American Auditory Society Scientific and Technology Meeting
March 2-4, 2017

POSTER ABSTRACTS

Topic areas, poster numbers, and abstract codes:

Topic Area	Poster Numbers	Abstract Code
POSTER SESSION I – Thursday – Friday		
Amplification	Poster #1-12	(AMP01-12)
Anatomy and Physiology	Poster #13-14	(ANAT01-02)
Audiology / Otology	Poster #15-22	(AO01-08)
Auditory Processing	Poster #23-27	(AP01-05)
Cochlear Implants	Poster #28-41	(CI01-14)
Electrophysiology	Poster #42-50	(EP01-09)
Hearing Disability	Poster #51	(HD01)
Hearing Health	Poster #52-53	(HH01-02)
Hearing Loss	Poster #54-61	(HL01-08)
Immittance	Poster #62-63	(IM01-02)
Noise Exposure	Poster #64	(NE01)
Otoacoustic Emissions	Poster #65-69	(OAE01-05)
Psychoacoustics	Poster #70-78	(PSY01-09)
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POSTER SESSION II – Friday - Saturday		
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Audiology / Otology	Poster #112-119	(AO09-16)
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Cochlear Implants	Poster #126-138	(CI15-27)
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Hearing Health	Poster #147-148	(HH03-04)
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Otoacoustic Emissions	Poster #156-161	(OAE06-11)
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Speech Perception	Poster #170-179	(SP11-20)
Tinnitus	Poster #180-183	(TIN04-07)
Training / Rehabilitation	Poster #184-189	(TR06-11)
Vestibular	Poster #190	(VEST01)

AMPLIFICATION

Poster # 1 – AMP01

Comparing Objective and Subjective Outcomes of Two Frequency-Lowering Algorithms
Mentored Student Research Poster Award
Bethany Rose, MS; Matthew Bakke, Gallaudet University, Washington, DC

Frequency-lowering algorithms are used to make high frequency speech information audible for the hearing aid user. There is a lack of information comparing the efficacy of different frequency lowering algorithms. This study objectively and subjectively compared non-linear frequency lowering to spectral envelope warping frequency lowering. Objective outcomes were measured using word recognition in quite and speech sentence recognition in noise. Subjective outcomes were measured using a paired comparison, forced choice tournament. Participants were adult hearing aid users with a high frequency, bilateral, and symmetrical sensorineural hearing loss. The objective test materials included recordings of the Auditec NU-6 word lists and QuickSIN lists from the output of two hearing aids, each utilizing one of the frequency-lowering algorithms. The subjective test used Auditec CID-W1 spondee word lists, recorded through both hearing aids with its FL algorithm turned off and on. Analyzing word recognition scores in quiet showed no significant effect of either frequency-lowering algorithm when compared to the baseline audiometric word recognition score and no significant difference between the mean scores of the NLFL algorithm and the SEWFL algorithm. Analysis of speech recognition in noise showed that participants performed significantly worse with both of the frequency-lowering algorithms when compared to their baseline audiometric test. The subjective test measures indicated a significant preference for the sound quality of the hearing aid with the NLFL when the NLFL feature was disabled and a significant non-preference for the sound quality of the SEWFL.

Poster # 2 – AMP02

Influence of Hearing Aid Compression Ratio on Horizontal Localization **Mentored Student Research Poster Award**
Steven Taddei, BA, Burbank, IL
King Chung, PhD; Matt Wilson, PhD; Diane Schecklong, AuD, Dekalb, IL

Interaural intensity difference is used for localization of high frequency sounds. Yet, compression algorithms implemented in hearing aids change the relative amplitudes of soft and loud sounds. This study examined the effects of independently applied wide dynamic range compression on horizontal localization. Sixteen normal hearing individuals listened to binaural recordings made when KEMAR was wearing two behind-the-ear hearing aids programmed to 1:1, 2:1, 3:1 and 10:1 compression ratios. The hearing aid frequency responses were match at 80 dB SPL. Normal and vocoded male and female speech were presented at 80 dB SPL every 15 degrees from 0 to 360 degrees. Background noise was presented at 61 dB SPL from 8 loudspeakers evenly spaced from 0 to 360, resulting in an overall level of 70 dB SPL. The recorded sentences were then presented to each participant randomly at his/her most comfortable listening level. Results indicate high compression ratios and female vocoded stimuli reduced the accuracy of horizontal localization and increased reaction times ($p<0.0083$). Localization of normal speech and male vocoded stimuli are less affected by compression because of the presence of lower frequency cues. Compression ratios of hearing aids should be kept low to avoid compromises of users' localization ability.

Poster # 3 – AMP03

Using Perceptual Weights to Investigate Loudness Acclimatization in Hearing-Aid Patients
Mentored Student Research Poster Award
Katie Thrailkill, BS, University Of Nebraska-Lincoln, Lincoln, NE
Marc Brennan, PhD; Walt Jesteadt, PhD, Boys Town National Research Hospital, Omