowels when stimuli contained no pitch cues (i.e., 0ST>4ST). Noise-related changes in FFR were greater for 0ST than at 4ST. Findings indicate that the separation and identification of concurrent speech sounds may be degraded by a process that integrates multiple stimuli in an additive or suppressive manner. They further reveal that while pitch cues can be used to parse speech sounds, their effectiveness deteriorates in noise at both behavioral and neural levels.

Poster # 32

Validation of Frequency-Swept-Tone DPOAE with current Clinical DPOAE Systems
Joshua Hajicek; Simon Henin; Glenis Long, The Graduate Center, City University Of New York, New York, NY
Jitpakorn Pichaitanaporn; Jungmee Lee; Ann Eddins, University of South Florida, Tampa, FL

A novel technique for measuring high-resolution OAEs using frequency-swept tones [Long et al., (2008), J. Acoust. Soc. Am. 124:1613-1626] produces reliable estimates of DPOAEs when compared with traditional measurements using discrete tones. The swept-tone DPOAE paradigm enables component separation and

provides information about fine-structures that may be sensitive to pathological changes in the cochlea. Validation against clinical measurements has yet to be established. We compared swept-tone DPOAEs collected using a custom software application, OAEToolBox (OTB), to discrete DPOAEs collected on two clinical systems, Otodynamics, Echoport ILO V6 (ILO) and Intelligent Hearing Systems SmartDPOAE (IHS). DPOAEs from each system were measured at two primary levels with L2/L1=45/57 and 60/63 dB SPL, and f2 frequencies from at least 1000-8000 Hz with f2/f1=1.22. We hypothesized and confirmed that system differences within participants are due to differences in in-the-ear calibration strategy. Furthermore, high-resolution fine structure obtained by the swept-tone paradigm were similar to data from both clinical systems. The swept-tone procedure produces high-resolution DPOAE estimates with better signal-to-noise ratios and in a fraction of testing time when compared to the clinical systems. These results validate and support the clinical feasibility of the swept-tone paradigm which provide additional information for hearing evaluations.

Poster # 33

The ASSR, ACC and BMLD

Kayla Ichiba, BS; Siena Schoelen; Barbara Cone, PhD, University Of Arizona, Tucson, AZ
Spencer Smith, PhD, Northwestern University, Evanston, IL

We evaluated the effect of phase change on auditory steady-state (ASSR), onset CAEP and ACC responses. The aim was to determine how phase change is encoded at lower levels of the auditory system and then processed at the cortical level. The test subjects were 23 young adults with normal hearing. We first recorded ASSRs and stimulus-onset CAEPs in a control condition using a 800 ms duration 500 Hz tone, amplitude modulated at 80 Hz, presented binaurally at 1/s. In the test condition, the phase of the 500 Hz tone was inverted 180 in one ear at 400 ms to evoke the ACC. Broad-band noise was introduced at an -5 dB SNR and the test condition repeated. Stimulus levels were varied to find the threshold of the ACC. Perceptual binaural masking level differences (BMLD) for a 500 Hz tone were also determined. At the phase change, ASSR amplitudes were diminished, and the ACC was 1.5-2.0 times larger than the onset CAEP response. This indicates amplification of the phase-change information in the ascending auditory pathway. These findings contribute to the development of an electrophysiological index for BMLD.

Poster # 34

Children's Auditory Cortical Responses When Using a Remote Microphone System

Carlos Benitez-Barrera, MA; Anne Marie Tharpe, Vanderbilt University School Of Medicine, Nashville, TN
Alexandra Key, PhD, Vanderbilt University Medical Center, Nashville, TN

Processing speech in the presence of background noise is a difficult task for children (Elliot & Katz, 1980). Remote microphone systems (RMS) are known to improve speech recognition skills in settings where noise and distance are present (e.g., classroom or home environments; Bertachini et al., 2016). To date, no studies have investigated the effects of RMS use on the cortical auditory processing of children when listening to speech in background noise. We investigated these potential effects utilizing cortical auditory evoked potentials (CAEPs) and speech-in-noise behavioral tasks in a group of 33 normal hearing children 8 to 11 years of age. N1 amplitude responses were enhanced in a simulated RMS condition as compared to a noise condition without RMS, suggesting more efficient neural speech encoding when the RMS was

used. The relationship between the CAEP responses in noise with and without the RMS and the behavioral speech-in-noise recognition skills of these children was also examined. N1 amplitudes were inversely related to the speech-in-noise recognition skills, with children with better speech-in-noise recognition skills showing reduced N1 amplitudes. This work is an early step in understanding the impact of RMS use on cortical auditory responses in varying levels of noise of young children.

Poster # 35

Circadian Influence on Auditory Function After Noise Overexposure
Andrew Nash, BA; Kevin Ohlemiller, PhD; Tejbeer Kaur, PhD; Mark Warchol, PhD, Washington University In St. Louis, St. Louis, MO

Circadian rhythm is the daily adjustment of the biological system to changes in the light-dark cycle of a 24-hour day. Little is known of the Circadian clock's effect on auditory function. This study uses a 24-hour light-dark cycle of 6AM to 6PM (light) and 6PM to 6AM (dark) to regulate the murine biological clock. Young adult (8 weeks of age) C57BL6 mice were exposed for 2 hours to an octave band (8-16 kHz) noise at 90 dB SPL at one of the following times of the day; 6AM, 12PM, 6PM, and 12AM. Animals exposed to ambient noise served as controls. Auditory Brainstem Responses (ABR) and Distortion Product Otoacoustic Emissions (DPOAE) were measured prior to noise exposure, immediately after, and two weeks post exposure. ABRs immediately post noise exposure revealed a significant elevation in hearing thresholds in the 12AM and 6AM groups compared to the 12PM and 6PM groups. There was a significant decrease in OAEs in the 12AM and 12PM groups compared to the 6AM and 6PM groups. ABRs and DPOAEs recovered to normal levels by two-weeks post noise exposure. These results indicate a relationship between time of day of noise exposure and auditory function.

Poster # 36

Envelope Following Response in Military Veterans Suggests Cochlear Synaptopathy
Rachel Etzler, NCRAR, University Of Louisville, Louisville, KY
Naomi Bramhall, PhD; Sean Kampel, AuD, NCRAR, Portland, OR

In animal models, noise-exposure and aging can lead to the degeneration of auditory nerve synapses, even in the absence of outer hair cell loss or threshold shifts. This synaptic degeneration, termed cochlear synaptopathy, can only be confirmed through histological analysis of the temporal bone, making it difficult to diagnose in humans. A non-invasive measure of synaptopathy is vital for future clinical diagnosis of this condition and for determining its perceptual consequences. In animals, synaptic loss is associated with lower auditory brainstem response (ABR) wave I amplitude, but variability in ABR amplitudes in humans limits the diagnostic potential of this measure. The envelope following response (EFR) is sensitive to synaptopathy in mice and may be less susceptible than the ABR to sources of variability. In young military Veterans and non-Veterans with normal auditory thresholds and otoacoustic emissions, we measured the ABR in response to a suprathreshold stimulus and the EFR at two modulation frequencies and three modulation depths. The results indicate that the EFR may be more sensitive to differences in noise exposure history than the ABR. These findings suggest that future research should be done to optimize the use of the EFR in humans as a non-invasive measure of synaptopathy.

Poster # 37

Effects of Blast Exposure on P300 in a Go/No-Go Paradigm

Kelly Hanscom, BA, National Center For Rehabilitative Auditory Research/University Of Maryland, Portland, OR
Melissa Papesh, PhD; Curtis Billings, PhD; Frederick Gallun, PhD, National Center For Rehabilitative Auditory Research, Portland, OR

Military Veterans exposed to high-intensity blasts often report auditory problems, such as difficulty hearing in noise, despite having normal hearing. These Veterans also suffer from higher rates of post-traumatic stress disorder (PTSD), as well as cognitive symptoms. To further understand the effects of blast exposure on the auditory system, electrophysiological and behavioral measures were assessed in blast-exposed Veterans, Veterans with PTSD, and control participants. A Go/No-Go oddball paradigm was used to measure the participants' P300 response. Preliminary data reveal that in both the Go and No-Go conditions, responses were most robust among control participants, least robust among blast-exposed participants, and intermediate for PTSD participants. Group differences were larger in the No-Go condition compared to the Go condition. These electrophysiological results are well correlated with self-perceived auditory deficits and behavioral measures, reflecting poorer auditory processing and reduced cognitive control among blast-exposed participants and, to lesser degree, PTSD participants. Overall, these results indicate that both PTSD and increased cognitive load impact auditory performance among Veterans. Further, the No-Go paradigm better reveals auditory dysfunction in this population compared to the traditional 'Go' oddball paradigm. These findings have significant implications for the identification and treatment of auditory dysfunctions in those exposed to blasts.

Poster # 38

Noise Damage in Vglut3 Wild Type, Heterozygous, and Knockout Mice

Bethany Davis, BS; Mark Rutherford, PhD; Aizhen Yang-hood, MD; Shelby Payne, Washington University School Of Medicine, Saint Louis, MO

Hearing is dependent on the neurotransmission between mechanosensory inner hair cells and cochlear nerve fibers via ribbon-type synapses. Noise exposure can result in the dissociation and loss of cochlear ribbon synapses and is thought to be glutamate-induced. This research studied mice having one, two, or zero copies of the vesicular glutamate transporter-3 (Vglut3). Although Vglut3 KO mice are profoundly deaf, hearing thresholds in HET mice are not different from WT. Following noise exposure, DPOAEs reduced and recovered similarly in WT, HET, and KO mice. In WT and HET mice, noise at 100 dB SPL caused a threshold shift and loss of about 50% of synapses at 1 day, both of which partially recovered by 2 weeks postexposure. Recovery of ABR threshold and ribbon synapse number was significantly better in WT compared with HET mice. Noise-induced synaptopathy was evident as disintegration between the presynaptic ribbon and postsynaptic AMPA receptors. In KO littermates the same noise exposure resulted in no synaptic disintegration, suggesting that synaptopathy depended on glutamate. 94 dB SPL noise caused ABR threshold shifts that recovered by 4 weeks in WT and HET mice. Amplitudes of ABR Wave I tended to recover faster in WT; however, the difference was relatively small.

HEARING LOSS / REHABILITATION

Poster # 39

Detecting Hidden Hearing Loss in College Marching Band and Orchestral Students - A Comprehensive Approach

Breanna Oakes, Ohio University, Springfield, OH
Fuh-cherng Jeng, PhD; Nelish Washnik, PhD; Jeff Russell, PhD; Rebecca Meier, AuD, Ohio University, Athens, OH

Excessive exposure to music can result in various degrees of hearing loss. Recent studies have demonstrated that some individuals may have a very slight amount of hearing loss that is undetectable by a pure-tone audiogram, i.e., hidden hearing loss. It remains unclear whether hidden hearing loss can be detected by using a spectrum of behavioral and electrophysiological measurements. Therefore, the purpose of this study was to develop a comprehensive test battery to detect the presence of hidden hearing loss in individuals with a history of excessive music or noise exposure. We hypothesized that hidden hearing loss could be detected through a well-designed series of tests. Two groups of participants were recruited. The experimental group consisted of participants who were in collegiate marching band or orchestra, and the control group participants were non-musician students. For each participant, a series of tests was administered: pure-tone audiogram, DPOAEs, ABR, FFR, and a noise-exposure questionnaire. Responses of the experimental group were analyzed and compared to those of the control group. Our results suggest that this series of tests may be clinically applicable as a comprehensive test battery to detect hidden hearing loss among humans where pure-tone audiograms alone are inadequate.

Poster # 40

Hidden Hearing Loss: Music is Noise to the Ears

Rachel Ackerman, BA; Lata Krishnan, PhD; Ananthanarayan Krishnan, PhD, Purdue University, West Lafayette, IN

Recreational noise exposure has been shown to cause cochlear synaptopathy (hidden hearing loss)-characterized by a loss of inner hair cell synaptic ribbons, but normal hearing sensitivity and outer hair cell function. We have previously shown that musicians have reduced auditory brainstem response (ABR) Wave I amplitudes, shorter Wave III and Wave V latencies, and a larger III/I amplitude ratio compared to controls with no significant noise exposure. It is not clear whether these differences reflect music experience-dependent changes in the brainstem. To address this question, we evaluated DPOAEs and ABRs in normal-hearing college-age students that had a significant history of noise exposure and no musical training. Our preliminary findings suggest no differences in DPOAEs, thus intact outer hair cell function, reduced amplitude of the auditory nerve response (Wave I) and shorter latency of the later responses (Wave III and V). These results are essentially similar to the ABR changes seen in musicians, suggesting that the change in ABR do not appear to be related to musical training. Clinically, these results may help with early identification of hidden hearing loss, and development of preventative and intervention strategies.

Poster # 41

Band-Importance Function and Transfer Function for Korean Clear Speech

Oh hongyeob, BA; Heo Sohee; In-ki Jin, PhD, Division Of Speech Pathology And Audiology, Hallym University, Chuncheon

Background: Clear speech is a speaking style that is used for effective communication in difficult listening situations and draws on techniques such as accurate articulation, speaking slowly, and the inclusion of pauses. Clear speech can improve speech intelligibility for people with hearing loss. Even though several acoustical characteristics for Korean clear speech have been reported, there are still many features that have not yet been investigated. Purpose: The purpose of this study was to compare the band-importance function and transfer function between Korean clear speech and conversational speech. Research design: Band-importance functions and transfer functions were compared using a research design that applied and analyzed observed datasets. Data collection and analysis: Seventy-eight native Korean adults with normal hearing participated in this study. Intelligibility performances by clear speech and conversational speech were measured, in various signal-to-noise ratios, with 21 high- and 21 low-pass filters. Then both functions were derived using MATLAB software. Results: Low frequencies were more important in the band-importance function for clear speech. The transfer function for clear speech was steeper than the function for conversational speech. Conclusions: In terms of the Speech Intelligibility Index (SII), in the Korean language, clear speech is more intelligible than conversational speech.

Poster # 42

The Relationship Between Two Questionnaires Assessing Spatial Hearing Ability

Hua Ou, PhD, Wayne State University, Detroit, MI
Ann Perreau, PhD, Augustana College, Rock Island, IL

The six-item shortened version of the Spatial Hearing Questionnaire (SHQ-S) has been developed to quickly measure spatial hearing ability. One of the short versions of the Speech, Spatial, Qualities of Hearing Scale (SSQ5) with five items is also available. Both questionnaires measure self-reported speech understanding in noise and sound localization. The purpose of the study was to explore similarities and differences between the SHQ-S and the SSQ5 for a group of participants with hearing loss (n = 47). The results indicated that both questionnaires shared the same factor structure. There were significant correlations between the factor scores of the two questionnaires (Factor 1: $r = 0.47$, $p = 0.0009$; Factor 2: $r = 0.78$, $p < 0.0001$). Further, no significant difference was found between the total scores of the SHQ-S and SSQ5 ($p = 0.55$). A transformation equation between the subscale scores of the SHQ-S and the SSQ5 was developed as well for comparison. It was concluded that both questionnaires might be used interchangeably to assess spatial hearing ability, though the focus of the two questionnaires is different and needs to be explored when determining which assessment could be used in a clinical context.

Poster # 43

Understanding the Identities of Adults Not Using Their Hearing Aids

Caitlyn Ritter, BS; Brittan Barker, PhD; Kristina Scharp, PhD, Utah State University, Logan, UT

In the United States, it is estimated that 48.1 million people, aged 12 years or older, report experiencing hearing loss (HL) in either both ears or one ear (Lin, Niparko, & Ferrucci, 2011). Not only does HL affect people's ability to successfully communicate, but HL can also contribute to underlying psychological and emotional issues if left untreated. Hearing aids (HAs) are an effective treatment for individuals with HL that have been shown to dampen (and sometime ameliorate) the negative effects of HL. Despite these considerations, many individuals choose to neglect HAs as a form of treatment. The current study will gather and analyze stories to better understand the personal experiences motivating these individuals' choices not to use their HAs. Specifically, we will use thematic narrative analysis to uncover recurring themes from these individuals' stories, which will allow us to assign identities to the individuals based on these themes. These findings will contribute to the field by providing audiologists insight into individuals' perspectives and experiences following their diagnosis of HL and prescription of HAs. We propose this knowledge could lead to the development of more effective, patient-centered hearing healthcare that best addresses these individuals' concerns and expectations.

Poster # 44

Epidemiology of Hearing Loss in Older Americans: 2010-2015
Jagdish Khubchandani, PhD; Lynn Bielski, PhD, Ball State University, Muncie, IN

Hearing loss is a leading chronic health problem in older Americans associated with significant socioeconomic and disease burden leading to premature mortality. Previous studies that have examined the prevalence of hearing loss in older Americans have profound limitations. Published work was based on small clinic based studies or convenience samples, often did not directly assess hearing loss as a unique entity, examined limited number of comorbidities associated with hearing loss, and assessed the prevalence over a small time period. Thus, the purpose of our study was to assess the hearing loss prevalence trends and correlates from a large national random sample of older adults over a period of 5 years (n>50,000 older adults). Polynomial regression analyses revealed statistically significant quadratic trends for the overall prevalence of hearing loss ($p<0.05$), linear trends for differences based on race and gender ($p<0.05$), and in Bayesian cluster analysis 3 separate groups of older adults with hearing loss were identified based on comorbidity profiles and differences in health outcomes (i.e. group 1= no comorbidities, and groups 2 and 3 had psychological, metabolic, and cardiovascular comorbidities- with higher health service utilization). Implications for population health and clinical practice will be discussed based on study results.

Poster # 45

Qualitative Observation as an Approach to Evaluating Aural Rehabilitation
Laura Coco, AuD; Maia Ingram; Nicole Marrone, PhD, University Of Arizona, Tucson, AZ

Adult aural rehabilitation involves counseling, sensory management, training, and instruction with the goal of minimizing negative effects of hearing loss and improving its self-management. However, a recent systematic review of randomized control trials revealed no significant treatment effects. The authors noted null findings may be in part due to deficiencies in current methods of data collection. In this study, we present a novel method of qualitative data collection for a counseling-based group aural rehabilitation intervention. Trained observers collected detailed notes from comments made by participants with

hearing loss and their partners over the course of five aural rehabilitation sessions. Common themes included feelings of distress and denial upon initiating the classes. Participants expressed increased use of communication strategies and reported increased advocacy with family and community members over the course of the program. By adopting mixed methods for the evaluation of group aural rehabilitation interventions, effects may be more demonstrable and the absence of change may be better understood based on cultural and contextual factors. Future work will be directed towards understanding mixed methods study outcomes.

Poster # 46

Clinical Assessment of Functional Hearing Deficits

Sandeep Phatak, PhD; Benjamin Sheffield, MS; Danielle Zion, AuD; Douglas Brungart, PhD; Ken Grant, PhD, Walter Reed National Military Medical Center, Bethesda, MD

A disconnect between everyday speech-in-noise communication difficulties reported by patients and their clinical assessment is often reported (Hannula et al., 2011; Jerger, 2011; Pienkowski, 2016). Standard audiometric evaluation, along with a simplistic speech recognition test (with or without noise), fails to characterize the functional hearing deficits. To address this issue, recognition performance of listeners with various degree of hearing loss was measured in 33 different speech-in-noise listening conditions. A subset of non-redundant test conditions that were most sensitive to hearing loss was identified. The *performance* in these speech-in-noise test conditions was not completely predictable from hearing thresholds. Thus, adding this subset of short speech-in-noise tests (each about 5 minutes long) to standard audiological evaluation can potentially improve the characterization of functional hearing deficits. The measured speech-in-noise performance on these test was compared with subjectively perceived hearing difficulties.

Poster # 47

Baltimore HEARS Pilot: A Community Health Worker Hearing Care Intervention

Jonathan Suen; Hae-Ra Han; Carrie Nieman; Frank Lin, Johns Hopkins University, Baltimore, MD
Shirley Crowder; Anne Madiso; Carolyn Peoples n, Weinberg Senior Living
Nicole Marrone, University of Arizona, AZ

Recent national reports have called for the development of novel approaches to address hearing loss as a public health imperative. The vast majority of adults over the age of 70 have hearing loss, and approximately 80% of those do not use hearing aids. Hearing care disparities exist based on race/ethnicity and socioeconomic position and underline the need for innovative approaches to address these disparities. The Baltimore HEARS intervention, delivered by community health workers (CHW's), accounts for key barriers in accessibility through a community-based approach. The study cohort included primarily minority older adults (>59 years) with hearing loss, living in independent, subsidized urban housing. Preliminary results demonstrate the feasibility and acceptability of hearing care intervention, delivered by CHW's, that incorporates over-the-counter amplification and aural rehabilitation with audiology supervision. Initial pilot study results document the preliminary efficacy of a CHW-delivered hearing care intervention, where participants (N=10) reported reductions in hearing handicap (HHIE-S) at 3-month follow-up. A majority of participants (9/10) identified the CHW as the

most valuable component of the HEARS intervention. Insights from this pilot study will inform the design of a larger, multi-site randomized controlled trial of an affordable, accessible hearing care intervention delivered by trained CHW's.

Poster # 48

Understanding the Utility of 'Photovoice' for Audiologists and Audiology Researchers
Lauren Dillard, BS; Gabrielle Saunders, PhD; Melissa Frederick, AuD; Shienpei Silverman, MA, National Center For Rehabilitative Auditory Research, Portland, OR

Photovoice is a research method in which individuals take photographs representing aspects of their daily lives relevant to a certain area of study. Participants annotate the photographs and later discuss them with researchers. Such discussions may help patients and clinicians develop detailed rapport, leading to joint decision making and a more patient-centered approach to care. In this study, four smaller experiments were conducted to examine the utility of photovoice as a tool in audiology research by evaluating it (1) as a tool for providing advice regarding communication strategies, (2) as a post-hearing aid fitting counseling tool, (3) as a tool to encourage discussion and problem-solving regarding hearing loss, and (4) as a method for understanding the impact of hearing loss on individuals. Participants (n= 36) were assigned to one of four possible study groups. They came in for two study visits; at the first, participants were tasked with taking 5-25 photographs until their second visit, at which the photographs were discussed with researchers. Results from the photograph discussions were qualitatively analyzed by group, and support the idea that photovoice may be a valuable tool for audiology researchers and clinical audiologists to make appropriate recommendations in counseling and rehabilitation.

Poster # 49

Initial Evaluation of the Self-Identified Hearing Goals Questionnaire
Brittany England, BA; Emily Lobianco; Ashley Light, BA; Sherri Smith, PhD, Mountain Home Va Medical Center, Mountain Home, TN

There are a limited number of clinical tools that clinicians can use to assess specific listening goals of the patient and how patients function in those listening situations that are most important to them. The Self-Identified Hearing Goals Questionnaire (SIHG) is a newly-developed self-report measure that was designed to assess patient-specific listening goals and assess self-perceptions in six outcome domains regarding each listening goal to facilitate a tailored rehabilitative approach. The purpose of this study was to evaluate initial responses on the SIHG. A sample of 25 experienced hearing-aid users completed a version of the SIHG. Participants also received an updated hearing evaluation, had their hearing instruments verified to prescriptive targets, and completed a battery of standardized hearing-aid outcome measures. Results indicated that participants scored within norms on the standardized questionnaires; however, their SIHG responses demonstrated the possible need for additional intervention to meet their nominated goals. These results emphasize the importance of follow-up visits to ensure patient-specific outcomes are maximized. Currently, SIHG responses from a group of first-time hearing-aid users are being evaluated pre- and post-intervention. Their results also will be reported.

HEARING SCIENCE / PSYCHOACOUSTICS

Poster # 50

Sound Source Localization: A Multisystem Process
William Yost, PhD; Michael Torben Pastore, PhD, Arizona State University, Tempe, AZ

While sound source localization has been a topic of scientific inquiry for more than a century, it is usually not recognized that the ability to locate sound sources in the everyday world requires more than just auditory spatial cues. Sound source localization, especially if sources and listeners move, requires integration of auditory spatial cues (e.g., interaural differences) and cues indicating head position relative to the surrounding environment. The Spatial Hearing Laboratory at ASU is uniquely equipped to explore sound source localization when listeners and/or sound sources may or may not move. Studies will be described, indicating the importance of the integration of auditory spatial and head position cues for locating sounds sources in the everyday world. The experimental logic rests on selectively depriving listeners of head position cues such as vision, vestibular, proprioceptive, etc. and then evaluating sound source localization perception when only auditory spatial cues are provided. Listeners' auditory spatial performance is very different when only auditory spatial cues are provided as compared to when both auditory spatial and head position cues are provided. The required integration of the two types of cues has important implications for evaluating the effects of hearing impairments on sound source localization.

Poster # 51

Bayesian Estimation of the Auditory-filter Shapes
Yi Shen, PhD; Allison Kern, Indiana University Bloomington, Bloomington, IN
Virginia Richards, PhD, University of California, Irvine, Irvine, CA

The auditory filter is a psychophysical model of frequency selectivity. A Bayesian adaptive procedure was implemented to improve efficiency in the estimation of the auditory-filter shape. This adaptive procedure, the quick-auditory-filter (or qAF) procedure, was evaluated using a group of 50 listeners with wide ranges of age and hearing status. The goal of the qAF procedure is to provide estimates of the auditory-filter shape in only 15 min compared to hours needed for conventional procedures. The qAF procedure was used to estimate test-retest reliability for estimating the auditory-filter shape centered at 2000 Hz and for low-sensation levels, which was satisfactory. The qAF procedure directly estimates model parameters, and for the model fitted the parameters included the sharpness of the curve, the contribution of the low-frequency tail, and the listener's detection efficiency. Based on this large data set, it was observed that the parameters of the auditory filter describing the filter's low-frequency tail was closely associated with the degree of hearing loss. In contrast, no significant influence of age on the auditory-filter shape was found.

Poster # 52

Headphone Type Indicating Risk Factors for Hearing in Young Adults

John Parsons, BA; Nicolette Dome; Shaina Jones; Amanda Kaae; Carlee Michaelson; Shannon O'Donnell; Mark Reed, PhD; Peter Torre III, PhD, San Diego State University, San Diego, CA

Personal listening device (PLD) use in background noise has shown to be dangerous in young adults. Certain headphones can limit background noise more effectively than stock ear buds. Binge drinking, cannabis and hard drug use have also been associated with high-volume PLD use. The purpose of this study is to explore the relationship between preferred headphone type, listening level and risk-taking likelihood. Two hundred undergraduates completed a PLD use and risk behavior survey. Survey data included self-reported social risk factors such as alcohol and marijuana use. Otoscopy, tympanometry and pure-tone threshold testing were completed. Participants listened to one hour of music with preferred headphone type with a probe microphone in the ear canal to measure equivalent continuous sound level (LAeq). LAeq was similar across headphones. Participants who reported higher amounts of drinks per month and smoking marijuana within the last month had significantly higher LAeq levels than those who reported lower amounts of drinks per month and not smoking marijuana in the last month. There was no significant interaction between headphone type and reported drinks per month or marijuana use. These data suggest greater risk behaviors in young adults, although headphone type was not associated with any of them.

Poster # 53

No Benefit of Video Game Training for Hearing in Adults

Hannah Stewart, PhD; Jasmin Martinez; Audrey Perdew, BA; David Moore, PhD, Cincinnati Children's Hospital, Cincinnati, OH
Shawn Green, PhD, Dept of Psychology, Madison, WI

Playing of action video games (AVGs) can produce 'far transfer' of improved visual perception and cognition (Bavalier and Green, Sci Am, 2016). Since multimodal cognition appears to underlie much if not all of this improvement, we asked whether BKB speech reception threshold and auditory selective attention (Zhang, PLOS ONE, 2012) are related to amount and type of video game play. Normal hearing (.5-8kHz - 20dBHL) 18-30 year olds (n=55) also reported game playing activity in extensive questionnaires. Initial analysis divided players into amount of play (more/less than 3 hours/week) and predominant type of game (action/non-action). No significant differences were found between participants on the basis of amount or type of play on either auditory task or on a visual motion object tracking (vMOT) task previously found to improve following frequent AVG play. We next examined whether those with better performance on the vMOT task, irrespective of gaming background, also had better auditory performance. Again, we found no significant difference between groups, suggesting that successful visual game play did not transfer to hearing. Finally, factor analysis and regression were used to model performance to dissect the variance without assumptions concerning AVG experience (amount and type), but failed to show differences.

Poster # 54

The Importance of Extended Bandwidth on Sound Quality while Streaming with MFi Hearing Aids

Timothy Streeter, MS; Madeline Huberth; Suzanne Levy, PhD; Lindsay Prusick, AuD; Drew Dundas, PhD; Kelly Fitz, PhD, Earlens Corporation, Menlo Park, CA

Hearing aids featuring the Made-For-iPhone (MFi) technology allow for wireless streaming of audio sources from compatible Apple devices. In a previous study examining the importance of bandwidth on sound quality, participants rated music presented over a wide bandwidth, extending to both the high and the low frequencies, to be more natural (Moore, 2012). When compared to Acoustic Hearing Aids (AHAs), a Light-Driven Hearing Aid (LDHA) has been shown to provide amplification over an extended bandwidth from 125 to 10,000 Hz (Struck and Prusick, 2017). When streaming audio signals, the ability of the LDHA to provide significant amplification over an extended bandwidth is hypothesized to be particularly advantageous when compared to that of AHAs. Using the Multiple Stimuli with Hidden Reference and Anchor (MUSHRA) procedure, subjective ratings of sound quality were obtained for a variety of music, speech and movie audio sources. These ratings were compared between an extended bandwidth LDHA and several premium AHAs.

Poster # 55

Spectro-Temporal Modulation Detection Across Multiple Stimulus Generation Methods
Sittiprapa Isarangura, BS; Eric Hoover, PhD; David A. Eddins, PhD, University Of South Florida, Tampa, FL
Frederick J. Gallun, PhD, Oregon Health and Science University and VA RR&D National Center for Rehabilitative Auditory Research, Portland, OR

Several reports have documented spectro-temporal modulation (STM) detection using different methods of stimulus generation. The current study evaluated whether or not stimulus generation method differentially impacts behavioral detection thresholds. Four different methods were compared across eight conditions using a combination of temporal modulation at frequencies 0, 4, and 32 Hz, spectral modulation at frequencies 0, 0.5, and 2 cycles/octave, and spectro-temporal modulation at the combination of those frequencies. The same nominal carrier bandwidth (400 to 3200 Hz), duration (1 second), and presentation level (80 dB SPL) were used across methods. Detection thresholds were measured in nine young listeners with normal hearing using a three-interval, two-alternative forced-choice presentation with a three-down, one-up tracking rule. Average detection thresholds were significantly different across methods ($F_{3,24} = 25.081$, $p < 0.001$, $2 = 0.758$), supporting the notion that STM sensitivity can be dependent on the method chosen for stimulus generation. The results also showed that the thresholds from this study were consistent with those reported in previous studies. The most likely sources of deviation among methods are differences in carrier component density and spectral envelope shaping. Several computational methods were used to highlight those differences.

Poster # 56

Pure-tone Frequency Discrimination in Preschoolers, Young School-Age Children, and Adults
Jane Rose, BA; Mary Flaherty, PhD; Jenna Browning, AuD; Lori Leibold, PhD, Boys Town National Research Hospital And University Of Maryland, Omaha, NE
Emily Buss, PhD, University of North Carolina at Chapel Hill, Chapel Hill, NC

The ability to discriminate frequency differences plays an important role in speech understanding, and has been associated with children's language and reading skills. Previous research evaluating the development of frequency discrimination abilities suggests that school-age children perform more poorly

than infants or adults. Data on preschooler abilities are limited. This study evaluated frequency discrimination abilities in preschoolers, school-age children, and adults using the same method and stimuli across age groups to better determine age-related changes in this basic auditory skill. Performance was assessed using a single-interval, observer-based method and a continuous train of stimuli similar to that previously used to evaluate infants. Testing was completed using 500- and 5000-Hz standard tones, fixed within a condition. Thresholds for frequency discrimination were obtained using an adaptive, two-down one-up procedure. Results suggest an effect of frequency and age-group on thresholds, but no interaction between these two factors. Performance was better in the 500-Hz standard condition compared to the 5000-Hz standard condition. Preschoolers performed like young school-age children, and both groups perform more poorly than adults. These findings support the hypothesis that the non-monotonicity in frequency discrimination abilities previously observed can be explained by differences in the methods and stimuli used across age groups.

Poster # 57

Sound Localization Under Virtual Reality
Steven Carter; G. Christopher Stecker, PhD, Vanderbilt University, Nashville, TN

Vision is an important facet for localization since it is often more reliable than auditory stimuli and thus typically the dominant cue. Lab studies of multisensory spatial perception, however, typically cannot replicate the real-world sense of 'immersionÂ'within a 360 shared space. Virtual reality (VR) technology offers one approach to do so. This study aims to verify basic aspects of performance under VR conditions, which could allow for the ability to easily manipulate the visual landscape during sound localization tasks while maintaining strict experimental control. Normal-hearing participants completed minimum-audible angle (MAA) and virtual localization tasks while seated in an anechoic chamber and viewing a simple VR scene via head-mounted display. In some conditions, the VR scene depicted actual or altered sound-source locations. VR-based MAA thresholds and localization accuracy were comparable to previous literature and to control data. Binaural recordings via probe tubes were used to confirm the frequency-specific binaural cues available with and without the head-mounted display and characterize any distortions. These results show that sound localization can be accurately measured under VR conditions, supporting future applications in spatial hearing research, assessment, and habilitation. [Supported by NIH-NIDCD T35DC008763, R01DC011548]

HEARING TECHNOLOGY / AMPLIFICATION

Poster # 58

Listening Preferences for Sound Therapy Options in a Combination Device
Craig Newman, PhD; Sharon Sandridge, PhD; Gina Stillitano, AuD, Cleveland Clinic, Cleveland, OH

Combination devices [CD; hearing aid (HA) and sound generator housed in the same device] are an option to provide sound therapy to patients who have hearing loss as well as bothersome tinnitus. The present study evaluated listening preferences for different sound options for tinnitus relief produced by a commercially-available CD (Alta2 Pro Ti, Oticon). Participants wore the CD over a 6-month period. At each session (baseline, 1-. 3- , 6-months), participants had the option to change sounds and were asked to

indicate most and least preferred sound. In addition to the HA, the CD has four stationary broadband sound (BBS) options (S1, shaped to audiogram; S2, white sound; S3, pink sound; S4 red sound) and three ocean sound options (O1; O2; O3; based on proprietary variations of modulation patterns). A total of four CD programs (P) were available to each participant: P1 - HA plus S1; P2 - HA plus S2, S3 or S4; P3 - HA plus O1, O2, or O3; and P4 - HA only. The percentage of patent preferences (most/least preferred) for each program including the specific BBS (P2) and ocean sound (P3) along with activity analyzer data (in hours) will be reported for the 6-month trial.

Poster # 59

Band Importance Function and Transfer Function for Korean Stimuli

Sohee Keo, BA; Hongyeop Oh; Seungyeop Jeong; In-ki Jin, PhD, Division Of Speech Pathology And Audiology, Hallym University, Chuncheon, South Korea

Background: The Speech Intelligibility Index (SII) is a useful tool for predicting intelligibility performance through a transfer function. Band-importance function (BIF), which refers to the relative contributions of the different frequency areas to intelligibility, is a key component in deriving the transfer function. Although transfer functions for various stimuli in English have been studied, Korean stimuli have been rarely studied. Purpose: The purpose of this study was to derive BIFs and transfer functions for different Korean standardized stimuli (words and sentences). Research design: Band-importance functions and transfer functions were obtained using a research design that applied and analyzed observed datasets. Data collection and Analysis: Seventy-eight native Korean adults with normal hearing participated in this study. Intelligibility was measured in 5 signal-to-noise ratios and 42 filtering conditions. Then BIF and transfer functions were derived, using a computing program. Results: Unlike English BIFs, low frequency areas were more important for BIFs in Korean stimuli although there were differences in importance among the stimuli. The steepness of the transfer function was in the order of high-predictable sentences, mixed sentences (50% high- and 50% low-predictable sentences), and monosyllabic words. Conclusions: Result of this study will contribute to develop of SII for the Korean language.

Poster # 60

A Self-Administered Consonant Contrast Test: Effects of Low-Pass Filtering

Gregory Hobbs, BS; Arthur Boothroyd, PhD, San Diego State University, San Diego, CA

For ongoing research on hearing-aid self-fitting, we have developed a self-administered, 4-alternative forced-choice test of the ability to differentiate consonants on the basis of pre- and post-vocalic place, voicing, continuance, and clustering. Recorded test words were incorporated into software for self-administration in quiet and noise. Performance in quiet was measured in young adults, listening under conditions of low-pass filtering (accomplished in real time, using the 2017a version of the UCSD Open-source Speech-processing Platform). Group mean composite contrast score, after correction for chance, fell to around 50% at a (6 dB) cut-off frequency of 660 Hz. With a cut-off frequency of 1 kHz, group-mean contrast scores were in the region of 30 to 35% for place and clustering, 70% for continuance, and over 90% for voicing. Composite contrasts scores for the eight forms averaged 56 % with a range from 45 to 67%. Further work will be needed to improve form-equivalence under spectral degradation.

Nevertheless, the test has potential value both as a source of feedback to the listener during self-adjustment of amplification and as a diagnostic measure of outcome.

Poster # 61

Objective Comparative Analysis of Self-Fit Personal Sound Amplification Products
Antoinette Oliver, BS; Nirmal Srinivasan, PhD; Peggy Korczak, PhD, Towson University, Towson, MD
Frank Lin, MD; Nicholas Reed, AuD, Johns Hopkins University School of Medicine, Baltimore, MD

Personal sound amplification products (PSAPs) are electronic devices that amplify sounds. PSAPs can be purchased over-the-counter (OTC) or online and self-fit 'out-of-the-box' using the manufacturers' instructions or by using the manufacturers' cell phone app (advanced-user protocol). Recently, the House and Senate approved an FDA-regulated category for OTC hearing aids to ensure their safe use by individuals with mild to moderate hearing loss. The aim of this study was to evaluate whether the fitting protocol (out-of-the-box, advanced-user, or gold-standard audiologist fit) influenced the listeners' performance with two advanced PSAPs (Soundhawk and CS-50). Nine adults with slight to moderate sensorineural hearing loss were evaluated using real-ear measurements and speech-in-noise testing (AzBio). Results revealed that 53-69% of NAL targets were met across fitting protocols for both PSAPs, with the lowest percentage occurring in the out-of-the-box condition and the highest percentage occurring in the gold-standard condition. Mean difference scores (aided-unaided AzBio scores) were calculated for each condition. Results revealed aided improvement across fitting protocols; however, the greatest aided improvements (15-18%) occurred in the gold-standard condition with both PSAPs. These findings suggest that the gold-standard audiologist fit results in the greatest accuracy in meeting NAL targets and the greatest improvement in speech-in-noise performance.

Poster # 62

Evaluating the Benefits of Bimodal Fitting
Justin Aronoff, PhD; Abbigail Buente; Daniel Lee, University Of Illinois At Urbana-champaign, Champaign, IL
Smita Agrawal, Advanced Bionics, Valencia, CA
Jennifer Black, AuD; Michael Novak, MD, Carle, Urbana, IL

Patients with a cochlear implant in one ear and a hearing aid in the other (bimodal) are often not optimally programmed. There is typically little to no coordination between the two devices and the amplification needs of a bimodal listener are different from a patient who only has access to sound through hearing aids. Recently, a bimodal fitting system has been created (Naida Link) that aims to optimize the gains for this population by providing more gain for low frequencies and reduced gain at frequencies corresponding to potential dead regions in the cochlea. It also aligns the loudness growth and dynamic AGC characteristics of the bimodal hearing aid to that of the cochlear implant processor. The goal of the current study was to determine if bimodal fitting via the Naida Link yielded better speech understanding abilities compared to an individual's current standard clinical fitting of a cochlear implant and hearing aid. To test this, patients were fit with standard and independent cochlear implant and hearing aid programs (only relative loudness for the two ears was adjusted). Patients were also fit with the Naida Link system. Speech understanding in noise was compared in the two configurations. Preliminary results will be discussed.

Poster # 63

Does Cognition Affect Potential Benefits of Audiologic Intervention with OTCs?
Ginny Acosta, BA; Allison Hines; Jani Johnson, PhD, University Of Memphis, Memphis, TN

For the hearing-impaired individual who cannot or chooses not to purchase traditional hearing aids, over-the-counter hearing devices (OTCs) might be an attractive option. Although OTCs allow access to hearing assistive technologies without audiologic intervention, it is unclear how this dispensing model might influence outcomes with these devices. Furthermore, it is not clear how the cognitive capabilities of OTC users might further impact the relative benefits received from audiologic fitting and orientation practices. This randomized control trial was designed to explore these topics. Twenty adults with bilateral sensorineural hearing loss who had no previous experience with hearing aids participated in a one week trial with OTCs. The experimental group received an audiologic orientation that covered standard hearing aid care, use, and maintenance information. In addition, recommended volume and program settings were determined using real-ear verification for this group. The control group received no recommendations, information, or counseling regarding the devices. Outcomes were assessed in the following domains: self-reported aided benefit, skills associated with using the devices, and acoustic output. The impact of cognition on these outcomes was explored.

Poster # 64

Towards Individualization of Hearing Aid Microphone Technologies in Children
Todd Ricketts, PhD; Erin Picou, PhD; Samantha Gustafson, Vanderbilt University Medical Center, Nashville, TN

For hearing aid users, microphone technologies have the potential to significantly improve speech recognition in noisy situations. However, optimal performance is greatly affected by the interaction between source location (on- versus off-axis) and microphone processing. For example, directional processing can optimize the signal-to-noise ratio for one listening environment (talker front), while providing a detriment for another (talker behind). Further, remote microphones including FM systems typically provide benefits related only to the talker wearing the microphone. Our research in adult listeners has demonstrated that the preferred microphone setting in complex noisy environments is often the setting that provides the best SNR for the primary talker, and can be predicted by differences in individual listening needs and abilities. The purpose of this study was to examine the potential relationships between performance, benefit, listening needs and microphone preference in complex listening environments in children. Results suggest that, similar to adult listeners, preference does not appear to be related to the magnitude of microphone benefit. The long term goals of this work is to develop a clinically viable test battery which better predict preferred microphone settings in individual listeners. Scientific and clinical implications of the findings will be discussed.

Poster # 65

Bilateral Hearing Aids Do Not Preserve Binaural Cues

Homira Osman, PhD; Ashley Deonarain; Blake Papsin, MD; Karen Gordon, PhD, The Hospital For Sick Children, Toronto, ON

We aimed to characterize any distortions to interaural level and timing differences (ILDs and ITDs) delivered by bilateral hearing aids. We hypothesized that common hearing aid (HA) algorithms could compromise ILDs and ITDs, potentially reducing bilateral benefits,3,4. To test this, ILD/ITD distortions caused by five program settings (omnidirectional, fixed-directional, adaptive-directional, binaural beamformer, and binaural beamformer + non-linear frequency compression) when Phonak Sky V50-P HAs were fit using DSL-Adult for two types of hearing loss (flat moderate symmetric and asymmetric hearing loss) were assessed. Hearing aid outputs were measured by a Brel & Kjr Head and Torso Simulator (HATS) manikin. Stimuli were 10-Hz sinusoidal amplitude-modulated noise bursts presented from a loudspeaker at 65 dBSPL at 0-345 from the front of the manikin in 15 increments. Hearing aid output was filtered into 1/3 octave bands 0.5-6 kHz. Compared to the control condition, all program settings caused ILD/ITD distortions of the amplitude-modulated noise. The magnitude and spectral extent of ILD/ITD distortions depended on the type of hearing loss, the HA programs, the compression parameter settings, the frequency band of the input and azimuth of stimulus presentation. Distortions in envelope ITDs.

Poster # 66

The Effects of Amplification on Listening Self-Efficacy in Hearing Aid Users

Lauren Kawaguchi, BS; Christi Miller, PhD, The University Of Washington - Department Of Speech And Hearing Sciences, Seattle, WA
Ruth Bentler, PhD; Yu-hsiang Wu, PhD, The University of Iowa - Communication Sciences and Disorders, Iowa City, IA

There is more to the treatment of hearing loss than assessing thresholds and fitting adequate hearing aids. Non-audiologic factors can significantly affect the best-intentioned intervention. For example, self-efficacy is known to have predictive potential for positive patient outcomes for a number of health conditions, but it has not been extensively studied within the field of audiology. In comparison to studies of hearing aid self-efficacy, there is a notable lack of studies focusing on listening-self efficacy. Our study evaluated the influence of amplification on listening-self efficacy using data from 168 experienced hearing aid users with sensorineural hearing loss that completed the Listening Self-Efficacy Questionnaire (LSEQ) while considering aided and unaided conditions. If hearing aid use can improve listening-self efficacy in one-on-one conversations in quiet, directed listening, and in complex auditory scenes, then improvement of listening self-efficacy may be a worthwhile goal in auditory rehabilitation. Our results showed that aided listeners reported significantly greater listening self-efficacy on all subscales, even when holding hearing loss severity constant ($p<.0001$). Analyses are being conducted to determine whether particular signal processing features influenced aided LSEQ ratings. The results of this study provide evidence supporting the effectiveness of hearing aids in daily life.

Poster # 67

User Fitting of Hearing Aids Using Learning Algorithms

S R Prakash, PhD, Caraway Technologies, Saratoga, CA

Caslav Pavlovic, PhD, President And Ceo, Batandcat Corp., Palo Alto, CA

A hearing aid user is often dissatisfied with the sound quality of the amplification device despite the sophisticated adjustment by a trained audiologist. Self-fitting approaches attempt to mitigate the problem by letting the user adjust the device based for maximum comfort, but often limit the space of adjustable parameters. In this study we explore self-fitting using machine learning methods to efficiently search the parameter space. The proposed method presents sequences of parameter settings in a rapid succession, refining the 'best-parameter set' estimate based on user inputs to each sequence. In this presentation, we will discuss the rationale for and the development of this algorithm. We also report the results of our initial studies with normal-hearing individuals that test the reliability of user responses to parameter sequences, and the feasibility of this user-fitting approach. Follow-up studies on hearing-impaired individuals will compare the proposed fitting with the traditional audiogram-based fitting in terms of speech reception in noise, and in terms of subjective preference. This research was supported by a grant from the National Institute for Deafness and Communication Disorders (#R43DC016251). The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH.

Poster # 68

Improving Pediatric Wideband Real-Ear-to-Coupler Difference Predictions Using Absorbance
Anastasia Grindle, Northern Illinois University, DeKalb, IL
Meredith Spratford, AuD; Ryan Mccreery, PhD, Boys Town National Research Hospital, Omaha, NE
Elizabeth Walker, PhD, University of Iowa, Iowa City, IA

Wideband real-ear-to-coupler difference (WRECD) measures are necessary to ensure safe and appropriate pediatric hearing aid fittings. Factors such as limited cooperation, middle ear pathology, or ear canal occlusion may require the use of age-related average WRECD. Age-related average WRECD values may vary from measured WRECD values by +/- 10-15 dB in children of the same age. Thus, the use of average WRECD may lead to over- or under- amplification. By including ear canal volume in average RECD estimates, low frequency predictions of measured RECD values improve compared to average RECD alone (McCreery et al., 2016). This study investigates whether wideband tympanometric information can be used to more accurately predict individual children's on-ear WRECD measurements, as compared to average WRECD. Participants included 149 children between the ages of 2-10 years. Prediction errors of +/- 12 dB were seen between age-average and measured WRECD values. Adding ear canal volume and absorbance information resulted in improved predictions of the measured WRECD, with the magnitude of improvement varying across frequency. These findings support the development of a clinical tool that would allow audiologists to utilize immittance characteristics to more accurately predict WRECD values in children when on-ear verification is not an option.

SPEECH PERCEPTION

Poster # 69

Forward and Backward Masking of Consonants in School-Age Children
Heather Porter, PhD; Lori Leibold, PhD, Boys Town National Research Hospital, Omaha, NE

Emily Spitzer; Emily Buss, PhD; John Grose, PhD, University Of North Carolina At Chapel Hill, Chapel Hill, NC

This experiment sought to determine whether children's increased susceptibility to non-simultaneous masking, particularly backward masking, is evident for speech stimuli. Normal-hearing 5- to 9-year-olds and adults heard nonsense consonant-vowel-consonant targets. In experiments 1 and 2, those targets were presented between two 250-ms segments of 70-dB-SPL speech-shaped noise, at either -30 dB SNR (Experiment 1) or at listener threshold (Experiment 2). In Experiment 3, the target was presented in steady speech-shaped noise at listener threshold. For all experiments, percent correct was estimated for initial (forward-masked) and final (backward-masked) phonemes. In the non-simultaneous noise conditions, child-adult differences were larger for the final consonant than the initial consonant whether listeners were tested at -30 dB SNR (Experiment 1) or at 0 dB SL (Experiment 2), consistent with previous psychophysical studies using tonal stimuli. Phoneme perception in steady noise was similar for adults and children, regardless of phoneme position (Experiment 3). Children's greater susceptibility to non-simultaneous masking, and backward masking in particular, could play a role in their limited ability to benefit from masker envelope modulation when recognizing masked speech.

Poster # 70

Comparison of English and Chinese Sentence Recognition in Noise

Alexa Patton, BS; Lauren Muscari; Li Xu, PhD, Ohio University, Athens, OH

Our previous research assessed the equivalency of AzBio sentences and HINT/MHINT sentences in English and Chinese, respectively. Results showed that the sentence lists were not equivalent between the two languages, but MHINT and English AzBio sentences were closest in level of difficulty. The purpose of the present study was to assess sentence recognition in noise when comparing English AzBio sentences and MHINT sentences. We further compared HINT and MHINT sentence performance. Testing conditions were completed using two-talker babble (TTB) and speech shaped noise (SSN) at varying signal-to-noise ratios (-20, -15, -10, 0, 5 dB). Results show differences in sentence recognition scores in the TTB condition between the two languages. Lexical tone variations in the TTB may interfere with sentence recognition more than the SSN. SSN results showed nearly equivalent performance between MHINT and English AzBio. Chinese results had a large variance among participants in the TTB condition while English did not. SSN results were very similar in variance between the two languages. In summary, MHINT and English AzBio are equivalent in performance when tested in SSN and should be used in cross-language comparison of speech perception in noise. Future evaluation of these sentence lists in hearing-impaired listeners will be informative about performance in those populations.

Poster # 71

Role of Semantic Expectancy During Online Processing of Degraded Speech

Tina Grieco-Calub, PhD; Katherine Simeon; Nancy Le; Klinton Bicknell, PhD, Northwestern University, Evanston, IL

Online speech processing is slower and less accurate in the presence of competing sounds. One strategy individuals use to improve the speed and accuracy of language comprehension is semantic expectancy, which refers to the ability to apply conceptual and linguistic knowledge to speech input. Semantic

expectancy is typically viewed as a processing advantage; however, the mechanisms underlying its advantage are not well understood. The present study tested how young adults use semantic expectancy in quiet and in the presence of speech-shaped broadband noise at -7 dB and -12 dB signal-to-noise ratio. Twenty-four young adults were tested on a four-alternative-forced-choice task whereby they listened to sentences while viewing four images with rhyming labels (e.g., 'bat', 'cat', 'hat', 'mat'). Listeners were instructed to select the image that matched the sentence-final acoustic target. The semantic expectancy of the sentences was unrelated to (neutral), congruent with, or conflicting with the acoustic target. Congruent expectancy improved speed and accuracy and conflicting expectancy decreased accuracy relative to neutral, consistent with a theory where semantic expectancy shifts listeners' beliefs toward likely words and away from unlikely words. The results will be interpreted within the context of ideal observer models of speech perception.

Poster # 72

Perceptual Outcomes Following Parametric Manipulations of Adaptive Nonlinear Frequency Compression

Joshua Alexander, PhD, Purdue University, West Lafayette, IN

When programming hearing aids with frequency lowering, clinicians face numerous decisions about parameters that control the input frequency range subjected to lowering and the output frequency range where this information is moved. The latest variant of frequency lowering, adaptive nonlinear frequency compression (ANFC), has two states that are conditional on whether incoming sounds have a low- vs. high-frequency emphasis. ANFC compounds the clinical decision-making problem because audiologists now must consider how the software manipulations affect sounds produced by each of these frequency-lowering states. To help develop evidence-based guidelines for optimizing parameter selection, 36 normal-hearing adults identified a variety of words and nonsense syllables that were low-pass filtered at frequencies representative of either a severe-to-profound, moderately-severe, or mild-to-moderate hearing loss. Within each group, 9-10 frequency-lowering conditions were tested in which the parameters for each ANFC state were systematically varied. Results indicate that a psychoacoustic model is able to account for 80-90% of the variance in the data. An equivalent metric based on an auditory nerve model captures even more variance. Validation of the neural metric will allow us to generate predictions for how speech perception will influenced by different ANFC settings, and other frequency-lowering techniques, for a variety of hearing losses.

Poster # 73

Level Dependence of Preferred Speech Spectrum

Jason Duda, BA; Arthur Boothroyd, PhD, San Diego State University, San Diego, CA

This work was designed to assess the effect of rms speech level on preferred spectral balance. A sample of young adults with normal hearing were tested with Goldilocks software designed for hearing-aid self-adjustment. Prerecorded sentences spoken by a male talker were presented continuously to participants at overall rms levels ranging from 44 to 84 dB SPL. At each level, participants were asked to adjust, to their liking, the high-frequency boost, relative to the original spectrum. Adjustments controlled the spectral slope above 1 kHz in steps of 2 dB per octave from 0 to 8. Group-mean preferred slope increased

linearly from 1 dB per octave at 84 dB SPL to 6 dB per octave at 44 dB SPL a rate of 1.4 dB per octave for every 10 dB change in rms level. When averaged across listening levels, individual preferences covered almost the whole range of available slopes. It is likely that individual differences were influenced by the relative importance given to comfort, quality, and intelligibility. If these findings are replicated in listeners with hearing loss, they suggest the potential value of high-frequency amplitude compression to accommodate changing speech levels, but they also stress the need to accommodate individual differences.

Poster # 74

The Effects of Multiple Talkers and Noise on Hearing-Aid Users

Taylor Chafin, BA; Brittan Barker, PhD; Sarah Leopold, PhD, Utah State University, Logan, UT

The present study assessed the sentence recognition skills of listeners with sensorineural hearing loss (SNHL) in different types of background noise and when listening to multiple talkers. Specifically, 13 people with SNHL independently completed a sentence recognition task. They listened to sentences spoken by 20 different female talkers and one single female talker in the presence of cafeteria noise, 4-talker babble, and silence. A within-subjects ANOVA yielded a significant main effect of noise, with listeners performing best in quiet, followed by cafeteria noise. There was also a significant main effect of talker; the single talker yielded the best performance. There was no significant interaction of talker and noise. These results reiterate that listeners with SNHL struggle to perceive speech in the presence of background noise, and when speech is presented by multiple talkers.

Poster # 75

Target/Masker Differences in F0: Effects of Age and Hearing Loss

Mary Flaherty, PhD; Jenna Browning, AuD; Lori Leibold, PhD, Boys Town National Research Hospital, Omaha, NE
Emily Buss, PhD, The University of North Carolina at Chapel Hill, Chapel Hill, NC

This study investigated the extent to which children (6-17 yrs.) who are hard of hearing benefit from fundamental frequency (F0) differences between target words and competing sentences for speech-in-speech recognition. Adults with hearing loss benefit from F0 differences to a similar degree as adults with normal hearing (Mackersie et al., 2011). Examining children with normal hearing, Flaherty et al. (2017) demonstrated that 5- to 8-year-olds derived little to no benefit from F0 differences between the target and masker, compared to a large benefit for older children and adults. Children with hearing loss were expected to have a more protracted time course of development than their normal-hearing peers due to degraded spectral resolution and reduced experience with high quality acoustic cues. Using a picture-pointing task, word recognition thresholds were measured adaptively in continuous two-talker speech. The F0 of the target was unaltered or shifted higher than the masker by 3, 6, or 9 semitones. One male talker produced the target and masker speech. Participants wore their personal hearing aids during testing. Results suggest that children with hearing loss have reduced ability to use F0 differences. The impact of severity of loss and consistency of hearing aid use will be discussed.

Poster # 76

Perception of Degraded Speech by Non-Native English Learners
Andrew Wagner, BS; Li Xu, PhD, Ohio University, Athens, OH
Jing Yang, PhD, University Of Central Arkansas, Conway, AZ

Degraded speech signals contain distorted acoustic-phonetic information or lack the full range of acoustic details. Noise Vocoder (NV) processing is used to manipulate the temporal and spectral aspects of speech signals and can determine the extent in which a listener can endure absent acoustic information. Perception of native speech is robust to degradation of acoustic information; however, little is known about the perception of a degraded second language (L2). The present study is designed to examine how L2 listeners perceive degraded speech signals and what kind of perceptual processes they mainly use. A total of 65 participants ages 18-55 years old were divided into two groups. Group 1 consisted of native English-speaking (L1) adults. Group 2 consisted of L2 Mandarin speaking listeners with English as L2. Results show that L1 listeners require less acoustic information than L2 speakers for understanding. Data also suggests that contextual cues play a significant role in the ability to fill in missing information. L1 listeners show a greater propensity to utilize contextual cues to fill in missing information. L2 speakers cannot utilize this contextual information as efficiently as L1 listeners and therefore use more bottom up processing when listening to degraded non-native language.

Poster # 77

Assessing Olivocochlear Efferent Contributions to Speech Understanding in Noise
Kristin Johnson, BA; Zoë Dinger; Ian Mertes, PhD, University Of Illinois At Urbana-champaign, Champaign, IL

The olivocochlear efferent system modifies cochlear output to aid signal detection in noise, but the role of efferents in speech-in-noise understanding remains unclear. We recently reported that the slope of the psychometric function was associated with efferent function in older adults (Mertes et al., Ear Hear, 2017). The current study examined the contribution of olivocochlear efferents to speech-in-noise understanding in young, normal-hearing participants. Efferent activity was confirmed in all participants using contralateral suppression of transient-evoked otoacoustic emissions. Speech-in-noise perception was assessed using the coordinate response measure presented in ipsilateral speech-shaped noise at five signal-to-noise ratios. The contribution of olivocochlear efferents to speech-in-noise recognition was quantified as the change in performance with versus without the presence of contralateral white noise. Preliminary results in 18 participants revealed the following trends: in the presence of contralateral noise, percent correct tended to improve, the signal-to-noise ratio for 50% correct performance was lower, and response time was faster even at the highest signal-to-noise ratio. The results are consistent with the hypothesis that olivocochlear efferents benefit speech understanding in background noise and may decrease listening effort. Additionally, this work may contribute to the development of behavioral assessments of olivocochlear efferent function.

Poster # 78

Word Recognition in Noise By Children with Autism Spectrum Disorder
Sarah Yoho, PhD; Maryellen Mcclain, PhD, Utah State University, Logan, UT

The purpose of the current study was to determine whether children with high-functioning autism spectrum disorder perform more poorly than typically-developing children on word recognition in background noise. Individuals with autism spectrum disorder often display heightened sensitivity to environmental noises. In addition, young typically-developing children often display a decreased ability to perceive speech in noise relative to older individuals. However, it is unclear how children with autism spectrum disorder perform on speech reception tasks when background noise is present. Two groups of children, typically-developing individuals and individuals with high-functioning autism spectrum disorder, aged 6-12 years, participated in the current study. Word recognition was measured in four types of background noise: speech-shaped noise, temporally-modulated speech-shaped noise, multi-talker babble, and time-reversed multi-talker babble. Preliminary results indicate that children with high-functioning autism spectrum disorder perform similarly to age-matched typically-developing children on word recognition in all types of noise tested except multi-talker babble. These results suggest that the information content of the masker plays an important role in speech perception for children in this population.

Poster # 79

Evaluating the Television Experience: Materials Development and Pilot Data
Rebecca Wiacek, BS; Erin Picou, PhD; Todd Ricketts, PhD, Vanderbilt University, Nashville, TN

In this poster, we describe development of audio-video test materials as part of a larger study aimed at evaluating the effects of loudspeaker configuration, age, and hearing loss on the television and film experience. Audio-video materials were analyzed for content, with the goals of including speech of both American and British English accents, male and female talkers, and different rates of speech. An additional goal was to ensure speech was present in a wide range of sound backgrounds including conversations, music soundtracks, and environmental noise. The materials were then edited to equate for amplitude across the clips, and manipulated to be presented with two different signal to noise ratios (SNRs). The materials and associated hardware and software were then arranged so that the audio portion could be delivered via 5.1 surround sound, external stereo loudspeakers, or the stereo television speakers. The finished clips were arranged into 6 lists containing continuous dialogue; these clips were presented in 10 second segments with two different SNRs. The clips were then configured to be randomly presented through the aforementioned three speaker configurations. [Supported by NIH-NIDCD T35DC008763]

Poster # 80

Auditory Selective Attention and Speech-in-Noise Perception in Older Adults
Jonathan Hirst, BS, University Of Florida, Department Of Speech, Language, And Hearing Sciences, Gainesville, FL
Jennifer Whittaker; Chad Rogers, PhD; Tommy Peng, MS; Dennis Barbour, PhD; Jonathan Peelle, PhD, Washington University In Saint. Louis, St. Louis, MO

Mounting evidence suggests that age-related hearing loss can increase the cognitive demands on listeners, such that listeners with poorer hearing experience more effortful listening. As listeners, we

frequently need to separate a sound source of interest (such as a conversational partner) from interfering noise (such as background noise at a cocktail party). In real-world listening, these sound sources are typically located in different areas, allowing us to use spatial information to help separate them. Unfortunately, many speech-in-noise tests present the same signals to both ears, precluding the use of spatial attention in comprehension. How does auditory attention interact with acoustic challenge in the context of speech perception? In the experiment reported here, we simulated a spatial speech-in-noise task using an interactive word-detection task in a group of 40 older adults (aged 60+ years) with self-reported normal hearing. We then assessed the relationship between standard audiometric measures (pure-tone thresholds, word recognition score, speech reception thresholds, and speech-in-noise scores), clinical dichotic listening task (dichotic digits), a clinical cognitive screening tool (MOCA), and a novel dichotic semantic priming task. Results will discuss the relative contributions of hearing sensitivity, binaural speech-in-noise processing, and dichotic listening abilities to a complex speech perception task.

Poster # 81

Cognitive Flexibility as a Predictor of Speech Perception in Noise

Jacob Sommers, BS, Louisiana Tech University, Ruston, LA
Kate Mcclannahan, PhD; Mitchell Sommers, PhD, Washington University In St. Louis, St. Louis, MO

Difficulty understanding speech in noisy environments is one of the most common complaints of older adults. While pure-tone hearing thresholds are the current standard of care for identification of hearing aid candidates, they often fail to predict speech perception in noise (SPIN) capabilities. One cognitive ability that shows promise as a non-auditory predictor of speech perception in noise is cognitive flexibility (CF); the ability to adjust one's behavior according to a changing environment (Dajani & Uddin, 2015). This study examined CF in a sample of older adults (N=37, 54-77 years), with hearing thresholds ranging from normal to severe sensorineural hearing loss. We hypothesized that CF would uniquely predict SPIN. Participants completed audiometric, SPIN, and CF testing. Correlational analysis revealed a significant positive relationship between the CF measure and QuickSIN scores. However, a subsequent stepwise linear regression revealed that this relationship was due to a moderate correlation between CF and PTA. Preliminary findings suggest CF alone did not account for unique variance in SPIN scores for this sample of older adults. Future studies are needed to examine CF in adults with greater degrees of hearing loss and in hearing aid users.

Poster # 82

Effect of WDRC on Compression in Reverberation using DSL Rrescription

John Massey, University Of Florida/Boystown National Research Hospital, Gainesville, FL
Marc Brennan, PhD, University Of Nebraska-lincoln/boystown National Research Hospital, Lincoln, NE
Ryan Mccreery, PhD, Boystown National Research Hospital, Omaha, NE

Wide-dynamic range compression (WDRC) with a fixed 3:1 compression ratio was recently shown to degrade speech recognition in reverberation for adults. The results of that study could have implications for the use of prescriptive procedures with children, who are typically prescribed a higher compression ratio than adults. This study addressed this important issue by examining the effect of WDRC on consonant-vowel-consonant recognition in the presence of reverberation (0, .5, and 1 second) for adults

and children. A MATLAB hearing aid simulator, set to Desired Sensation Level targets, was used with a 10-ms attack time and 3 separate release times: 12, 90, and 1200 milliseconds. It was hypothesized that the deleterious effects of WDRC, if any, would be greater as the reverberation time increased and in children than adults. Contrary to our prediction, none of the compression speeds had a significant effect on speech recognition in reverberation. These results stand in contrast to a previous finding that indicated a negative impact of WDRC on speech recognition in reverberation and suggest that the use of variable compression ratios set using DSL may afford better access to speech in reverberation to children and adults than a fixed 3:1 compression ratio.

Poster # 83

Effect of Time Compression and Reverberation among Younger and Older Listeners with Normal Hearing

Emily Wilson, BS, University Of Wisconsin, Madison; National Center For Rehabilitative Auditory Research (NCRAR), Madison, WI
Amie Roten; William Bologna, PhD; Michelle Molis, PhD, National Center For Rehabilitative Auditory Research (NCRAR), Portland, OR

Impaired auditory temporal processing has been implicated as a potential factor affecting speech recognition performance in older listeners, independent of hearing status. To assess how impaired temporal processing may affect speech perception without the potential confound of reduced audibility, the present study evaluated the effects of temporal distortions on speech recognition performance among younger and older adults with normal hearing. Stimuli were 100 seven-digit strings, processed via time compression, simulated reverberation, or both. Digit recognition was assessed with two experimental paradigms (fixed or adaptive time compression) and two scoring methods (strict and lax). For the fixed paradigm, younger adults were more accurate than older adults for both the strict and lax scoring. For the adaptive paradigm, younger adults obtained significantly lower time-compression thresholds than older adults when strict scoring was applied, but not for lax scoring. These results suggest that in less demanding listening environments older adults are able to rely on partial information to understand speech and can perform as well as younger listeners. However, considerable variability was noted within the two age groups. Additional analyses will be presented to describe these individual differences. [Work supported by the VA RR&D NCRAR and NIH/NIDCD].

TINNITUS

Poster # 84

Tinnitus Relief: A Comparison Between Hearing Aids and Combination Devices

Sharon Sandridge, PhD; Craig Newman, PhD; Gina Stillitano, AuD, Cleveland Clinic, Cleveland, OH

Audiologic management of patients with hearing loss and bothersome tinnitus focuses on the use of hearing aids (HAs) or combination devices [CDs; HA and sound generator (SG) housed in the same device] along with ongoing counseling. The present study evaluated the clinical effectiveness of a commercially-available CD (Alta2 Pro Ti,Oticon) compared to HA alone (Alta2 Pro, Oticon). Participants were randomized to either a control (HA only) or treatment (CD) group. Disease-specific (TFI, Tinnitus

Functional Index; THI, Tinnitus Handicap Inventory) and generic health status questionnaires (PHQ-9, Patient Health Questionnaire-9; GAD-7, Generalized Anxiety Disorder-7) were administered over a 6-month interval (baseline, 1-. 3- , 6-months). Preliminary analyses (n=40) indicated that both treatment groups received benefit from each treatment HA only or CD. For the HA alone group, 77% showed more than a 13 point reduction in TFI score while 67% of the participants in the CD treatment group had greater than 13 point reduction (considered clinically significant). A series of t-tests, however, indicated that there were no significant differences between treatment groups for the TFI. Additional analyses will be presented. Initial findings support recent observations that HAs alone can provide significant relief from tinnitus compared to CD.

Poster # 85

Associations between Traumatic Brain Injury and Tinnitus Severity

Kelly Reavis, MPH, MS; Kathleen Carlson, PhD; Susan Griest, Mph; Sarah Theodoroff, PhD; Emily Thielman, MS; Cody Blankenship, BS; Wendy Helt, MA; Jane Gordon, MS; James Henry, PhD, VA Rr&d, National Center For Rehabilitative Auditory Research, Va Portland Health Care System, Portland, OR

Traumatic brain injury (TBI) is associated with tinnitus. However, it is unknown if tinnitus severity differs between individuals with, versus without, TBI or with, versus without, TBI plus blast-exposure. We examined these associations cross-sectionally among post-9/11 Veterans. Participants enrolled in The Noise Outcomes in Servicemembers Epidemiology Study completed a comprehensive audiological examination including questionnaires to assess military-related TBI and blast-exposure history. Tinnitus severity was assessed using the Tinnitus Functional Index (TFI). Bivariable analyses examined associations between TBI, blast, and tinnitus severity and its subscales. Multivariable multinomial regression models were used to generate adjusted odds ratios (aORs) and 95% confidence intervals (CIs) estimating associations between TBI (with and without blast) and tinnitus severity while controlling for age and gender. Compared to individuals without TBI, individuals with TBI and TBI plus blast had worse scores on the TFI and on all eight subscales. Veterans with TBI and TBI plus blast were three times more likely to report severe, problematic tinnitus relative to non/mildly problematic tinnitus (aOR=2.8; 95% CI: 1.3-6.1; aOR=3.1; 95% CI:1.2-8.2, respectively). These finding may have implications for the treatment of individuals with tinnitus. Further research will help disentangle effects of blast and TBI on tinnitus severity.

Poster # 86

Comparing Multiple Methods of Measuring Tinnitus Pitch and Spectrum

Leslie Grush, AuD; Candice Manning, PhD; Emily Thielman, MS; James A. Henry, PhD, NCRAR/Portland VA, Portland, OR

Two of the most commonly evaluated psychoacoustic characteristics of tinnitus are its pitch, the perceived dominant frequency of the tinnitus, and its spectrum, the frequency components of the tinnitus. The standard method of measuring tinnitus pitch is to obtain a single pitch match; however, repeated pitch matches will typically vary over 2-3 octaves. To improve reliability, other techniques have been investigated, including the use of Bayesian modeling to calculate how many repeated pitch-matches must be obtained to estimate an individual's tinnitus frequency with a certain level of precision, and

using a forced-choice paradigm to narrow in on tinnitus pitch. Tinnitus pitch estimates may be related to tinnitus spectrum, as it may be impractical to select a true pitch match when tinnitus resembles a wide-spectrum noise rather than a pure tone. The current study utilizes both automated and conventional testing to measure tinnitus pitch and spectrum. Data from approximately 130 participants will be presented. The various methods of pitch estimation will be described in further detail and results from each will be compared, including analysis of reliability across four study visits over six months. The relationship between pitch and spectrum will be investigated.

Poster # 87

Defining Tinnitus Probability using GAP Detection: Critical factors for Assessment

Rod Braun, PhD; Antonela Muca; James Warila, MS; Aaron Apawu, PhD; Anthony Cacace, PhD; Avril Holt, PhD, Wayne State University, Detroit, MI

Although promising, gap detection data are often confounded, with a lack of standardized analyses complicating the distinction of differences among experimental groups. Therefore, reducing uncertainty in testing parameters and applying powerful statistical analyses are critical. Three areas of analysis were refined and implemented in an animal model of tinnitus with objectives of reducing variability and identifying tinnitus relevant patterns. Assessment of gap detection was performed on 10 noise exposed (16 kHz 106 dB SPL 1 hr) Sprague-Dawley rats and nine age-matched controls. Exclusionary criteria were set for each animal based upon the average time to startle + 1.5 standard deviations (Tmax) and force applied + 2.0 standard deviations (Fmax) for each session, resulting in minimal elimination of data (< 5%), but substantial reduction in variability. Startle force patterns acquired with and without a silent gap were compared across parameters and fit to a linear mixed-effects model. Significant differences between treatment groups across specific frequencies and intensities were demonstrated with predicted marginal means under gap and no gap conditions. Determining individual exclusionary criteria by session and assessing gap effects increases reproducibility and allows accurate evaluation of tinnitus-relevant Gap detection for future assessment of tinnitus probability in humans.

Poster # 88

Tinnitus in Blast-Exposed Veterans with Hearing Handicap but Normal Audiograms

Linmin Kang, MD; Elizabeth Haley, AuD; Malcolm McNeil, PhD; Sheila Pratt, PhD, Va Pittsburgh Healthcare System; University Of Pittsburgh, Pittsburgh, PA
Lee Baugh, PhD; Kelene Fercho, PhD; Lindsey Jorgensen, PhD, Va Sioux Falls Healthcare System; University Of South Dakota, Vermillion, SD
Frederick Gallun, AuD, VA Portland Healthcare System, Portland, OR

High-level noise exposure can induce auditory synaptopathy, which can be reflected in a reduction of ABR wave I amplitude at suprathreshold presentation levels. Recent studies also suggest that synaptopathy may play a critical role in the formation of noise-induced tinnitus. Military Veterans exposed to blasts experience intense sound levels along with the physical effects of the blast waves, so it is not unexpected that traumatic brain injury (TBI) secondary to blast-exposure also has been associated with a substantial rise in the prevalence of tinnitus as a service-connected disability. Compared to neurologically healthy Veterans, Veterans with blast-induced mild TBI (mTBI) have elevated rates and

severity of tinnitus. A similar pattern has been noted in preliminary data from our ongoing multisite study assessing blast-exposed Veterans who have normal audiograms but substantive auditory complaints. However, no study has used the Auditory Brainstem Responses (ABR) to examine tinnitus complaints in this population. Thus, the aim of this investigation was to determine if tinnitus differentially affects the ABR wave I amplitude and if mTBI secondary to blast-exposure is a contributing factor. Using the ABR wave I to confirm subjective tinnitus ratings also will be discussed.

ANATOMY / PHYSIOLOGY OF AUDITORY & VESTIBULAR SYSTEMS

Poster # 89

Electrophysiological Measures of Neural Degeneration in Relation to Gap Discrimination
Dawn Konrad-Martin, PhD; Naomi Bramhall, PhD; Garnett Mcmillan, PhD; Serena Dann, AuD; Frederick Gallun, PhD, National Center For Rehabilitative Auditory Research (ncrar), Va Portland Health Care System, Portland, Or, Portland, OR
Sharon Kujawa, PhD, Eaton-Peabody Laboratory, Massachusetts Eye & Ear Infirmary, Boston, MA

Loss of synaptic ribbon connections between afferent auditory nerve fibers and their inner hair cell targets is a primary effect of aging and noise overexposure in animal models. Auditory brainstem response (ABR) wave I amplitude is correlated with synaptic ribbon and auditory nerve fiber survival in these models. Previously, we found that age, independent of threshold sensitivity, was a strong predictor of temporal gap discrimination (Gallun et al. 2014). We hypothesized that cochlear synaptopathy and degeneration of the type I afferent system more generally may contribute to impaired temporal processing among the elderly. The present report uses a linear mixed model to relate monaural gap discrimination to ABR wave I amplitude and a non-auditory metric of cognitive processing speed in 49 listeners (mean age of 44.4 yr; range 18-75) with no more than a moderate hearing loss. Results indicate that ABR wave I amplitude is an independent factor predicting temporal processing ability after adjusting for pre-neural cochlear function using distortion-product otoacoustic emissions (DPOAEs), but that cognition exerts a greater influence. Further, the DPOAE adjusted ABR wave I amplitude identifies individuals who are older and/or have a history of high noise exposure and thus may be at risk for synaptic/neuronal degeneration.

Poster # 90

Use of Non-Invasive Measures to Predict Cochlear Synaptic Ribbon Counts
Garnett McMillan, PhD; Dawn Konrad-Martin, PhD; Naomi Bramhall, PhD; Serena Dann, AuD, Va Rr&d Ncrar, Portland, OR
Sharon Kujawa, PhD, Eaton-Peabody Laboratory, Massachusetts Eye & Ear Infirmary, Boston, MA

Cochlear synaptopathy, the loss of synaptic connections between inner hair cells and auditory nerve fibers, has been documented in animal models of aging, noise, and ototoxic drug exposure, three common causes of acquired sensorineural hearing loss in humans. In each, the synaptopathy begins prior to threshold sensitivity and hair cell losses; thus, this underlying injury can be hidden in a normal threshold audiogram. Since cochlear synapse loss cannot be directly confirmed in living humans, non-invasive assays will be required for diagnosis. When thresholds are normal, the amplitude of wave I of the

auditory brainstem response (ABR) is highly correlated with synapse counts; however, synaptopathy also occurs when thresholds are elevated, complicating the use of this metric, alone, for diagnosis. This report shows, using an age-graded series of mice and a Bayesian statistical approach to the modeling of structure-function relationships, that the combination of a small number of ABR and distortion product otoacoustic emission (DPOAE) measures can be used to accurately predict synaptic ribbon counts (to within 1-2 ribbons per inner hair cell of their true value) at various cochlear frequencies. These results provide partial validation of a noninvasive approach to identify synaptic/neuronal loss in humans using ABRs and DPOAEs.

Poster # 91

Influence of Platinum Derivative Treatments on Different Otoacoustic Emission Paradigms
Brittany Vlosich, BS, San Diego State University/UC San Diego, La Jolla, CA
Laura Dreisbach Hawe, PhD, SDSU, San Diego, CA

Platinum derivatives, such as cisplatin, oxaliplatin, and carboplatin, are often used as treatments for cancer, and are known to cause damage to the auditory system. These ototoxic drugs generally target the outer hair cells in the basal end of the cochlea. Several studies have examined the sensitivity of behavioral and physiologic measures of auditory function in response to ototoxic damage. Distortion product otoacoustic emissions (DPOAEs) have shown changes in the auditory system in response to ototoxic damage sooner than other measures at conventional frequencies (1-8 kHz). Other studies have shown that the repeatability of extended high-frequency DPOAEs is similar to that of conventional frequencies. This project examined the influence of platinum derivatives on three extended high-frequency distortion product otoacoustic emission paradigms for twelve patients. Paradigms included gross (f2 =16-2 kHz ; f2/f1=1.2; L1/L2 =62/52 dB FPL) and concentrated (f2=highest frequency; f2/f1=1.2; L1/L2 =62/52 and 72/72 dB FPL) frequency, level (L2=57, L1=27-67 dB FPL and L1=57, L2=12-67 dB FPL), and ratio (f2/f1=1.1-1.25; L1/L2 =62/52 dB FPL) sweeps. Preliminary results indicate changes in concentrated sweeps at high and moderate levels before changes in other paradigms. Most concentrated sweeps were measured at frequencies higher than conventional equipment currently can test.

Poster # 92

Planum Temporale: Morphological Taxonomy of the Posterior Superior Temporal Plane
Bryan Wong; Aaron Whiteley; Barrett St. George; Frank Musiek, PhD, University Of Arizona, Tucson, AZ

Background: Planum Temporale (PT) is a crucial neuroauditory structure, instrumental to higher auditory processing. Despite studies examining PT function, there remains difficulty in differentiating PT from Heschl's Gyrus in some cases. The goal of this study was to take the first step in creating a morphological taxonomy to solve this problem. Methods: A total of 28 intact brain MRIs (56 hemispheres) were included in this retrospective study. Ages ranged from 21-36 years (mean= 25.9 years). A 3D cortical mesh for each brain, using BrainVISA Anatomist neuroimaging software, was generated from high-resolution, T1- weighted MRIs (OASIS database). The PT was categorized by morphological shape based on quantification of edges, angles, and vertices exhibited by PT boundaries and compared to surrounding Superior Temporal Plane (STP) structures inter- and intra-hemispherically. Results: A total of four PT configurations were identified based on our criteria: (1) Pie-

shaped [52% of hemispheres], (2) Trapezoid-shaped [29% of hemispheres], (3) Rectangular-shaped [14% of hemispheres,] and (4) None [5% of hemispheres]. PT configuration was influenced by HG morphology ($p<0.05$), but not influenced by posterior SF termination ($p=0.17$). Discussion: The proposed taxonomy offered here will herald more research to enhance the identification of structures in the Posterior STP.

Poster # 93

Does Heightened Visual Attention Affect Inner Ear Function?

Wiktor Jedrzejczak, PhD; Rafal Milner, PhD; Edyta Pilka, MS; Malgorzata Ganc; Henryk Skarzynski, PhD, Institute Of Physiology And Pathology Of Hearing, Warsaw, Poland

The aim of the present study was to test whether increased visual attention caused corresponding changes in inner ear function, which was measured by the strength of otoacoustic emissions (OAEs) recorded from the ear canal in response to a steady train of clicks. To manipulate attention, we asked subjects to attend to, or ignore, visual stimuli delivered according to an odd-ball paradigm. The subjects were presented with two types of visual stimuli: standard and deviant (20% of all stimuli, randomly presented). During a passive part of the experiment, subjects had to just observe a pattern of squares on a computer screen. In an active condition, the subject's task was to silently count the occasional inverted (deviant) pattern on the screen. At all times, visual evoked potentials (VEPs) were used to objectively gauge the subject's state of attention, and OAEs in response to clicks (transiently evoked OAEs, TEOAEs) were used to gauge inner ear function. As a test of descending neural activity, TEOAE levels were evaluated with and without contralateral acoustic stimulation (CAS) by broadband noise, a paradigm known to activate the MOC pathway.

Poster # 94

Comparison of Distortion-Product Otoacoustic Emissions between Brazilian and United States Children

King Chung, PhD; Kaitlin Anderson; Kara Combs, Northern Illinois University, DeKalb, IL

Otoacoustic emissions is a sensitive measure of cochlear function that may allow the detection of preclinical conditions. Yet, racial differences may limit its use in diagnosing hearing loss among children. The purpose of this study was to compare the amplitude of distortion-product otoacoustic emissions (DPOAEs) of children from Brazil and the United States. A total of 756 Brazilian and US children aged 10-18 years were tested using an identical hearing screening protocol: Cursory otoscopy, tympanometry, and DPOAEs at 1500, 2000, 3000, 4000, 5000, and 6000 Hz. Brazilian children who failed the screening protocol and all US children were tested using pure tone audiometry. Only 77.1% of Brazilian children but 90.0% of US children met the inclusion criteria: unremarkable otoscopy, Type A tympanograms, DPOAEs present in 4 of the 6 test frequencies, and pure tone thresholds <20 dB HL at octave intervals between 500 and 8000 Hz. Univariate and multifactorial analysis revealed US children, on average, had significantly higher DPOAE amplitudes than Brazilian children in each age between 10 and 18 years ($p<0.05$). The inclusion rate and DPOAE amplitude differences suggest Brazilian children may have reduced cochlear functions compared to the US children.

AUDIOLOGY / OTOLOGY

Poster # 95

Adaptive Assessment of Individualized Annoyance Levels with Ecologically Valid Stimuli
Krishna Rodemerk, AuD; Kamil Wojcicki, PhD; Jason Galster, PhD, Starkey Hearing Technologies, Eden Prairie, MN

Patients with hearing aids often complain of annoyance when listening to loud, impulse or transient sounds. This work introduces a new measure of annoyance, the individualized annoyance level (IAL). This assessment uses ecologically valid transient stimuli that are adapted to a level at which the sound becomes subjectively judged as annoying. The stimuli include hammer, drawer slam, cutlery clattering, keys jingling, and a spoon hitting a ceramic bowl. We were interested in assessing the extent to which traditional audiometric measurement of uncomfortable loudness (UCL) relate to the IAL. For this study, stimulus specific IALs were averaged over multiple trials and compared to participant's measured tonal UCLs at 500 and 3000 Hz. We found that (1) IALs were stimulus and listener dependent, and (2) UCLs and IALs were significantly correlated.

Poster # 96

Measures to Validate Speech-in-Noise Complaints in Young, Normal Hearing Individuals
Lauren Kelly, BS; Alexandra Brockner; Michelle Manning; Amy Sanchez; Jason Sanchez, PhD, Northwestern University, Evanston, IL

We recently showed that a battery of objective, performance and perceptual measures could validate an individual's complaint of speech in noise (SIN) difficulties despite having normal hearing. In particular, wave I of the auditory brainstem response (ABR) was a reliable predictor of both performance and perceptual measures of SIN ability, suggesting a peripheral auditory involvement underlying the complaint. The current objective was to determine whether the same test battery could validate SIN difficulties in normal hearing young adults, of whom ~25% report such problems. Using the ABR (objective measure), modified quick SIN (mQuickSIN, performance measure), & the Speech, Spatial and Qualities of Hearing Questionnaire (SSQ, perceptual measure), we found that the SSQ and wave I amplitude of the ABR can predict performance on the mQuickSIN. This result was not evident with wave V and was supported by participants' normal performance on a central auditory processing test. These results suggest that (1) complaints of SIN difficulty are present among a younger population of normal hearing adults, (2) the test battery may be an effective toolbox for assessing SIN complaints in older and younger adults and (3) complaint of SIN difficulty despite normal hearing may be attributed to a peripheral auditory phenomenon.

Poster # 97

Outer Hair Cell Function in Children with Listening Difficulties
Lisa Hunter, PhD; Chelsea Blankenship, AuD; Allison Bradley, PhD; Nicholette Sloat, MA; Audrey Perdew; Bethany Wysocki; David Moore, PhD, Cincinnati Children's Hospital Medical Center, Cincinnati, OH

Listening difficulties (LiD) are a primary complaint of auditory processing disorder in children, a poorly understood condition lacking scientifically validity. In a longitudinal study, we are exploring the role of peripheral auditory function on LiD in children, as this has not been systematically studied. All participants had normal audiometric thresholds (20dBHL; 0.25-8kHz). Children with LiD (N=63, 6-14 yrs), identified from parent report (ECLiPS, Barry et al. E&H, 2016), and typically developing (TD) children (N=56,6-14yrs) completed audiometric testing (0.25-16kHz) and chirp-evoked transient evoked otoacoustic emissions (TEOAEs; 0.7-14.7kHz; Keefe et al.,JASA,2016). TEOAE signal-to-noise ratios (SNR) and coherence synchrony (CS; response reliability) did not differ significantly between the LiD and TD group. Children with a history of tubes or extended high frequency (EHF) hearing loss had significantly lower SNR and CS values in both the standard and EHF ranges up to 14.7kHz. Wideband absorbance did not differ significantly based on LiD, tube history, or EHF hearing, thus the TEOAE differences were due to outer hair cell dysfunction (Hunter, ARO2018). In summary, chirp-evoked TEOAEs provide objective evidence for impaired EHF hearing and impact of earlier otitis media or tubes, but did not show evidence of OHC dysfunction specifically associated with LiD.

Poster # 98

Automated Wideband Acoustic Reflex Threshold Test

Kim Schairer, PhD; Elizabeth Kolberg, AuD, Mountain Home Va Health Care System , Mountain Home, TN
Douglas H. Keefe, PhD; Denis Fitzpatrick, PhD, Boys Town National Research Hospital, Omaha, NE
Daniel Putterman, AuD; M. Patrick Feeney, PhD, National Center for Rehabilitative Auditory Research, Portland VA Medical Center, Portland, OR

Acoustic reflex thresholds (ARTs) are used clinically as a cross check for behavioral results and as a measure of 7th and 8th cranial nerve function. In clinical test batteries, ARTs are measured as a change in middle ear admittance of a pure tone probe in the presence of a pure tone or broadband noise (BBN) reflex activator. ARTs measured using a wideband probe may yield lower thresholds because the criterion change for 'present' reflexes can be observed across a range of frequencies rather than at a single frequency. ARTs were elicited in a group of 25 adults with normal hearing using a 226-Hz probe and a wideband (250 to 8000 Hz) probe, and activators of 500, 1000, and 2000-Hz and broadband noise (BBN). Wideband ARTs were estimated using an automated adaptive method. Lower mean ARTs were obtained for the wideband method compared to the clinical method by as much as 5-10 dB for tonal activators and 15 dB for BBN. Clinical benefits of lower ARTs include reduced activator levels during threshold estimation, and present rather than absent responses in some ears with absent ART using the clinical method. Results are encouraging for the automated adaptive ART procedure.

Poster # 99

AudGenDB: Big Data Approaches to Studying Pediatric Progressive Hearing Loss

Jordan Racca, AuD; Linda Hood, PhD, Vanderbilt University, Brentwood, TN
Faith Sikorski, AuD; E. Bryan Crenshaw, PhD, Children's Hospital Of Philadelphia, Philadelphia, PA

The Audiologic and Genetic Database (AudGenDB) is a large pediatric database (n=~164,000 patients in Nov, 2017) that integrates auditory and medical information for analyses by the hearing research

community. In previous studies, we evaluated metrics for describing progressive hearing loss in pediatric patients (Lee and Hood, 2014). The current analyses focus on sensorineural aspects of hearing loss through examination of bone conduction data. We developed algorithms using R programming language that combined medical diagnostic and procedural codes with data from patients identified with progressive hearing loss. Codes were categorized by body system to identify relationships to sensorineural hearing loss (SNHL) and progressive hearing loss, in particular. We compared two definitions of progressive hearing loss in patients with masked bone conduction threshold data at 3 or 4 frequencies for at least 3 hearing tests. Inclusion criteria were met by 10,499 patients with normal hearing or hearing loss. General findings in the 184 patients demonstrating progressive hearing loss included unilateral cases, progression from normal hearing, and greater low-frequency hearing loss than expected. Characteristics unique to younger populations, including low frequency loss and greater likelihood of fluctuating conductive overlays, must be considered when studying hearing loss progression. [Supported by NIH-NIDCD R24DC012207]

Poster # 100

Measuring Auditory Thresholds with Narrowband Verbal Commands

Sarah Poissant, PhD; Kathryn Sheehan; Richard Freyman, PhD, University Of Massachusetts Amherst, Amherst, MA

It can be difficult to assess hearing in toddlers due their limited attention spans and lack of interest in commonly employed audiometric stimuli (e.g., pure tones). Previously, we found that frequency-limited environmental sounds and spondee words have high potential for use as alternative stimuli during threshold measurement. Here we share the results of one experiment designed to assess the validity and reliability of sound-field thresholds obtained with short commands expected to be interesting to very young children (e.g., 'Point to your tummy!'). Subjects were young adults with normal hearing whose warble tone detection thresholds were compared to closed-set reception thresholds for octave-band filtered (96 dB/octave) commands produced using child-directed speech. A subset of conditions employed hearing loss simulation with both rising and falling audiometric slopes. The threshold tester was blind to the hearing loss configuration. For flat configurations, filtered command thresholds were highly stable and, on average, 10 dB poorer than warble tone thresholds (likely due to the reception versus detection task difference). For both rising and falling slopes, reliability was good and thresholds were closely aligned to those obtained with warble tones. Results suggest strong promise for the eventual application of these narrowband speech stimuli to the pediatric population.

Poster # 101

Wideband Acoustic Immittance and Age Effects of the Middle Ear

Chris Sanford, PhD; Gabriel Bargen, PhD; Jessy Noblitt, BA; Jeff Brockett, Idaho State University, Pocatello, ID

With the recent commercialization of wideband acoustic immittance (WAI) technology, the need to translate research work to clinical practice, including the creation of normative data, has been accelerated. Aims of the present study were to identify age related differences in WAI and further develop a WAI normative database across the age spectrum. WAI absorbance data from individuals in six age groups were examined, including 6 - 12 months; 2 - 5; 10 - 15; 20 - 30, 45 - 55, and 65 - 75 years.

Absorbance was similar for the two oldest age groups across the entire frequency range (250 - 8000 Hz). However, significant age effects were found for absorbance with the 20 - 30 year group. With the pediatric groups, trends toward more significant age effects were found with the youngest group; in particular, absorbance for the 6 to 12 month children was lower than all of the older groups for approximately 600 through 3000 Hz. Overall, these results suggest more significant differences in WAI for the youngest and oldest groups along with a trend toward decreasing middle-ear stiffness with age. They also hold relevance for the establishment of normative data for WAI measurements and for understanding the aging process in the peripheral auditory system.

Poster # 102

Acoustic Reflexes Unveil Subclinical Cranial Polyneuropathy in Adults with HIV/AIDS
David Downs, PhD, Listening Interventions, Llc, Wichita, KS

The vertical acoustic reflex (AR) pattern occurs when both crossed and uncrossed AR thresholds are measured at elevated hearing levels in the same ear as the immittance probe. This poster describes, for the first time, cases of adults with HIV/AIDS who have the vertical AR pattern that unveils subclinical neuropathy of two or more cranial nerves. An audiologist completed a battery of peripheral and central audiological measures -- including crossed and uncrossed AR testing -- on 82 adults diagnosed with HIV/AIDS at the University of Kansas School of Medicine at Wichita. He then retrospectively scrutinized audiometrics, medical records, and interviews of a subset of three cases who showed a vertical AR pattern. Despite otherwise being clinically asymptomatic for hearing and facial disorders, Case 1 had a vertical AR pattern and positive SSI/PI rollover in one ear. Cases 2 and 3 each had a vertical AR pattern with symptomatic auditory and facial neuropathy on the clinically affected side; but normal hearing sensitivity with retrocochlear impairment corroborated by poor BKB-SIN test scores on the unaffected side. These cases suggest crossed and uncrossed AR testing -- especially when combined with speech-in-noise testing -- is useful in detecting subclinical cranial polyneuropathies in some adults with HIV/AIDS.

Poster # 103

Relationship Between Personal Hearing Aid Settings and Infant Speech Discrimination
Melinda Anderson, PhD; Kristin Uhler, PhD, University Of Colorado School Of Medicine, Aurora, CO
Paige Mowery, Univeristy Of Colorado, Boulder, Boulder, CO

Current infant hearing aid (HA) fitting protocols are based on assuring audibility. A gap exists in the knowledge surrounding the impact of personal HA settings on infant speech discrimination. In this study, we related characteristics of the output of a hearing aid to performance on a behavioral discrimination task. Subjects included infants who used bilateral HAs. Visual Reinforcement Infant Speech Discrimination (VRISD) was used to assess infant speech discrimination of two speech contrasts (/a-i/ and /ba-da/). The acoustic analysis used the cumulative signal processing output and quantified the amount of signal manipulation based on personal HA settings. The acoustic analysis of the personal HA settings was completed using two techniques. First, we established the output levels of the hearing aids for the VRISD contrasts for each presentation level (50, 60, 70 dBA). Second, we calculated the amount of cumulative distortion in the output of the HAs. Results indicate that audibility and amount of signal modification may impact discrimination abilities of infants wearing HAs. Developing a better

understanding of the relationship between hearing aid processing and speech discrimination in infancy will enhance our ability to fine-tune HA settings, making intervention more effective.

Poster # 104

PEDRA: Standardized Ear Disease Detection for Non-Physician Hearing Healthcare Providers

Samantha Kleindienst Robler, PhD, Norton Sound Health Corporation, Nome, AK
Donald Nielsen, PhD, Don Nielsen Consulting, Llc, Dublin, OH
Sumitrajit Dhar, PhD; Niall Klyn, PhD, Northwestern University, Evanston, IL
James Griffith, PhD, Northwestern University, Chicago, IL
Larry Lundy, MD; Razan Al Fakir, PhD; David Zapala, PhD, Mayo Clinic Florida, Jacksonville, FL
Deborah Carlson, PhD, The University of Texas Medical Branch, Galveston, TX
Jamie Bogle, PhD, Mayo Clinic Arizona, Scottsdale, AZ

Recently both the U.S. Food & Drug Administration (FDA) and the Federal Trade Commission (FTC) abandoned their long-standing policy that adults should obtain a medical evaluation before purchasing hearing aids. As a result, responsibility for the early detection of ear disease now falls upon the audiologist, hearing aid dispenser, and consumer. We recently published our work outlining how well naive consumers could recognize their own ear disease risk using the CEDRA questionnaire (Kleindienst et al, 2017). Here we present preliminary data on how well a standardized evaluation tool called PEDRA (Professional Ear Disease Risk Analytics)assists audiologists in ear disease risk assessment. PEDRA includes a semi-structured interview and evidence-based analysis of audiological test data to estimate the probability of ear disease. The audiologist can use the probability estimate to decide when a hearing aid seeking consumer should be referred for medical evaluation with a known level of precision. Our initial results demonstrate 97% sensitivity and a low (<5%) false positive rate for ear disease detection. Since false positive rates drive wasteful healthcare spending, PEDRA represents an accurate and efficient tool that can be deployed across the hearing health care system to standardize ear disease detection in hearing aid seeking adults.

Poster # 105

Diagnostic Precision of Automated Forced-Choice Word Recognition Tests

Tzu-Ling J Yu, MS; Robert S Schlauch, PhD, Department Of Speech-language-hearing Sciences, University Of Minnesota, Twin Cities, Minneapolis, MN

Hearing loss is a prevalent chronic health condition that affects speech understanding. A hearing test for tones quantifies the amount of loss, but a test of speech understanding is important for quantifying the distortion. This study compares the diagnostic precision of the generally accepted method for assessing word-recognition ability, where a person repeats back words they heard on a recording, to a computer-driven forced-choice version, where a person selects response target word they heard among a set of foils. To establish the relative merits of these two approaches, known hearing loss conditions - elevated hearing thresholds and decreased clarity of speech - are simulated by presenting speech in noise and processing speech through sinewave vocoder, respectively. This study examines if the performance between two approaches of word recognition testing yields a consistent, predictable relationship for different amounts and types of simulated hearing loss. Also, a computer simulation was conducted using

the fitted performance function in each test in order to learn how many test words are necessary to produce equivalent diagnostic precision between two approaches. The results suggest that the forced-choice word recognition task lacks the precision of the open-set measure for the same number of words.

Poster # 106

Perceived Self-Competence in School-Age Children Who are Hard of Hearing
Caitlin Sapp, AuD; Elizabeth Walker, PhD, University Of Iowa, Iowa City, IA

Previous studies have shown that children with hearing loss are at risk for delays in psychosocial development; however, there are numerous gaps in our knowledge of the social-emotional development in children with mild to severe hearing loss. The Harter Self-Perception Profile for Children examines the construct of global self-concept, as well as self-competence in specific areas such as scholastic achievement, social acceptance and physical appearance. The current study adapted the Harter scale for use with school-age children who are hard of hearing (CHH) and children with normal hearing (CNH).

Poster # 107

Masked Speech Perception Thresholds for 2- to 7-Year-Old Children
Angela Bonino, PhD, University Of Colorado Boulder, Boulder, CO

Collecting reliable behavioral data from toddlers and preschoolers is challenging. As a result, our understanding of human auditory development for these age groups has significant gaps. Because toddlers and preschoolers spend most of their day listening in noise, the objective of this work was to develop a reliable behavioral method for measuring speech perception in noise for this age group. For this study, masked speech perception thresholds in a two-talker speech or speech-shaped noise masker were collected for 2- to 7-year-old children and adults. Thresholds were measured using an observer-based testing method, in which a child's behavior was judged by an experimenter using a two-interval, two-alternative testing paradigm. Children's response to the stimulus were further shaped by training them to perform a conditioned play-based response to the sound. Sessions were also video recorded to evaluate observer reliability. Preliminary data indicate that this task is feasible and reliable for 2- to 7-year-old children. Children's thresholds were elevated compared to adults for both masker conditions. However, the child-adult difference was substantially larger in the two-talker masker condition than for the speech-shaped noise masker.

Poster # 108

Children With Cochlear Implants Produce Smaller Acoustic Contrasts Between Emotions
Jenni Sis, BS; Monita Chatterjee, PhD, Boys Town National Research Hospital, Omaha, NE
Sara Damm, University Of Nebraska-Omaha, NE

An important limitation of cochlear implants (CIs) is the poor transmission of voice pitch information. Voice pitch is an important element of speech prosody. In this study, we compared voice emotion productions by seven early-implanted CCIs (7-18 years old at testing) to productions by nine children

with normal hearing (CNH; 6-18 years old at testing). Twenty sentences were each spoken in a happy and sad emotion by the child talkers. Preliminary acoustic analyses of the productions indicate smaller acoustic contrasts between the CCIs' happy/sad productions compared to the CNHs' happy/sad productions. Groups of normally-hearing (NH) adult and child listeners heard each production and indicated the intended emotion in a forced-choice procedure. A group of NH adults also participated in a test of intelligibility of the productions. The results showed that the CCIs' productions were highly intelligible in terms of words identified correctly. However, consistent with the acoustic analyses, the results showed significant deficits in the CCIs' emotion productions compared to the CNHs' productions (in terms of percent correctly identified as happy or sad by the NH listeners). Additional tests with adult, post-lingually deaf CI users indicate no deficits in their emotion productions compared with adult NH participants.

AUDITORY PROCESSING

Poster # 109

Auditory Brainstem and Middle Latency Response Changes in a Rodent Repeat-Mild Traumatic Brain Injury Model

Brandon Lehrich, Department Of Biomedical Engineering, University Of California At Irvine, Irvine, CA
Alessandro Presacco, PhD, Department Of Otolaryngology, University Of California At Irvine, Irvine, CA, Center For Hearing Research, University Of California At Irvine, Irvine, CA
Ronald Sahyouni, MS, Department of Biomedical Engineering, University of California at Irvine, Irvine, CA, School of Medicine, University of California at Irvine, Irvine, CA
Sammy Sahyouni, Irvine Valley College, Irvine, CA USA
Khodayar Goshtabhi, School of Medicine, University of California at Irvine, Irvine, CA
John Middlebrooks, PhD, Department of Biomedical Engineering, University of California at Irvine, Irvine, CA, Department of Otolaryngology, University of California at Irvine, Irvine, CA, Center for Hearing Research, University of California at Irvine, Irvine, CA, Department of Neurobiology and Behavior, University of California at Irvine, Irvine, CA, Department of Cognitive Sciences, University of California at Irvine, Irvine, CA
Harrison Lin, Department of Otolaryngology, University of California at Irvine, Irvine, CA

Mild traumatic brain injury (mTBI) causes a variety of cognitive and physiological deficits, however, the effects of mTBI on the auditory system remain poorly understood. We investigate auditory brainstem and middle latency response (ABR & MLR) changes in a murine model of repeat-mTBI. ABR and MLR changes were measured across five-timepoints pre (baseline) and post (day-1, week-1, week-3, and week-5) injury at four frequencies (8, 16, 24, and 32 kHz). Stimuli intensities ranged from 20 to 80dB SPL (increments of 10dB) for ABR, and only an 80dB SPL intensity was presented for MLR, to three different wild-type C57/Bl6 mice groups (sham [n=7], 5-Hit [n=8], and 10-Hit [n=8]). Direct cortical impacts were delivered to each anesthetized mouse with a TBI-0310 Impactor (speed: 5 m/s, depth: 1 mm, dwell time: 500 ms). MLR amplitudes increase over time for the 10-hit group up until 1-week post-injury and then regresses to baseline amplitudes by 5-weeks post-injury. A similar behavior was observed in ABR wave-V amplitudes at 8 kHz. Our results suggest that mTBI causes only temporary changes in MLR and ABR. Future studies are needed to understand the impact of a higher number of hits and the long-term influences of head injury on auditory processing.

Poster # 110

Development of a Portable Test of Spatial Release
Kasey Jakien, BA; Frederick Gallun, PhD, Oregon Health And Science University, Portland, OR
Trevor Stavropoulos, BA; Aaron Seitz, PhD, UC Riverside, Riverside, CA

Previous work showing the independent influences of age and hearing loss on spatial release from masking with multiple talkers (e.g., Marrone et al., 2008; Jakien et al., 2017) has set the stage for translation of this test to the clinic, where spatial benefit may potentially explain the differences in listening success and effort across patients. Such translation requires tests that are automated, portable, and reliable. This presentation will present data collected with a portable tablet-based automated test of spatial release from masking that has been shown to be reliable in laboratory testing. Verification of the acoustical performance of the system will be presented, as well as within-participant comparisons of the tablet and laboratory tests. Results show that the Apple iPad with Sennheiser 280Pro headphones is acoustically equivalent to high-end laboratory equipment and that the amount of spatial release measured is equivalent across both test systems. The platform has already seen deployment across multiple clinical and clinical research settings, which will allow large sets of comparable normative and clinical data sets to be obtained.

Poster # 111

Age and Acoustic Degradation Affect Auditory Selective Attention During Childhood
Kristi Ward; Tina Grieco-Calub, PhD, Northwestern University, Evanston, IL

Younger children are poorer at recognizing speech amidst acoustic competition than older children. We hypothesize that this discrepant performance is partially due to younger children's inability to selectively attend to the target auditory stream - a skill expected to develop with age. We further hypothesize that this age-related difference in auditory selective attention is greater under conditions of acoustic degradation, during which there is an increased demand on younger children's immature attentional processes to resolve the input. The purpose of this study is to investigate the development of auditory selective attention, and to determine how degraded acoustic input affects this processing. Auditory selective attention was evaluated in children (5-12 years) using a behavioral change detection task. Children were instructed to detect frequency deviants in the target stream while ignoring the distractor stream. Target and distractor streams contained words that were either clear or degraded by low-pass filtering. Auditory selective attention was 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. Preliminary results support our hypotheses that auditory selective attention develops with age during childhood and that degrading the acoustic input disrupts this processing.

Poster # 112

Development of Temporal Fine Structure Processing in Children: FM Detection
Emily Buss, PhD; John Grose, PhD, University Of North Carolina At Chapel Hill, Chapel Hill, NC

The age-dependence of temporal processing abilities in school-age children has been demonstrated with envelope-based tasks such as gap detection. The purpose of this study was to assess developmental effects at the level of temporal fine structure (TFS) processing. The detection of low-rate frequency modulation (FM) carried by a low-frequency tone is thought to rely on TFS cues. This is particularly so when the modulator is out-of-phase across the two ears such that the interaurally inverted frequency transitions result in binaural beats that aid detection. Normal-hearing children aged 4 - 10 years were tested on diotic and dichotic 2-Hz FM detection with carrier frequency (fc) = 500 Hz. The task was 3AFC with stimulus durations of 1.25 sec. Presentation level was 65 dB SPL. Detection thresholds were generally lower for the dichotic than diotic configuration, and more so for the older children. Detection thresholds improved with age, and performance for the older children approached that of young adults. Use of TFS cues was supported by reference adult data where the dichotic benefit was evident for fc = 500 Hz but not for fc = 5000 Hz. This study demonstrates that developmental effects for temporal processing extend to TFS measures.

Poster # 113

Effects of Blast Exposure and mTBI on Central Auditory Processing

Tess K. Koerner, PhD; Melissa A. Papesh, PhD; M. Samantha Lewis, PhD; Frederick J. Gallun, PhD, Va Rr&d National Center For Rehabilitative Auditory Research, Portland, OR
Marjorie R. Leek, Ph. D, VA Loma Linda Healthcare System and Department of Otolaryngology/Head & Neck Surgery, Loma Linda, CA

Previous studies have shown that a history of blast exposure may be related to difficulties understanding speech in complex auditory environments even when peripheral hearing sensitivity is within normal limits. Work from the Gallun lab has suggested that deficits in central auditory processing are uniquely linked to blast-related injury, as a history of mild traumatic brain injury (mTBI) has not been predictive of performance on tests of auditory processing. The current study follows up on this recent work to further explore the effects of blast exposure and mTBI on various tests of central auditory processing and speech perception in noise in a group of blast-exposed participants with or without mTBI, a group of non-blast-exposed participants with mTBI, and a group of control participants with no history of blast exposure or mTBI. Results showed that a history of blast exposure was significantly related to reduced performance across measures compared to the non-blast-exposed mTBI and control groups. Consistent with previous findings, results showed that a diagnosis of mTBI was not predictive of performance across groups. This work has important clinical implications regarding the identification of central auditory processing issues in those with a history of blast exposure or mTBI.

Poster # 114

Blast-Exposed Veterans with Auditory Complaints: Language Processing and Executive Function

Sheila Pratt, PhD; Malcolm Mcneil, PhD; Elizabeth Haley, AuD; Leslie Zhen; David Jedlicka, AuD, Va Pittsburgh Healthcare System And The University Of Pittsburgh, Pittsburgh, PA
Lindsey Jorgensen, PhD, VA Sioux Falls Healthcare System and the University of South Dakota, Vermillion, SD
Frederick Gallun, PhD; Serena Dann, MA, VA Portland Healthcare System and Oregon Health and Science University, Portland, OR

Preliminary language processing and verbal working-memory and attention results from an ongoing multisite study investigating blast-exposed Veterans will be presented. The blast-exposed Veterans had normal or near normal pure-tone thresholds on standard audiometric testing but substantive hearing handicap. They were enrolled into one of three groups based on the presence of mild TBI (mTBI) and PTSD: mTBI-only, PTSD-only, and PTSD+mTBI. A control group of Veterans with no history of blast-exposure or hearing handicap also was included. The participants completed a large battery of assessment procedures that targeted various levels of the auditory system, and cognition/language. This poster will focus on the results from the listening, reading and Stroop versions of the Computerized Revised Token Test (CRTT; McNeil, et al, 2015) administered in quiet and in speech babble. These results captured and will be presented relative to the impact of background speech babble on language processing across auditory and visual modalities per group, and the impact of mTBI and PTSD on language processing and executive function.

Poster # 115

Visual Distraction Costs: Aging and Cochlear Implants

Anna Tinnemore, AuD; Gavin Mahoney; Matthew J. Goupell, PhD; Sandra Gordon-salant, PhD, University Of Maryland, College Park, College Park, MD

Listeners use visual cues to enhance their speech understanding, especially in challenging listening environments. In real-world listening situations, visual distractors are often present and may be relevant for a secondary task. Older listeners are likely more affected by distractions than younger listeners due to age-related deficits in selective attention and inhibition, especially for challenging talkers (i.e., those with accents). However, listeners with hearing loss may develop proficiency integrating audio and visual information and thus minimize the influence of visual distractors. In this study, we report the effect of salient visual distractors on recognition of accented speech by younger and older normal-hearing listeners, as well as in listeners who use cochlear implants (CIs) compared to age-matched listeners presented with vocoded speech. The latter two groups receive a spectrally degraded signal and must make use of auditory temporal cues and visual information to perform this task. Listeners performed speech recognition tasks in four conditions: Auditory-only, Auditory-Visual (AV), AV with visual distraction, and AV + distraction + a secondary task. We report the effects of age, CI experience, and vocoding on these tasks. Our findings have relevance for the auditory rehabilitation of older listeners and those using CIs.

Poster # 116

Auditory Distraction and Working Memory under Cognitive and Perceptual Load

Erin Lynch, BS; Jeffrey Digiovanni, PhD, Ohio University, Athens, OH

Successful interpretation of acoustic information requires both attentional and working memory (WM) resources. Acoustic schemes are often complex and include more than a single stream of information. When goal-irrelevant stimuli interfere with WM and attentional processing, auditory distraction occurs. Existing research has primarily focused on cross-modal interference through auditory-visual paradigms, distraction specific to the auditory domain has not been well studied. Results from previous literature have demonstrated that the target-distractor semantic relationship, individual cognitive capacity

limitations, and load type individually contribute to differences in distractibility. This study employed a novel method of evaluating various cognitive and perceptual loads for both attentional and WM processes specific to the auditory domain. Findings suggest that under high perceptual load WMC is not indicative of distractibility, yet under cognitive load and in the presence of semantic target-distractor relationships WMC highly inform distractor effects. The aims of the current study were to provide data specific to auditory distraction and to draw connections among existing theories separately considering capacity limitations, load differences, and target-distractor relationships.

Poster # 117

Dichotic Listening in Patients with Auditory Hallucinations
Sarah MacKenzie, BS; Liza Clark; Kayla Ichiba; Frank Musiek, PhD, University Of Arizona, Tucson, AZ

Findings of decreased volume of the auditory cortex in individuals with auditory hallucinations (AH) has triggered interest from those involved in basic and applied hearing science. Also, the prevalence of AH is much greater than often considered with 7.3 per cent of the general population reporting this condition. In addition, there have been insightful findings on dichotic listening tasks obtained from those with AH. Therefore, this current study sought to perform a systematic extensive literature search and analysis of data obtained on dichotic listening in patients with AH and compromised auditory cortices. A total of 21 studies (761 participants) were found via software and manual literature searches of which 16 were accepted for analysis. Fourteen out 16 studies demonstrated statistically significant poorer performance on dichotic listening than the control groups. In 13 out of these 14 studies there was a right ear deficit or absent right ear advantage. These findings are compelling in two regards: 1- the sensitivity of dichotic listening to possible underlying cortical dysfunction and 2- the right ear deficit implicates the left auditory cortex as the site of involvement, consistent with previous cadaver and current fMRI data for those with AH.

COCHLEAR IMPLANTS

Poster # 118

Comparing Cochlear Implant Users' Vocal Control Across Tasks
Elizabeth Abbs; Abbigail Buente; Emilyann O'brien; Bailey Harmon; Justin Aronoff, PhD, University Of Illinois At Urbana-champaign, Champaign, IL

Bilateral cochlear implant (CI) users exhibit difficulties controlling the fundamental frequency (F0) of their voice when asked to produce a sustained vocalization. This difficulty with vocal control may be task specific, or it may reflect a general deficit in vocal control that generalizes across tasks. To compare the ability of CI users to maintain a stable F0 across vocal tasks, 8 bilateral CI users were tested using their clinical programs. They were instructed to complete two tasks: 1) maintain a steady state vocalization of the sound ‘ahh’, and 2) sing the song "Happy Birthday." To analyze their vocal control, F0 variability was extracted from both steady state vocalizations and from within individual notes of the song. Preliminary results found that the variability in steady state vocalizations correlated with the variability within individual sung notes. This suggests that CI users' vocal control difficulties reflect a general difficulty that influences vocal production across varying tasks.

Poster # 119

A CROS Aid for Patients with a Single CI

Michael Dorman, PhD; Sarah Natale, MS; Kalee Easter, Arizona State University, Tempe, AZ
Smita Agrawal, PhD, Advanced Bionics, Valencia, CA

At issue in this project was the relative value, in terms of speech understanding in noise when signals are not stationary in space, of two additions to a single CI -- an expensive addition, i.e., a second CI and a less expensive addition, i.e., a wireless CROS aid. Seven listeners fit with bilateral CIs were tested in three conditions: a single CI; bilateral CIs; and with a single CI and a CROS aid (Nadia Link CROS, Advanced Bionics). Testing was completed in the R-Space TM listening environment with restaurant noise presented from 8 loudspeakers surrounding the listener. Sentence material was presented from speakers at 0, -90 and +90 degrees azimuth. With a single CI, speech understanding was best when material was presented to the CI ear, was significantly poorer for signals in front and was poorest for signals presented contralateral to the CI ear. Both bilateral CIs and a CROS aid 'solved' the roving speaker problem: Intelligibility was the same for all loudspeaker locations. Given the large difference in cost, the CROS aid system is a cost effective solution for a common problem experienced by patients fit with a single CI.

Poster # 120

Aging Effects on ECAP Growth in Cochlear Implant Users

Bruna Mussoi, PhD, Kent State University, Kent, OH
Carolyn Brown, PhD, University Of Iowa, Iowa City, IA

Electrically Evoked Compound Action Potential (ECAP) growth functions illustrate how the amplitude response of the auditory nerve changes as a function of stimulation level, and can be recorded in cochlear implant (CI) users without the need for additional instrumentation. ECAP growth functions have been shown to reflect peripheral neural status in animal models (Pfingst et al 2014). A steeper ECAP growth function suggests that with increasing stimulus level, more auditory nerve fibers are available and able to respond to the stimulus. Recent studies have suggested that the aging process may lead to the selective loss of low spontaneous rate auditory nerve synapses followed by the fibers, which code stimuli presented at high levels (Sergeyenko et al, 2013). Thus, it might be expected that older CI users would show flatter ECAP growth curves, especially at higher stimulation levels. To test this hypothesis, this study compared ECAP growth curves obtained at a mid-array electrode for 10 younger (post-lingually deaf) and 10 older experienced Nucleus CI users. Age-related differences in slope of the ECAP growth function will be quantified and discussed. In addition, the relationship between ECAP growth slopes and speech perception in noise performance on the QuickSIN test will be examined.

Poster # 121

Perception of Contrastive Stress in Vocoded Speech

Alix Klang, BA; Hannah Herd, MA; Arlene Carney, PhD; Edward Carney, PhD, University Of Minnesota, Minneapolis, MN

The purpose of this study was to determine the effect of reducing periodicity cues on the perception of contrastive stress (CS) in vocoded speech. CS is a suprasegmental feature of speech used to signal a difference from what is expected through the emphasis of a single word in relation to other words in a sentence. Four talkers (two male and two female) produced sentences that varied word stress within the sentence in response to a question. Stimuli were analyzed acoustically to measure F0, intensity, and duration cues. Listeners heard the stimuli with low-pass filter cutoffs of 50, 160, and 250 Hz and judged whether sentences had stress on the subject, verb, or object or no stress. We found significant perception effects for filter condition, talker, and syntactic place, as well as a significant interaction of talker by syntactic place. These results suggest that the perception of CS in vocoded speech is influenced by the availability of periodicity cues primarily conveyed by F0, talker variation, and the syntactic place of the stressed word in a sentence. The results may partially explain the range of performance experienced by cochlear implant users in tasks that test the perception of suprasegmental cues.

Poster # 122

Aging and Spectral Degradation Effects on Processing of Temporal Cues
Casey Gaskins, BA; Lindsey Roque; Matthew Goupell, PhD; Samira Anderson, PhD, Hearing And Speech Sciences At The University Of Maryland College Park, College Park, MD

As one ages, the ability to process the temporal components of auditory signals becomes increasingly difficult, negatively affecting speech understanding abilities. Speech understanding may further decrease when acoustic information is spectrally degraded, as experienced by older cochlear-implant (CI) users. The present study assessed effects of aging and spectral degradation on the perception and neural representation of the words 'dish' and 'ditch.' Perceptual identification functions were obtained to a continuum that varied the duration of the silent interval in 10-ms intervals from 0 ms (dish) to 60 ms (ditch) in unprocessed and eight-channel sine vocoded conditions. The 50% crossover points on the identification function were later and the slopes were shallower for vocoded compared to unprocessed stimuli, and these effects were more pronounced in older compared to younger listeners. Frequency-following responses (FFRs) were recorded to the endpoints of the dish-ditch continuum and were analyzed using stimulus-to-response (STR) correlations and phase-locking factor (PLF) analyses. STR correlations and PLF values were lower for vocoded than unprocessed stimuli, and aging exacerbated these differences. Higher PLF values related to earlier crossover points for both unprocessed and vocoded conditions. These data have implications for older CI users who mainly rely on temporal information to understand speech.

Poster # 123

Duration of Daily Cochlear Implant Use on Initial Speech Perception
Margaret Richter, BA; Margaret Dillon, AuD; Meredith Rooth, AuD, UNC Department Of Otolaryngology/ Head And Neck Surgery, Chapel Hill, NC

Cochlear implant patients are counseled to listen with their cochlear implant during all waking hours to experience improved performance. However, there is limited evidence on duration of device use and early performance growth. Understanding this relationship can assist the clinician's ability to counsel

patients on realistic expectations and various factors that can influence their performance. To examine this relationship, datalogging results were compared against early speech perception performance. Preliminary data suggests that subjects who listen at least 10 hours per day experience similar performance with their cochlear implant.

Poster # 124

How Binaural Hearing affects Listening Effort in Normal Hearing Listeners

Emily Burg, BS; Tanvi Thakkar; Sara Misurelli, PhD; Ruth Litovsky, PhD, Waisman Center, University Of Wisconsin-madison, Madison, WI

Binaural hearing facilitates both improved speech perception in noise, and precision in sound localization abilities compared with monaural hearing. Individuals with single-sided deafness do not have access to the benefits of binaural hearing, yet sound localization and speech understanding, in some conditions, improves after they receive a cochlear implant (CI) in their deaf ear. However, performance in these spatial tasks does not capture how much effort listeners expend. Listening effort is a component of processing where cognitive load is impacted by a behavioral listening task. This can be objectively measured using pupillometry, the measure of pupil dilation. Hearing impaired listeners frequently report elevated levels of effort while trying to listen and understand speech, which can have negative consequences. This study employed pupillometry to investigate whether binaural hearing leads to a release from effort compared to listening with only one ear during a speech-in-noise task in normal hearing listeners. Results suggest that binaural hearing facilitates a release from effort compared to monaural hearing, even when one ear is provided with a degraded version of the speech signal, similar to a signal processed through a CI.

Poster # 125

Impact of Scalar Location on Number of Available Spectral Channels

Katelyn Berg, BA; Jack Noble, PhD; Benoit Dawant, PhD; Robert Labadie, MD; Rene Gifford, PhD, Vanderbilt University, Nashville, TN

This study investigated the impact of scalar location on the number of electrodes needed for maximum speech understanding and sound quality in adult CI recipients. Electrode placement was determined by CT imaging using validated CI position analysis software (Noble et al, 2014) in 11 implanted ears, 7 ST perimodiolar and 4 STSV perimodiolar (planned enrollment = 14, 7 ST, 7 STSV). CI programs with active electrode counts ranging from 4-22 were created based on the methods of Friesen et al. (2001). Speech understanding, spectral resolution, and sound quality was assessed. Both ST and STSV receipients demonstrated asymptotic performance with 16-22 electrodes for CNC words and AzBio sentences in quiet ($p < 0.05$). ST recipients achieved asymptotic performance on AzBio sentences at +5 dB, consonants, and vowels with 16-22 electrodes, whereas the STSV recipients reached asymptote with 8-10 electrodes ($p < 0.05$). ST recipients also achieved significantly higher scores than STSV recipients on measures of vowel recognition (60% vs. 36% correct), sentence recognition in noise (56% vs, 25% correct), and spectral modulation detection (68% vs. 58% correct). Clinical implications regarding device selection and clinical software settings to consider will be discussed.

Poster # 126

Mechanisms underlying Speech Masking Release in Hybrid Cochlear Implant Users
Viral Tejani, AuD, University Of Iowa Hospitals And Clinics, Iowa City, IA
Carolyn Brown, PhD, University Of Iowa, Iowa City, IA

Hybrid cochlear implant (CI) users utilize low-frequency acoustic and high-frequency electric stimulation in the implanted ear, outperform traditional CI users in speech perception in noise (Gantz et al., 2017), and show 'masking release,' an improvement in speech recognition in fluctuating noise relative to steady noise (Turner et al., 2004). Improved performance in noise has been attributed (but not proven) to the spectral resolution and temporal fine structure (TFS) provided by acoustic hearing. Spondee recognition in two-talker and ten-talker babble was assessed in Hybrid CI users, and masking release was calculated as the percent difference in performance in two-talker (easy condition) and ten-talker (hard condition) babble. Spectral ripple density discrimination thresholds and fundamental frequency discrimination limens was also assessed, as these psychophysical measures reflect underlying spectral resolution and TFS and correlate with speech perception in noise in traditional CI users (Won et al., 2007; Goldsworthy et al., 2013; Goldsworthy, 2015; Jeon et al., 2015). Preliminary data suggest masking release is possible in Hybrid CI users, and that psychophysical measures and masking release may be correlated, suggesting a role of spectral resolution and TFS in masking release. The extent of residual hearing also appears to correlate with psychophysical and masking release performance.

ELECTROPHYSIOLOGIC RESPONSES

Poster # 127

Narrow Band LS-Chirp for ABR in Pediatric Hearing Assessment
Doris Lewis, PhD; Jessica Marchiori; Warlesson Gonalves, PUC-SP

Introduction: New Technologies in ABR recordings, as the stimulus NB LS CE-Chirp can optimize the results for different intensities with larger amplitudes, and minor correction factors, compared to tonebursts. Goal: to describe latencies and amplitudes when NB LS CE-Chirp stimulus was used in ABR recordings. Method: The study was conducted at Centro Audição na Criança (PUCSP); 6 boys and 7 girls normal hearing were tested. NB LS CE-Chirp stimulus was used for 500, 1000, 2000 and 4000 Hz, stopping criteria was residual noise under 0.40nV, FMP equal or higher than 3.1, maximum 3000 sweeps. Ethics Committee (PUC-SP) approved the project under the number 1.908.319. Results: Average latencies found were: 500 Hz 6.44ms (80 dBnHL); 7.90ms (60 dBnHL), 8.00ms (40 dBnHL) and 7.98ms (20 dBnHL); in 1000 Hz 6.24ms (80 dBnHL), 6.78ms (60 dBnHL), 6.73ms (40 dBnHL) and 8.16ms (20 dBnHL); 2000 Hz 6.47ms (80 dBnHL), 6.83ms (60 dBnHL), 7.41ms (40 dBnHL), 8.21ms (20 dBnHL), and 8.75ms (10 dBnHL); for 4000 Hz 6.33ms (80 dBnHL), 6.98ms (60 dBnHL), 7.66ms (40 dBnHL), 8.62ms (20 dBnHL), and 9.19ms (10 dBnHL). Amplitudes will be described in the pôster. Conclusion: NB LS CE-Chirp stimulus showed to be efficient in ABR recordings for children.

Poster # 128

Maturation of Octave-Band CE-Chirp ABR Latency in Newborns and Infants

Sinnet G B Kristensen, MA; Sren Laugesen, PhD; James M Harte, PhD, Interacoustics Research Unit, Kongens Lyngby
Inga Ferm, MS, Croydon University Hospital, Croydon
Guy Lightfoot, PhD, ERA training & Consultancy Ltd, West Kirby, Wirral

Currently there are no published normative data on the maturational effect on auditory brainstem response (ABR) wave V latency to octave band CE-Chirps in newborns and infants. ABRs from newborns and infants were previously recorded using octave band CE-Chirps at center frequencies of 0.5 kHz, 1 kHz, 2 kHz and 4 kHz and made available for analysis for this project. Data were collected using the Interacoustics Eclipse EP25 ABR system at 0-50 dB nHL. The population were recruited after failing newborn hearing screening as part of their referral for threshold estimation ABR. Data were recorded from 30 (0.5 kHz), 59 (1.0 kHz), 31 (2.0 kHz) and 63 (4.0 kHz) ears respectively at the different octave-band CE-Chirp center frequencies. Stimuli were presented using a TDH39 headphone and correction factors applied to compare the data to normative adult ABR latencies recorded with the ER-3A insert earphone. Only newborns and infants found to have normal hearing were included in the data analysis and wave V latency were determined by an experienced evaluator following the NHS guidelines. The maturational effect in the newborns and infants shows, as expected, reducing latency with age. This study provides age-specific normative ABR latency data for the octave-band CE-Chirps.

Poster # 129

Residual Noise using Intelligent Hearing and Vivosonic Integrity ABR Systems

Julie Thein, BS; Joseph Vasey; Linda Norrix, PhD; David Velenovsky, PhD, The University Of AZ, Tucson, AZ

Various averaging and noise reduction techniques are employed by instrument manufacturers to reduce unwanted noise (e.g., physiologic noise from movement, electromagnetic noise from other equipment, electrical activity of the brain) during the recording of an auditory brainstem response (ABR). The remaining residual noise must be low enough to allow the detection of a threshold ABR that is small in amplitude. In this study, we compare residual noise (RN) measures obtained using artifact rejection as implemented on the Intelligent Hearing System (IHS) to Kalman weighting, the Amplitrode, and Bluetooth technologies as implemented on the Vivosonic Integrity System (VIS) under quiet and active subject motor states. Recordings were obtained simultaneously so that any motor activity influenced both IHS and the VIS recordings similarly. All recordings were performed without an evoking stimulus. Pilot data show that the RN is very similar for the VIS and IHS systems when subjects are in a quiet activity state. When subjects are not in a quiet state, the VIS shows an advantage over the IHS. Findings will be discussed by examining the effectiveness (the RN level obtained using the noise reduction strategy) and efficiency (the time it takes to reach a low RN criterion) of each system.

Poster # 130

Oddball cABR and Attention in Young Adults

Katharine Fitzharris, PhD; Jackie Davie, PhD, Nova Southeastern University, Fort Lauderdale, FL

The complex auditory brainstem response (cABR), fast neural responses to speech stimuli, have been a promising evaluation tool for individuals with auditory processing disorders (APDs); however, due to time, equipment, training, and fiscal constraints, these measures have yet to obtain widespread clinical adoption. While both the traditional ABR and the cABR have been used to demonstrate differences in lower brainstem function in individuals with and without APD, studies have yet to explore if top-down effects can be successfully measured with the cABR in clinical populations. As a first step, the purpose of this study was to examine the utility of the oddball testing paradigm with the cABR to evaluate the measurable effects of attention on auditory brainstem activity. Twenty young adults with normal hearing were evaluated in two attention conditions (forced and unforced attention); cABRs were recorded to the speech syllables /ba/ and /da/ and analyzed relative to the peak amplitudes and latencies of characteristic waveforms (V, A, C, D, E, F, O). Preliminary results indicated quantifiable top-down influences on the cABR, e.g., earlier and larger peaks, in this young adult group. Future studies will utilize this paradigm in the evaluation of children with normal hearing as well as APDs.

Poster # 131

Frequency-Following Responses Elicited by Chinese Consonant-Vowel Combinations
Kristin Stump, BS; Fuh-cherng Jeng, PhD, Ohio University, Athens, OH

Frequency-following response (FFR) has been widely used to assess the mechanisms of speech processing with in the brainstem for speakers of tonal and non-tonal languages. In the literature two types of recording stimuli have been used to evoke FFRs, either by using consonant-vowels with a fixed intonation or by using a vowel with varying intonation, but not both. The goals of this study were to (1) determine the feasibility of recording FFRs with consonant vowel combination of a stop consonant /d/ and the vowel /i/ with varying intonation, and (2) examine the characteristics of speech processing for adults who speak a tonal language. Nineteen Chinese adults were recruited for this study between the ages 20 and 40 years of age. The FFR was elicited using the consonant /d/ combined with the vowel /i/ with a varying pitch contour (i.e., different intonation patterns) for a total of 8000 sweeps from each participant. From the recordings, tracking accuracy was computed to estimate the frequency tracking acuity (i.e., how closely the responses resembled the pitch contours of the stimuli). Results indicated feasibility of forging a consonant-vowel and intonation in a combined stimulus and significant subcortical responses were observed among the four intonation patterns.

Poster # 132

Age Effects on Neural Representations of Vowel Duration Speech Cues
Lindsey Roque, BS; Samira Anderson, PhD; Logan Fraser, University Of Maryland, College Park, College Park, MD

Age-related degradation in temporal processing may contribute to older adults' speech understanding difficulties. Previous studies have demonstrated that older adults experience increased difficulty discriminating between contrasting words that differ in brief temporal cues compared to younger adults. These difficulties may arise in part from reduced encoding of temporal envelope modulations and fine structure, limiting access to temporal and spectral information, respectively, that may contribute to accurate discrimination. Reduced precision of phase locking in the auditory midbrain may be responsible

in part for these limitations. The present study examines the neural mechanisms underlying older adults' temporal processing deficits using electrophysiological responses and perceptual judgments of contrasting words differing in vowel duration preceding the final plosive ('wheat' vs. 'weed') in younger and older adults with normal hearing. To assess neural representation, phase locking factor values were derived from frequency-following responses recorded to 'wheat' and 'weed.' To assess perception, identification functions were obtained for a 9-step continuum that varied in vowel duration, from 93 ms ('wheat') to 155 ms ('weed'). Increased phase locking was correlated with earlier 50% crossover points in the identification functions, suggesting a mechanism for the perceptual deficits noted for certain duration speech contrasts in older compared to younger adults.

Poster # 133

A Review of Diagnostic Indices of the Middle Latency Response
Bryan Wong, BS; Alyssa Everett; Aaron Whiteley; Frank Musiek, PhD, University Of Arizona, Tucson, AZ

Over the past 30 years, the MLR has accumulated numerous studies showing its value in defining dysfunction of the central auditory nervous system (CANS). In reviewing previous work on the MLR, a question regarding diagnostic effectiveness between inter- and intra-subject methods and stability of this auditory evoked response has been raised. In order to answer this question, a systematic literature review and analysis was performed using several databases and manual technique with a focus on sensitivity/specificity of the MLRs. Specifically, inter-subject measures (absolute amplitude, latency, presence/absence of Na/Pa complex) were compared to intra-subject measures (electrode and ear effects), in neurological populations (multiple sclerosis, traumatic brain injury, and various vascular pathologies). Intra-subject indices showed reduced variability and better sensitivity compared to inter-subject indices. Specifically, the electrode effect was the most sensitive intra-subject measure. For both intra-subject and inter-subject indices, amplitude was far more sensitive to CANS dysfunction than latency measures. Over the years, one of the concerns in the utilization of the MLR in the clinic and lab has been the variability in its results. However, in using intra-subject indices, the MLR appears to be a relatively sensitive tool to defining dysfunction in patients with confirmed CANS disorders.

Poster # 134

Auditory Training with Cochlear Implants: Changes in Brain and Behavior
Eun Kyung Jeon, PhD, University Of Utah, Salt Lake City, UT
Rachel Scheperle, PhD, Montclair State University
Bruna Mussoi, PhD, Kent State University
Kylee Mcfarlin, AuD; Virginia Driscoll, MA; Kate Gfeller, PhD; Carolyn Brown, PhD; Paul Abbas, PhD, University of Iowa

This study evaluated the effects of (1) short- and long-term music training, and (2) short-term spectral training in cochlear implant (CI) users. Outcome measures included related behavioral and electrophysiological (cortical: auditory change complex; ACC) spectral discrimination measures. Speech-in-noise was included to evaluate generalization. Experiment I. Eight CI users completed a short music-training session in the laboratory, followed by an adaptive, at-home music-training program. The one-month program involved 45-min sessions working through computer modules on pitch, timbre and

melodies, completed three times/week. Significant improvements following training were observed in a subset of behavioral measurements and in normalized ACC amplitudes. Changes in pitch discrimination were correlated with ACC amplitudes. Experiment II was designed because (1) short-term training appeared more effective than long-term training, and (2) the largest improvement was observed in the measure identical to the training task: musical note discrimination. Experiment II. Seventeen CI users completed short-term training focused on spectral modulation depth discrimination. Significant improvement on a behavioral discrimination task was observed post training. ACC amplitudes did not change following training. Results demonstrate that auditory training in musical and non-musical contexts can affect auditory processing. These effects can be observed in behavioral and electrophysiological measures to varying degrees across individuals.

HEARING LOSS / REHABILITATION

Poster # 135

Exploring the Identities of People Who Use Hearing Aids
Shea Long, BS; Brittan Barker, PhD; Kristina Scharp, PhD; Caitlyn Ritter, Utah State University, Logan, UT

In this study, we aimed to determine the identities that adults with hearing loss construct when telling stories about their experiences with hearing loss (HL) and hearing aids. Understanding these identities is important, considering who a person believes him or herself to be has implications for how they approach their healthcare as well as their personal well being (McAdams, 2006; Westby & Calatta, 2016). We employed a qualitative design and interviewed 30 adults with HL who self-identified as satisfied users of their hearing aids and accompanying accessories. We then used thematic narrative analysis (Braun & Clarke, 2006), to uncover reoccurring themes across the stories collected. These themes allowed us to assign identities to the hearing aid users. These findings are a first step to improving theoretical and clinical insights into the perspectives of satisfied hearing-aid users' perspectives and experiences following diagnosis of their HL and their hearing aid fitting. Such insights could ultimately improve audiologists' abilities to help adults with HL seek out, implement, and follow-through with family patient-centered healthcare.

Poster # 136

Application of Various NIH PROMIS Questionnaires for Single-Sided Deafened Individuals
Elizabeth Elkins, AuD; Stacey Watson, AuD; Alexandra Parbery-Clark, PhD, Swedish Medical Group, Seattle, WA
Jake Hillyer, Oregon Health Science University, Portland, OR
Anne Harvey, University of Washington, Seattle, WA

The National Institutes of Health (NIH) Patient-Reported Outcomes Measurement Information System (PROMIS) was developed to establish benchmarks for symptoms across chronic conditions as well as identify clinical thresholds for action or document meaningful change (i.e., improvement or decline). While it is well-documented that single-sided deafened (SSD) adults experience greater listening difficulties relative to normal hearing individuals, little is known about the impact on self-reported cognitive and executive function. Here we administered PROMIS questionnaires focusing on subjective

reports of executive function, cognition and social roles as well as a well-established, clinically relevant auditory-based questionnaire which has previously documented SSD listening difficulties (Speech, Spatial and Qualities of Hearing Scale or SSQ) to a group of SSD individuals (n=14) and a normal-hearing control group (n=8). As expected, individuals with SSD reported hearing difficulties in all subcategories of the SSQ. Conversely, the PROMIS questionnaires demonstrated no significant differences in response between SSD and NH groups. These findings suggest that the PROMIS instruments administered are not sensitive metrics for individuals with the chronic condition of SSD. Future directions of this investigation would include validating these PROMIS instruments for individuals with varying degrees of bilateral hearing loss, with and without usage of amplification.

Poster # 137

Hearing Impairment and Daily-Life Fatigue: A Qualitative Study

Jack Holman, MS; Graham Naylor, PhD, Mrc/cso Institute Of Hearing Research - Scottish Section, Glasgow
Avril Drummond, PhD, School of Health Sciences, University of Nottingham, Nottingham

Research into the impact of hearing impairment (HI) on fatigue is scarce and has focused mainly on fatigue as developed through increased cognitive effort in those with HI. The purpose of this study is to investigate the real world experiences of fatigue for those with HI. Semi-structured interviews were conducted with 14 participants using purposive sampling to encompass variations in age, hearing loss, gender, and employment status. Five themes emerged from Thematic Analysis: 1) the impact of HI on relationships with others 2) Increases in both cognitive and physical effort due to HI 3) Fatigue as driven by either effort, emotion or sleep deprivation 4) Coping strategies to avoid fatigue such as withdrawal from taxing situations or planning beforehand 5) The impact of hearing aids on fatigue and general well-being. The results highlight that hearing-related fatigue manifests itself in different ways in different people, perhaps modulated by the level of challenging activities encountered and utilisation of successful coping strategies. It also appears that emotions such as frustration and stress play a large role in the development of fatigue for some people, an idea distinct from the traditional research focus of effort-driven fatigue.

Poster # 138

Hearing-Aid Uptake in Severe Tinnitus Patients with Very Mild Losses

Suzanne Kimball, AuD; Carole Johnson, PhD; Jonathan Baldwin, MS; Kristen Barton; Caitlyn Mathews, University Of Oklahoma Health Sciences Center, Oklahoma City, OK
Jeffrey Danhauer, University of California Santa Barbara, Goleta, CA

Background Information: Persons with mild sensorineural hearing loss (MSNHL) may have significant tinnitus. Purpose: To describe patients with MSNHL and determine factors that predict hearing-aid uptake (HAU) (i.e., purchased and kept). Research Design: Retrospective chart review with regression modelling. Study Sample: Patients presenting to a tinnitus specialty clinic from 2015 to 2017. Data Collection and Analysis: Step-wise logistic regression conducted on data from charts. Results: N = 135; 2/3 had MSNHL (M age = 53 y; SD = 15) with ~50% of them having severe-to-catastrophic tinnitus (THI). FFPTA and age were significantly positively associated with HAU, but tinnitus severity was inversely related. Odds of receiving hearing aids was 1.14 (95% CI: 1.01, 1.27) times higher per yearly increase in

age and 1.48 (95% CI: 1.17, 1.86) per one point increase of FFPTA, but 0.35 (95%CI: 0.13, 0.95) times less per one point increase of tinnitus severity score. Conclusions: Hearing aid use may not be always be appropriate or desired for this sample of young adults with MSNHL and very severe tinnitus; extensive counseling and follow-up are required for this special population. These results likely would not generalize to and would differ from patients seen in routine audiology clinics.

Poster # 139

Prevalence of Use of Cognitive Screening Tools in Audiological Examinations

Karen Martin, MS; Patti Johnstone, PhD; Mark Hedrick, PhD; Katie Faulkner, University Of Tennessee Health Science Center, Knoxville, TN

Screening for cognition is a suggested guideline in the field of audiology, but is not a regular part of the protocol for hearing evaluations. This could have an impact on older patients who may have unidentified cognitive issues in addition to a hearing impairment. The lack of implementation of this guideline could because of a breakdown in knowledge translation (KT). A survey focusing on cognitive screening was developed and distributed to over 900 audiologists who perform hearing aid evaluations with the older population. The purpose was threefold. First, to investigate the prevalence of use of a cognitive screening tool when doing hearing aid evaluations with adults aged 65 years and older. Secondly, to identify any barriers which may exist that prevent the use of a cognitive screening tool; and thirdly, to determine where along the KT path this concern is situated. Results indicated that most audiologists who work with the older population currently do not use a cognitive screening tool. Barriers include a lack of access to the tools and a sense of discomfort and uncertainty in managing and presenting the results. Although awareness was somewhat of a contributing factor, the greater factors were found to be adherence and adoption.

Poster # 140

Differences in the Association of Depression and Disability by Hearing Ability in Older Adults

Nicole Armstrong, PhD, Johns Hopkins Center On Aging And Health, Baltimore, MD
Jennifer Deal, PhD, Johns Hopkins Bloomberg School Of Public Health
Stephen Kritchevsky, PhD, Gerontology and Geriatric Medicine, Sticht Center for Healthy Aging and Alzheimer's Prevention, Wake Forest School of Medicine, Winston-Salem, NC
Sheila Pratt, PhD, Communication Science and Disorders, University of Pittsburgh, Pittsburgh, PA
Tamara Harris, MD, Intramural Research Program, NIA, Bethesda, MD
Lisa Barry, PhD, Center on Aging, University of Connecticut Health Center, Framington, CT
Eleanor Simonsick, PhD, Intramural Research Program, NIA, Baltimore, MD
Frank Lin, MD, Department of Otolaryngology-Head & Neck Surgery, Johns Hopkins School of Medicine, Center on Aging and Health, Baltimore, MD

It is unclear whether hearing loss and depressive symptoms increase risk of incident major disability. Joint-effects Cox Proportional Hazards models were used to assess the synergistic effect between hearing loss (mild and moderate/severe vs. normal) and baseline depressive symptoms, defined as either a score of -8 on the 10-item Center for Epidemiologic Studies-Depression Scale (mCES-D) or self-reported antidepressant use, on onset of incident major disability among 2,035 Health, Aging and Body

Composition Study participants. The model was adjusted for age, race, sex, education, history of diabetes and hypertension, body mass index, and hearing aid use. Those with normal hearing and no depressive symptoms served as the reference group. Those without depressive symptoms and with mild hearing loss (Hazard Ratio, [HR]: 1.25, 95% Confidence Interval, [CI]: 1.02, 1.55) or moderate/severe hearing loss (HR: 1.38, 95% CI: 1.07, 1.77), had increased risk of incident major disability than the reference group. Risk of incident major disability was over two-fold greater in those with depressive symptoms and mild hearing loss (HR: 2.13, 95% CI: 1.48, 3.06), not moderate/severe hearing loss (HR: 1.17, 95% CI: 0.63, 2.15), as compared to reference group. Hearing loss and depressive symptoms may contribute to risk of major disability onset.

Poster # 141

Americanization of C2Hear Reusable Learning Objects

Preyanca Oree, BA; Michelle Looney; Michelle Arnold, AuD; Theresa Chisolm, PhD; Victoria Sanchez, PhD, University Of South Florida, Tampa, FL
Melanie Ferguson, PhD, University of Nottingham

New hearing aid users remember less than 80%.of information from the orientation visit (Reese & Chisolm, 2005). Thus there is a need for providing information in formats that can be accessed outside of the clinic. The C2Hear Reusable Learning Objects (RLOs; Ferguson et al 2015), developed in England, and accessible via YouTube, address this need. Data demonstrate that use of the RLOs results in increased confidence and knowledge about hearing aids. Thus, the RLOs were utilized in the Aging and Cognitive Health Evaluation in Elders (ACHIEVE; Deal et al., 2016) planning grant to support self-management. Feedback indicated that the RLOs were informative and helpful, but that the British English speakers were sometimes difficult to understand. Thus for future ACHIEVE work, we partnered with the C2H RLO developers to create an 'Americanized' version. The process consisted of script and content review, re-recoding of the audio with an American talker, and the addition of an RLO focused on newer technology, including streamers, and touchscreens. The Americanized RLOs (C2Hear US) were reviewed by participants from the ACHIEVE planning grant. The purpose of this poster is to provide information about RLO modification processes and the results of the review.
http://aja.pubs.asha.org/epdf.aspx?doi=10.1044/1059-0889(2005/009)

Poster # 142

Reverberation and Sound-Source Localization: A Comparison of Common Testing Environments

Lipika Sarangi, MS; Jani A. Johnson, PhD, The Hearing Aid Research Lab, Memphis, TN
Jingjing Xu, PhD, Starkey Hearing Technologies, Eden Prairie, MN

Being able to accurately localize sounds is a fundamental and important function of hearing. Poor sound localization is considered a major contributor to auditory handicap. Previous research has shown that reverberant energy can degrade the accuracy of locating a sound source. But, it is unclear the extent to which the reverberant energy in a sound treated room impacts sound localization performance. The present study explored the differences in horizontal sound localization in sound treated and anechoic rooms. Laboratory localization tests were conducted on forty normal hearing adults, using a 360 , 24-loudspeaker array. Test stimuli were high-frequency and low-frequency filtered sentences, and

performance was assessed in both quiet and noisy environments. Significant differences were observed between environments in one condition: participants performed better in the sound-treated room when stimuli were low-frequency and the environment was quiet. This suggests that researchers and clinicians should take care when comparing localization abilities for low-frequency stimuli to data collected in a more or less reverberant testing environment.

Poster # 143

Hearing Sensitivity, Severity of Cardiovascular Disease Risk, and Neurocognitive Function

Kathleen Bainbridge, PhD, NIDCD, Bethesda, MD
Wassim Tarraf, PhD, Wayne State University, Detroit, MI
Sumitrajit Dhar, PhD, Northwestern University, Evanston, IL
Franklyn Gonzalez Ii, MS, Gillings School of Public Health, University of North Carolina, NC
Martha Daviglus, MD, Feinberg School of Medicine, Northwestern Universiy, Chicago, IL
Hector Gonzalez, PhD, Department of Neurosciences, UC San Diego, La Jolla, CA

We examined whether associations between hearing loss and cognitive function varied by cardiovascular disease (CVD) risk using cross-sectional baseline data from 9180 adults aged 45-74-years of diverse Hispanic/Latino backgrounds from the Hispanic Community Health Study - Study of Latinos (HCHS-SOL). Hearing loss was defined as the better ear pure tone average of 500, 1000, 2000, and 4000 hertz > 25 decibels hearing level (dB HL). CVD risk was derived using a latent class analysis of traditional CVD risk factors. Cognitive tests included the Brief-Spanish English Verbal Learning Test (B-SEVLT)-summary, B-SEVLT-recall, global cognitive function, word fluency, and a digit symbol subtest (DSS), a measure of processing speed and executive function. Hearing loss was independently associated with lower performance on all cognitive tests except the DSS. We found consistent and significant negative interactions between higher CVD risk and hearing loss for the B-SEVLT - sum of trials (interaction (s.e.)=-1.40 (0.54)), B-SEVLT-recall (interaction (s.e.)=-0.58 (0.28)), and global cognitive function (interaction (s.e.)=-2.12 (0.84)), but not for word fluency or the DSS. Higher CVD risk amplifies associations between hearing loss and tests of learning/memory but not executive function among diverse Hispanics/Latinos.

Poster # 144

A Fatigue Scale for Children with Hearing Loss: Initial Development

Benjamin Hornsby, PhD; Maureen Virts; Hilary Davis, AuD; Stephen Camarata, PhD; Fred Bess, PhD, Vanderbilt University Medical Center, Nashville, TN
Sun-joo Cho, PhD, Peabody College of Vanderbilt University, Nashville, TN

Recent studies suggest some children with hearing loss (CHL) are at increased risk for listening-related fatigue. Currently, there are no measures designed specifically to assess listening-related fatigue for CHL. This lack is a significant barrier to improving our understanding of, and developing interventions to reduce, listening-related fatigue and its consequences. This poster describes our ongoing development of a tool to fill this gap- the Vanderbilt Fatigue Scale for Children with Hearing loss (VFS-CHL). We first reviewed the literature and conducted focus groups and interviews with to define the problem from the child's (7-17 years old; n=41), the parent's (n=17) and the teacher/service provider's (n=11) perspectives. Transcripts were coded, analyzed and used to identify prominent domains of listening-

related fatigue for CHL. This information was used to generate potential test items. An iterative evaluation process was used to refine and select an initial pool of 60 test items. These items assessed listening-related fatigue in three domains (Social-Emotional, Cognitive, and Physical fatigue). Responses with this preliminary scale from over 250 participants (71 Children; 149 Parents; 32 Teacher/service providers) have been collected to date and data collection continues. Preliminary analyses of factor structure and item quality, using item response theory, will be discussed.

Poster # 145

Exploring the Relationship Between Hearing Loss and Working Memory

Sara Misurelli, PhD; Ruth Litovsky, PhD, School Of Medicine And Public Health/Waisman Center, University Of Wisconsin, Madison, WI
Erica Bennett, PhD, Henry Ford Health System, Detroit, MI

Executive function (EF) constitutes multiple cognitive components thought to be involved in the regulation and control of purposeful and goal-directed behaviors. EF deficits can lead to the inability to perform everyday tasks. These deficits are exacerbated in complex auditory environments. Previous work suggests individuals with cochlear implants (CIs) perform worse on measures of EF, specifically tasks assessing working memory (WM), than individuals with normal-hearing (NH). The present study aims to understand factors likely to contribute to the gap in performance between CI and NH listeners. Participants completed the NIH-Toolbox List Sort WM Test. All individuals with CIs and half of the NH group was presented the auditory+visual stimuli; the other half of the NH group was presented visual-only stimuli. Results show that the CI auditory+visual and NH visual-only groups had similar scores of WM, suggesting that the CI group, when presented stimuli in two modes, performed similarly to the visual-only NH group. The NH auditory+visual group had the highest mean scores, indicating that auditory input provided important augmentative information for WM. These findings may impact habilitation after cochlear implantation. For example, there may be a benefit from including training of EF in therapy to enhance both auditory and neurocognitive mechanisms.

Poster # 146

An Abbreviated Auditory Working Memory Measure for Potential Clinic Use

Nicolette Bulter, BA; Amanda Thomas; Ashley Light, BA; David Ryan, PhD; Sherri Smith, PhD, Mountain Home Va Medical Center, Mountain Home, TN
Kathleen Pichora-Fuller, PhD, University of Toronto at Mississauga, Mississauga, Ontario

Working memory plays a small but important role in spoken speech comprehension. The amount of working memory capacity for speech understanding has been correlated with speech recognition performance and also with hearing aid outcomes. As such, measures of working memory recently have been advocated for inclusion in the audiological clinic test battery, but few measures are available in the auditory modality that are quick to administer in a busy clinical setting. The purpose of this study was to determine if a newly-developed auditory working memory measure, the Word Auditory and Recognition Recall Measure (WARRM; Smith et al., 2016) could be abbreviated through an alternative presentation paradigm. A group of younger adults with normal hearing and a group of older adults with hearing loss were administered the original 100-item WARRM and an experimental version of the WARRM with an

alternative presentation paradigm. Both listener groups showed similar performances on both versions of the WARRM. Regression analyses indicated that a shortened, alternative presentation of the WARRM revealed equivalent performance as the original WARRM. These findings indicate that an abbreviated WARRM version that takes less than 5 minutes to administer is feasible, thus, increasing the clinical utility of the WARRM.

Poster # 147

Spatial Accessibility of Rehabilitative Hearing Care in Florida

Adele Goman, PhD; Joshua Betz; Nicholas Reed, AuD; Frank Lin, MD; Frank Curriero, PhD, Johns Hopkins University, Baltimore, MD
Brenda Oduola, Towson University, Towson, MD

Hearing loss is a major public health issue affecting nearly two-thirds of adults aged 70+. Yet, the geographic distribution of hearing loss and the spatial accessibility of rehabilitative hearing care, which can require several visits to a hearing professional, remains under studied. Spatial accessibility is a key barrier to hearing care and consists of the availability of providers and the proximity of hearing professionals to patients. The distribution of hearing loss across geographical areas was explored by applying hearing loss prevalence estimates (calculated from existing audiometric data from the National Health and Nutrition Examination Survey) to Florida county level population estimates. We geocoded the practice addresses of active licensed audiologists and hearing aid dispensers in Florida and calculated Spatial Accessibility Indices, accounting for competition and differences in travel inclination across a subset of urban/rural locations to identify underserved areas. With an increasingly aging population, there is an urgent need to plan for the anticipated increase in demand for hearing care services in the coming years. This research has identified areas that could benefit from better access to hearing care services such as more traditional clinic based models or more novel interventions such as community health care workers and telehealth models.

Poster # 148

Cross-Cultural Adaptation of Hearing Loss Self-Management Patient Education Materials

Michelle Arnold, AuD; Alexandra Reichard; Victoria Sanchez, PhD; Laura Westermann; Kalene Gutman; Teresa Chisolm, PhD, University Of South Florida, Tampa, FL

By the year 2050 over 102 million persons of Hispanic/Latino background will reside in the US, roughly equivalent to a quarter of the total population. Hearing loss prevalence among older Hispanic/Latino adults is comparable to that of older Whites. Yet, older Hispanic/Latino adults are less likely to seek hearing healthcare. It is suggested that lack of culturally- and linguistically-appropriate interventions is a significant contributor to unsatisfactory healthcare service delivery and outcomes for those from Hispanic/Latino backgrounds. To address this issue, our objective was to complete a cross-cultural adaption of a "Hearing Loss Toolkit for Self-Management" for use with Spanish-speaking adults seen in a clinical setting. We utilized best practice recommendations from the International Society for Pharmacoeconomics and Outcomes Research (ISPOR)'s Quality of Life - Translation and Cultural Adaptation group to guide our process. Specifically, we engaged in preparation, forward translation, reconciliation, back translation and review, and harmonization according to the ISPOR guidelines,

followed by pilot testing with native Spanish-speakers to check understandability, interpretation, and cultural relevance of the translated Toolkit. The purpose of this poster is to describe each of the steps in the cross-cultural adaptation process, and to provide suggestions for future work in this area.

Poster # 149

Health Literacy in Relation to Hearing Aid Use
Niall Klyn, PhD; Zain Shaikh; Sumitrajit Dhar, PhD, Northwestern University, Evanston, IL

Health literacy may be defined as the ability of an individual to make use of health-related information. Low health literacy is associated with myriad health concerns, such as low use of preventive services, increased rates of hospitalization, and increased health care costs. Previous research in hearing health care (HHC) has shown that patient-oriented information in HHC often exceeds recommended guidelines for typical health literacy levels. However, systematic investigations of HHC patient health literacy are necessary to determine if there is a relationship between health literacy and HHC use. This study examines this relationship using the Health and Retirement Study (HRS) dataset. Health literacy was measured in a subset of the HRS respondents using a modified version of the Test of Functional Health Literacy in Adults. Hearing aid use, hearing ability, and demographic variables such as age, gender, race and ethnicity, and income were collected via self-report. Here we examine patterns of hearing aid use as functions of demographic variables, hearing ability, and health literacy in over 3,000 participants over the course of five years. The consideration of health literacy in hearing health care will be discussed.

HEARING SCIENCE / PSYCHOACOUSTICS

Poster # 150

Perceptual Consequences of Cochlear Synaptopathy in Middle Age
Brooke Flesher; Alexandra Mai; Kelsey Dougherty; Jennifer Simpson; Michael Heinz; Hari Bharadwaj, Purdue University, West Lafayette, IN

It is known that as the body ages, listening in noisy situations becomes increasingly more difficult. Middle-aged people have more difficulty than younger people in complex listening environments, even with similar audiometric thresholds. One hypothesis for why this might be, is age-related cochlear synaptopathy. Cochlear synaptopathy has been robustly observed to occur with normal aging in animals, and in post-mortem studies of human temporal bones harvested at different ages. However, there are currently no clinical assessments to measure cochlear synaptopathy or the perceptual consequences of this phenomenon. Currently, we are evaluating a battery of clinical and laboratory measures by comparing young and middle-aged listeners with matched audiometric thresholds within the normal range. The battery includes both objective physiological measures that correlate with synaptopathy in animal models, and perceptual measures that hypothetically may be sensitive to synaptopathy-mediated loss of redundancy in afferent coding. Here, we discuss our initial findings within these parameters.

Poster # 151

Recognition of Asynchronous Audiovisual Accented Sentences by Older Listeners
Maya Freund, BA; Kelsey Oppler; Alyson Schapira, BA; Sandra Gordon-salant, PhD, University Of Maryland, College Park, MD

Speech recognition in both younger and older adults generally improves when the listener has access to both auditory (A) and visual (V) information. When AV speech is temporally asynchronous, younger listeners are able to integrate the AV information and perceive the speech as synchronous over a 200 ms asynchrony window. Due to this integration, younger listeners maintain speech recognition performance over a range of AV asynchronies. In older adults, AV integration may be more difficult due to slowed auditory temporal processing, resulting in poorer AV asynchronous speech recognition performance, especially when auditory information precedes visual information. The present study investigates listeners' (younger and older normal hearing and older hearing impaired) detection and recognition of AV asynchronous speech over a wide range of asynchronies using unaccented and accented AV sentence materials in noise. Results indicate that age does not affect detection of AV asynchrony. However, younger listeners maintain speech recognition performance over a wider window of asynchronies than do older listeners in both unaccented and accented conditions. This suggests that although the temporal window of integration is similar in younger and older listeners, older adults are unable to make use of this integration as effectively as younger listeners.

Poster # 152

Roving-Level Tone-in-Noise Detection in Listeners with Sensorineural Hearing Loss
U-Cheng Leong, PhD; Douglas Schwarz, MS; Laurel Carney, PhD, University Of Rochester, Rochester, NY

Previous studies of 500-Hz tone detection in reproducible noise show that the use of temporal envelope vs. energy cues depends on the degree of hearing loss in listeners with hearing impairment (Mao et al., 2015). Listeners with normal hearing (NH) and mild sensorineural hearing loss (SNHL) utilize envelope cues that are resilient to roving-level paradigms. These listeners have no rove effects, i.e., their thresholds are similar between fixed- and roving-level conditions. In contrast, individuals with moderate SNHL have rove effects of about 5 dB, or of the rove range, indicating the use of energy cues. To better understand the use of envelope vs. energy cues in listeners with SNHL, this study examined tone-in-noise detection in listeners with NH and SNHL across a broader range of frequencies (0.5-4 kHz) and stimulus levels. Maskers were one-third octave bands of Gaussian noise with a 20-dB rove range. Across all stimulus conditions, NH listeners had no rove effects, and listeners with moderate SNHL had rove effects of 4-6 dB. Listeners with mild SNHL had rove effects that varied with frequency and level, indicating the use of different cues in different conditions. Correlations of tone-in-noise thresholds and clinical measures of hearing function were explored.

Poster # 153

Improving Reliability and Accuracy of Categorical Loudness Scaling Procedures
Sara Fultz, AuD; Tessa Culbertson; Judy Kopun, MA; Stephen Neely; Daniel Rasetshwane, PhD, Boys Town National Research Hospital, Omaha, NE

Although abnormal loudness perception drives dissatisfaction with hearing aids, loudness measurements are not performed during hearing-aid fitting, partly due to concerns regarding reliability and test time. Categorical loudness scaling (CLS) may provide useful information; however, current methods for analyzing CLS data consider inter-subject variability as measurement noise, which leads to less reliable results. We have developed a probability model of CLS perception that uses a multi-category psychometric function (MCPF) to model the statistics of a listener's response. Here, we (1) extend the MCPF approach by using Bayesian inference to select stimulus parameters that are predicted to yield maximum expected information (MEI) during data collection, and (2) assessed the test-retest reliability and accuracy of an adaptive procedure for MCPF-MEI, which utilizes a limited number of trials. Reliability was assessed relative to the International Standards Organization (ISO) adaptive procedure. The fixed-level CLS procedure, which utilizes numerous trials, served as the estimate of the 'true' CLS function for accuracy assessment. Based on 10 participants, reliability and accuracy of the MCPF-MEI test were similar to that of the ISO test. Data from a larger sample size will be reported. Improving the reliability and accuracy of CLS will enhance the clinical acceptability of loudness measurements.

Poster # 154

Time-Course of Click-Evoked Auditory Efferent Activity in Humans

Hilary MacCrae; Sumitrajit Dhar, PhD, The Roxelyn And Richard Pepper Department Of Communication Sciences And Disorders, Northwestern University, Evanston, IL
Sriram Boothalingam, PhD, Department Of Communication Sciences And Disorders And The Waisman Center, University Of Wisconsin-madison, Madison, WI

Stretching from the cortex to the cochlea the auditory efferent system gates afferent information flow via multiple feedback loops. Animal models suggest that this feedback mechanism is implicated in in several auditory tasks ranging from mediating attention to the periphery to protecting the outer hair cells. In stark contrast to the wealth of knowledge about the auditory efferents in animals, there is considerable disagreement on the functional role and clinical relevance of efferents in humans. One reason for this lack of consensus may be due to the variability in assays used to test efferents (e.g., types of otoacoustic emissions [OAEs], stimulus levels, types of elicitors). Therefore, the overarching goal of this work is to build and validate a OAE-based test of bilateral efferents that is also clinically applicable. As such, we used clicks to both evoke and monitor efferent activity. Because clicks are less potent in evoking efferents compared to broadband noise, in the present study we tracked the time-course of efferent activation using clicks (80 dB peSPL; 62.5 Hz rate) to optimize the duration of efferent stimulation using clicks. Preliminary findings suggest a time-course similar to that obtained using noise in prior studies. Further results will be discussed.

Poster # 155

Modern Methods for Using Subjective Hearing Measures in Epidemiology Research

Joshua Betz, MS, Johns Hopkins Bloomberg School Of Public Health - Department Of Biostatistics, Baltimore, MD
Nicholas Reed, AuD, Johns Hopkins University School Of Medicine - Department Of Otolaryngology-Head/Neck Surgery, Baltimore, MD

Jennifer Deal, PhD, Johns Hopkins Bloomberg School of Public Health - Department of Epidemiology, Baltimore, MD
Frank Lin, MD, Johns Hopkins University - Departments of Otolaryngology-Head & Neck Surgery, Geriatric Medicine, Mental Health, and Epidemiology, Baltimore, MD

While hearing loss is a major public health issue, few epidemiological cohort studies obtain self-assessed hearing loss, and even fewer obtain objective audiometric hearing loss. While use of self-assessed hearing loss measures may allow greater exploration of the associations between hearing and health or psychosocial outcomes, proper methods are necessary to avoid bias when using self-reported methods to infer about relationships with audiometric hearing loss. Modern statistical techniques in regression, such as LASSO, can be used to predict the pure tone average (PTA) from self-assessed items and demographics. Variability in audiometric hearing loss for a given level of self-reported hearing loss can be accounted for using measurement error models, potentially mitigating the biases introduced by using subjective hearing measures. We will use audiometric data and self-assessed hearing items from the National Health and Nutrition Examination Survey (NHANES) to predict PTA from widely available demographic variables and self-assessed items, which could quickly be obtained in epidemiologic or administrative datasets, and assess the impact of using a predicted PTA instead of audiometric data to explore associations with health or psychosocial outcomes. Such methods could help translate hearing loss research in epidemiology beyond the availability of audiometry.

Poster # 156

Integrating Spectral-Temporal Cues Across Normal- and Impaired-Sensitivity Cochlear Regions
Blas Espinoza-Varas, PhD; Jacobi Clark; Carol Johnson; Sara Maali; Aubree Newman; Jin Park; Madison Wilson, Communication Sciences & Disorders, Ouhsc, Oklahoma City, OK

For steep-slope, high-frequency sensorineural hearing loss (HFSNHL), hearing-aid prescriptions amplify both the high (H) and the low-to-mid frequencies (M), assuming that patients extract information from normal- and impaired-sensitivity frequency regions and integrate across frequencies. In HFSNHL patients, we stimulated simultaneously normal and impaired regions with complexes consisting of M (1000-1800 Hz, 80 ms, 5-35 dB SL) and H (3127-3864 Hz, 60 ms, 30-dB SL) components, and measured discrimination accuracy for M frequency (dFM), H duration (dTH), or both combined (dFM-dTH). The task presented a standard followed by two comparison complexes, one of which conveyed dFM, dTH, or combined dFM-dTH. Psychometric functions related the probability of correct responses, P(C), to dFM with dTH as parameter or the reverse. P(C) increased directly with the size of dFM or dTH. In the M region, keen frequency discrimination was observed from the outset at very low SLs, possibly resulting from the enlarged cortical representation. As the SL of M increased, P(C) decreased for dFM and improved for dTH, but the overall accuracy for dFM and dTH combined tended to remain constant. Since in the M region, dFM discrimination was more accurate at low than at high SL, M amplification may not improve overall performance.

Poster # 157

Tinnitus Psychoacoustic Measures: Comparing Loudness Matching, Rating, and Scaling

Candice Manning, PhD; Emily Thielman, MS; Leslie Grush, AuD; James Henry, PhD, National Center For Rehabilitative Auditory Research (NCRAR), Portland, OR

Chronic tinnitus is the persistent sensation of ringing, buzzing, or other sounds in the ears or head in the absence of acoustic stimuli. About 20% of people who experience tinnitus report that the sound adversely affects daily living such that clinical intervention is warranted. Numerous clinical studies have reported positive outcomes of various interventions for tinnitus; however, because there is no consensus on how to measure such outcomes, statistical evidence supporting the effectiveness of tinnitus interventions remains inconclusive. Although psychoacoustic measures of tinnitus perception have not been validated for detecting change in tinnitus as a result of intervention, they are used for this purpose nonetheless. The most common of these measures is tinnitus loudness matching. Additionally, non-standardized subjective rating scales of tinnitus loudness (numeric and visual analog) have most often been used to assess outcomes of various types of therapies. Completion of the current study will establish normative standards for measures of tinnitus perception by assessing tinnitus pitch and loudness psychoacoustic testing of 300 individuals over 4 visits (baseline, 1, 3, and 6-month visits). The test-retest reliability of tinnitus loudness matching, visual numeric loudness rating, and constrained loudness scaling of the first 150 participants will be presented.

HEARING TECHNOLOGY / AMPLIFICATION

Poster # 158

Relationship Between Automatic Behavior of Directional Microphone and Auditory Ecology
Sieon Kim, BA; Yu-Hsiang Wu, PhD; Octav Chipara, University Of Iowa, Iowa City, IA
Jingjing Xu, PhD; Jason Galster, PhD, Starkey Hearing Technologies, Eden Prairie, MN
Shareka Pentony, MS, Starkey Hearing Research Center, Berkeley, CA

Although laboratory studies have consistently shown that directional microphone (DM) improves signal-to-noise ratio, evidence supporting DM benefits in the real world is limited. Because the extent to which DM can provide its benefits is highly dependent on environmental contexts (i.e., auditory ecology), one reason for the limited DM benefit in the real world is that hearing aids (HAs) do not activate DM in the right situations at the right time. The purpose of this study is to investigate the relationship between the automatic behavior of DM, communication difficulty, and environmental context. Sixteen adults with hearing loss participated in the study. Smartphone-based Ecological Momentary Assessment, as well as HAs that have a wireless feature to stream real-time data-logging information to smartphones, was used. The results indicate that DM was activated in 12.2% of speech listening situations. For situations wherein listeners reported having difficulty understanding speech, DM was enabled 31.7% of the time. In other words, when HA users need help to better understand speech, DM is not available to them 68.3% of the time. These data may explain why HA users often perceive limited benefit from DM in the real world. The implications of HA fitting will be discussed.

Poster # 159

Speech Clarity Shapes Listener Preferences for Self-Adjusted Hearing Aid Gain
Trevor Perry, Univ. Of Minnesota, Richfield, MN

Peggy Nelson, PhD, University Of Arizona, Minneapolis, MN

For individuals with mild-to-moderate hearing loss, self-adjustment of hearing aid gain has been shown to have little impact on speech recognition when speech is presented at average conversational levels or in noisy backgrounds. However, speech recognition is more sensitive to changes in gain when speech is presented at lower levels. Listeners with mild-to-moderate hearing loss self-adjusted gain while listening to low level speech (45 and 55 dBA) in quiet. Additional gain settings were generated that produced poorer predicted speech recognition than the self-adjusted gain, based on Articulation Index estimates. Listeners completed paired preference comparisons between self-adjusted gain and NAL-NL2 prescribed gain or gain designed to elicit poorer predicted speech recognition. Speech recognition was measured for low level speech in quiet. Preliminary results suggest listeners might not always self-adjust gain to have equivalent intelligibility as NAL-NL2 prescribed gain in all conditions. However, preference data suggest that listeners with hearing loss incorporate a subjective sense of speech clarity when self-adjusting gain as well as when judging overall preferences for gain settings. Additional analyses will examine individual differences in gain preferences and determine trade-offs between speech audibility, comfort, and satisfaction. This work was supported by NIDCD (R01 DC013267-01 to PN).

Poster # 160

Comfort Assessment of Hearing Protection

Vidya Krull, PhD; Andrew Dittberner, PhD, GN Advanced Science, Glenview, IL

Users often need to wear hearing protection devices for long periods during the day. To get effective protection, it is imperative that the user wear these for the entire time that she is at risk of hazardous noise exposure. Discomfort, particularly during long-term wear often results in non-compliance with the use of hearing protection. The purpose of this study was to compare comfort for three hearing protection devices: a GN prototype, Invisio X50, and Silynx Clarus Pro. Ten normal-hearing subjects wore these active devices during the workday and rated devices on a 14 point bipolar comfort scale immediately after fitting, a half hour later, and after 6-8 hours of wear. These ratings were used to generate a 'comfort index' as a metric of device comfort. At the end of the study, users also rated sound quality. Results showed that comfort ratings for the GN prototype device were significantly higher than the other two devices. Perceived comfort decreased with increase in wear time. Sound quality ratings for the GN prototype were also significantly higher than that for Silynx, but not different from Invisio.

Poster # 161

Towards Building a Predictive Model of Comfort

Vidya Krull, PhD; Julien Jonvaux, PhD; Andrew Dittberner, PhD, GN Advanced Science, Glenview, IL

The design and development of device prototypes and subsequent subjective testing to assess comfort in users can be time and cost inefficient. If we were to predict user comfort reliably even in the design phase, we may be able to use this technique to test candidate designs, and only develop those that promise to be comfortable. The purpose of this investigation was to 1) develop a model that simulates the interaction between a simple device and the ear, and 2) to assess the feasibility of this model to predict perceived comfort in an individual. Three earplugs, expected to correspond to three different comfort

levels were selected and scanned to create CAD models. Pinna and ear canals of ten subjects were scanned and merged to create CAD models for each ear. The subjects wore these earplugs and rated them on an 8-item bipolar comfort scale immediately after fitting, and a half hour later. Ratings were used to calculate a 'comfort index'. Finite element models with model assumptions for choice of materials, mechanical properties, and boundary conditions were created. Simulations were run to assess the contact pressure and force when different earplugs were inserted in ears. Preliminary results will be discussed.

Poster # 162

Modulation Spectrum as an Additional Quantifier of Hearing Aid Processing
Petri Korhonen, MS, Widex Orca, Lisle, IL

Advanced signal processing features in hearing aids, such as wide dynamic range compression, digital noise reduction, and directional microphone may affect the spectrotemporal characteristics of the signal at the hearing aid output. Temporal amplitude envelope fluctuation cues play an important role for speech intelligibility, especially for listeners with hearing loss. This study demonstrated that the measurement of modulation spectrum can provide additional insight on the effects of hearing aid processing on temporal envelope that traditional test-box measures may not capture. Measurement of modulation spectrum allows the use of natural speech signal in quiet or in noise at levels, which activate the advanced features in a manner that is expected in real life use. Six commercial receiver-in-ear hearing aids programmed with manufacturers recommended default settings were compared. Effects of hearing aid processing was measured with continuous ISTS speech signal presented at 60, 70, and 80 dB SPL in quiet and in the presence of speech shaped background noise presented from the front or the back. The results showed that modulation spectrum is effective at investigating combined effects of processing on temporal envelope. The measure demonstrated differences in temporal processing in commercial devices despite little differences observed using standard test-box measures.

Poster # 163

Efficacy of a Coupler-Based Hearing-Aid Fitting Approach for Experienced Users
Sherri Smith, PhD; George Spanos, AuD, Mountain Home Va Medical Center, Mountain Home, TN
Todd Ricketts, PhD, Vanderbilt University Medical Center, Nashville, TN

In situ probe microphone real ear aided response (REAR) measurements are the gold standard method of verifying real-ear hearing-aid performance. The current study evaluated an experimental fitting approach for patients receiving replacement amplification. Participants randomly were assigned to one of three groups that completed a 4-week field trial with replacement hearing aids that were received during via face-to-face appointment or via the mail. The devices were verified and validated using either in situ REAR measurements or two alternative real-ear to coupler difference (RECD)-based fittings (incorporating individually measured or average RECDs). All participants had replacement devices re-verified using in situ REAR measures and were administered self-report measures at the conclusion of the trial. Results indicated that the in situ REAR fitting approach provided a good match to prescriptive targets (3 dB). In situ REARs of the alternative RECD-based fitting approaches revealed they were an overall good fit to prescriptive targets; however, the average RECD method slightly under fitted targets

from 1000-4000 Hz. There were no significant differences among groups on any self-report measure. Preliminary findings suggest that an alternative hearing aid fitting approach using individually-measured RECDs might be viable for issuing replacement amplification for select patients.

Poster # 164

Using Ecological Momentary Assessment in Audiology Research: The Participants' Perspective
Shareka Pentony, MS, Starkey Hearing Research Center, Berkeley, CA
Jingjing Xu, PhD; Jason Galster, PhD, Starkey Hearing Technologies, Eden Prairie, MN
Yu-hsiang Wu, PhD, University of Iowa, Iowa City, IA

Ecological Momentary Assessment (EMA) with smartphone technology has gained increasing popularity recently in audiology research. Compared to traditional questionnaires, EMA allows self-report measurements in-situ which minimizes recall bias. However, its repeated data collection manner makes participants' compliance become critical. The purpose of this paper was to understand participants' experience in an EMA study using smartphones. Eleven younger normal hearers and thirteen older hearing aid users participated in a study using a smartphone/hearing aid-based EMA system to evaluate auditory ecology. Each participant wore a pair of hearing aids for one week. Hearing aids for normal-hearing listeners were programed to have no gain. A 15-item survey regarding listening activity and acoustic environment was initiated on the smartphone about every 40 minutes during the active hours for each participant. An exit interview was performed on each participant regarding their experience in the study. A series of interview questions was asked, e.g., whether the repetitive survey interrupted their daily activities, the situations that they skipped the survey, frequency of survey delivery, and difficulty of the survey questions. Responses to these questions will be discussed. The feedback from the participants could inform the design of future EMA studies using smartphones.

Poster # 165

Linking Signal-to-Noise Ratio to Hearing Aid Success
Gina Hone, BS; Christi Miller, PhD; Michael Lee, PhD; Kelly Tremblay, PhD, The University Of Washington - Department Of Speech And Hearing Sciences, Seattle, WA
Yu-hsiang Wu, MD; Ruth Bentler, PhD, The University of Iowa, Communication Sciences and Disorders, Iowa City, IA

The goal of this study was to identify new variables contributing to aided outcomes. Behavioral and biological evidence suggests that the signal-to noise ratio (SNR) may be partially responsible for variability in aided outcomes. Using an observational approach, 179 adult hearing aid (HA) users (21-79 years old) with bilateral, symmetrical sensorineural hearing loss participated in this study. Data to define SNR using a multi-stage framework was obtained, which included device-centered variables (e.g., changes in SNR caused by HA processing) and patient-centered variables (i.e., three measures of 'intrinsic SNR'). The intrinsic SNR factors included the SNR required to understand 50% correct (SNR-50) on speech perception, the perceived SNR-50 using the Performance-Perceptual Test protocol, their over-or under-estimation of speech-in-noise abilities, and their preferred SNR listening levels (i.e., Acceptable Noise Level). Outcomes included aided speech perception measures and self-reported outcomes covering a range of independent domains of HA success. Preliminary analyses on 84 individuals has been

completed so far. For speech perception outcomes, all intrinsic SNR measures significantly explained some variance (6-35%). For self-report outcomes, the SNR-50 and perceptual SNR-50 explained 12-16% of the variance in all self-report outcomes except for satisfaction. HA output data is currently being analyzed.

SPEECH PERCEPTION

Poster # 166

Is Seeing Competing Speech Beneficial or Detrimental?
Karen Helfer, PhD; Alexandra Jesse, PhD, University Of Massachusetts Amherst, Amherst, MA

The experiment described in this poster tests the extent to which, in a situation with two simultaneous talkers, seeing the person who produces the to-be-ignored masking message can help segregate the two auditory speech streams. If listeners can use visual speech information in this way, seeing the competing talker should enhance the perception of the target talker's message. However, it might be the case that seeing the competing talker makes the masker stream more salient and therefore more difficult to ignore. This negative effect could be larger for older individuals with age-related decline in inhibiting irrelevant information. In this study, a target sentence and a competing sentence were presented simultaneously from a front loudspeaker. Older and younger adult participants were told to repeat the target sentence, which always began with a specified name. In an auditory-only condition, participants heard (but did not see) both talkers. Two audiovisual conditions were completed in which participants heard both talkers and saw either the target talker or the competing talker. We will report results of analyses that test the extent to which seeing the competing talker helps or hurts the recognition of target speech (Work supported by NIDCD R01-012057).

Poster # 167

Equalizing Consonant Perception on a Vowel-Consonant-Vowel Task
Judy Kopun, MA; Daniel Rasetshwane, PhD; Stephen Neely, Boys Town National Research Hospital, Omaha, NE

Current speech perception tests are insensitive to small changes in hearing-aid signal processing benefit because of the relatively larger variability of the speech materials. One source of that variability is in the level of perceptual difficulty. We propose to develop a set of vowel-consonant-vowel (VCV) stimuli in which the difficulty level of the phonemes has been equalized by speech-shaped noise. The purpose of this study was to identify the range of signal-to-noise ratios (SNRs) required for 90% correct identification of 13 consonants in 3 vowel contexts at 0, 6, and 12 dB SNR. Normal-hearing participants identified the consonants by selecting one of 14 buttons. Responses were averaged across subjects for each VCV. Over half did not reach the 90% correct criterion, indicating that the VCVs are not equally sensitive to SNR. These results demonstrate that VCVs vary in perceptual difficulty and different SNRs are needed to equalize difficulty. A second goal of the study was to demonstrate consonant perception error patterns for individual participants. Principal component analysis performed on consonant confusion matrices was used to identify error patterns. Automatic classification by k-means clustering

identified three clusters, demonstrating the usefulness of this method in revealing patterns of consonant perception.

Poster # 168

Perception of Contrastive Stress by Adult Cochlear Implant Listeners
Hannah Herd, MA; Alix Klang; Arlene Carney, PhD; Edward Carney, PhD, University Of Minnesota, Minneapolis, MN

While cochlear implants (CIs) may provide users with improved speech perception, there remains great variability in performance. Due to processing limitations, reduced periodicity cues are available for the perception of fundamental frequency (F0). In this way, CIs are less effective in transmitting information necessary for pitch perception. Contrastive stress (CS) is a suprasegmental feature of speech used to signal a difference from what is expected through the emphasis of a single word in relation to other words in a sentence. F0 is a major cue for the perception of CS. This study investigated the ability of CI users to perceive CS in naturally elicited sentences produced by multiple talkers. CI listeners had a wide range in recognition performance of CS. These results are consistent with the idea that some CI listeners are able to use periodicity cues to perceive CS at a high level, while others are unable to use the periodicity cues to perform the task much above chance. Finally, a strong and significant relationship was found between sentence recognition and labeling of CS categories suggesting that for CI listeners, the perception of CS may rely on the same underlying processes as phonemic perception, despite very different acoustic cues.

Poster # 169

Enhancing Fluctuation Contrasts in Vowels: Model and Intelligibility Results
Laurel H. Carney, PhD; U-cheng Leong, PhD; Douglas Schwarz, MS; Joyce M. Mcdonough, PhD, University Of Rochester, Rochester, NY

The responses of auditory-nerve (AN) fibers to vowel sounds cannot be described by a simple mapping of the sound spectrum to discharge rates across the population of nerve fibers. Several nonlinearities in the inner ear 'distort' this mapping. Nevertheless, AN fibers do encode important aspects of speech, such as the formant frequencies that identify vowels. We hypothesize that vowel formants are coded by contrasts in the amplitude of low-frequency (F0-related) fluctuations of AN responses and also in fast frequency transitions ('chirps') in the neural responses. These neural response features strongly excite or suppress neurons in the inferior colliculus (IC) of the auditory midbrain. These descriptions of response features are based on physiological recordings from single neurons. Computational models for the AN and IC illustrate the representation of these features across populations of neurons. Based on these model representations, we enhanced and degraded the cross-frequency contrasts by manipulating formant bandwidths, and thus both magnitude and phase spectra, of synthetic vowels. Manipulation of the vowels to enhance or degrade the neural contrast cues was found to influence intelligibility results in vowel identification tasks. Results for listeners with and without sensorineural hearing loss will be presented.

Poster # 170

Psychometric Comparison of the HINT and the AEMT
Jumana Harianawala, AuD; Jason Galster, PhD, Starkey Hearing Technologies, Eden Prairie, MN
Benjamin Hornsby, PhD, Department of Hearing & Speech Sciences, Vanderbilt University, Nashville, TN

This study contrasted outcomes of the Hearing in Noise Test (HINT) and the American English Matrix Test (AEMT). Both tests assess speech recognition in noise ability. the HINT has been widely used while the AEMT is comparatively new- both can be used for research and clinical applications. With the current study, we aimed to contrast psychometric properties of these tests and assess their utility as research tools. We administered both tests in the sound field using adaptive and fixed presentation formats. The fixed presentations used six signal-to-noise ratios (SNRs) ranging from -12 to +3 dB, while adaptive administrations converged on 50% thresholds. All testing included ten participants with hearing loss who were fitted bilaterally with hearing aids. Tests were administered twice, once in each hearing aid microphone mode (omnidirectional and directional). The results of this study revealed that participants performed differently on the HINT and AEMT, with adaptive AEMT testing yielding lower (more negative) thresholds than the HINT. The benefit provided by the directional microphones was not statistically different between the two tests. Slopes obtained on HINT and AEMT were significantly different; HINT steeper than AEMT. These findings have implications for signal processing behavior and face validity of test conditions.

Poster # 171

Effects of Modality and Linguistic Materials on Working Memory
April Pereira, BS; Jenna Pattison, MS; Kathy Pichora-Fuller, PhD, University Of Toronto Mississauga, Mississauga, Canada
Sherri L. Smith, PhD, James H. Quillen VA Medical Center, Mountain Home, TN

We set out to determine if working memory in older adults would show the same effects of modality and linguistic complexity as had been found in younger adults. For younger adults, recall was better for heard than for read materials and it was better for target words presented following a carrier phrase than for sentence-final words. Participants (> 65 years) with normal audiometric thresholds up to 3 kHz completed the same experiment as had the younger adults. Linguistic complexity was varied using WARRM and SPIN-R test materials. To vary modality, participants listened to the materials or read a text version. In all four conditions, 2 modalities (A,V) x 2 linguistic complexities (word in carrier phrase or sentence), participants repeated the items and completed a judgment task. When prompted, they recalled as many target words as possible for five recall lists tested at each of five increasingly larger setsizes (2, 3, 4, 5, 6). Overall, recall was poorer in older than in younger adults and the effects of modality and linguistic level on recall were less pronounced, especially when words were presented in sentences. The results support the WARRM as the best of the four conditions for measuring working memory.

Poster # 172

Speech-Cue Discrimination Predicts Weighting of Speech Cues in Hearing-Impaired Adults
Frederick Gallun, PhD, National Center For Rehabilitative Auditory Research And Oregon Health & Science University, Portland, OR

Richard Wright, PhD, University Of Washington, Seattle, WA
Pamela Souza, PhD, Northwestern University and Knowles Hearing Center, Evanston, IL

Previous work has demonstrated that when presented with synthetic speech for which spectral or temporal dimensions of are manipulated along unidimensional continua, hearing-impaired listeners asked to categorize the phonemes they hear vary in their use of these cues. We hypothesize that the listeners who categorize the phonemes primarily on the basis of temporal cues (i.e., envelope rise time) do so because they are unable to discriminate spectral detail (i.e., dynamic formant structure). Here, we measured spectral and temporal cue sensitivity in an adaptive discrimination task and relate those data to the individual weights obtained in the identification task (the 'cue profile'). Discrimination results are consistent with individual cue profiles. Specifically, adults with temporal cue profiles are unable to discriminate fine spectral detail, while adults with spectral cue profiles are able to discriminate both temporal and spectral cues. The discrimination task may offer a time-efficient measure of cue-use patterns that have implications for everyday listening. [Work supported by NIH.]

Poster # 173

Comparison of Recognition Performances on Two Recorded Versions of NU-6
Ashley Light, BS; Madison Thode; Cayce Griffin, East Tennessee State University, Johnson City, TN
Richard H. Wilson, PhD, Arizona State University, Phoenix, AZ

NU-6 recognition data from separate studies on young normal hearing (YNH) listeners suggest the Auditec version is ~5 dB easier than the VA version. Comparisons between the two NU-6 versions on older listeners with sensorineural hearing loss (OHL) are lacking. This study compared recognition performances on the two versions using 12 YNH and 36 OHL listeners. Each listener received the same words by both speakers at six presentation levels. The words and levels were randomized for each speaker. The data were evaluated in dB SL and dB HL. Each listener performed better on the Auditec version with performances at the highest SLs the same. At 50% correct, the respective differences between the Auditec and VA speakers were 3.2 dB (YNH) and 6.1 dB (OHL); the slopes of the functions were 5.2-5.3%/dB (YNH) and 3.3-3.5%/dB (OHL). 37.0% (YNH) and 64.3% (OHL) of the words achieved better performances on the Auditec version, whereas 16.3% (YNH) and 19.5% (OHL) were better on the VA version with the remaining 46.8% (YNH) and 16.2% (OHL) having equal performances. Subjectively, 85.4% of the listeners thought the Auditec version was easier to understand, 6.3% thought the VA version was easier 8.3% thought they were equal.

Poster # 174

Effects of Talker and Listener Sex on Speech Intelligibility
Sarah Yoho, PhD; Dane Whittaker, Utah State University, Logan, UT

Although there is some evidence to suggest that intelligibility is not equal for male and female speech, many studies of speech perception do not consider talker sex as a factor. In addition, the influence of listener sex is not generally considered. Here, the effects of both talker and listener sex on speech intelligibility in noise were assessed. Groups of male and female listeners heard sentences in cafeteria noise spoken by several male and female talkers. Talkers were chosen to approximately equate speaking

rate across talkers and to ensure pitch for each male and female talker was generally fell within norms for the respective sex. Both intelligibility and subjective impressions of intelligibility were measured. A multilevel model analysis was performed. Results indicate 1) female speakers are more intelligible than male speakers for both male and female listeners, 2) there are no significant differences in intelligibility as a function of listener gender, and 3) male listeners rate female speech (but not male speech) more poorly than female listeners. Implications for assessing intelligibility in speech perception research will be discussed.

Poster # 175

Band Importance for Male and Female Speech

Sarah Yoho, PhD; Kacy Herald, Utah State University, Logan, UT

Band-importance functions, which describe the relative contribution of various bands of speech, are an integral part of the Speech Intelligibility Index. Despite the fact that there are several important acoustic differences between male and female speech, many of the functions currently in the Speech Intelligibility Index were derived with the use of a single male talker. To determine whether talker sex plays a role in band importance, functions for male and female speech were created using the compound method of Apoux and Healy (2012). Five male and five female speakers were used to create the functions, such that each respective function would represent one sex more generally than if a single talker of each sex were used. The resulting functions were compared in terms of regions of maximum importance and overall shape. As expected, it was found that the regions of maximum importance for female speech were shifted upward in frequency relative to male speech. Implications for the Speech Intelligibility Index and it's applications will be discussed.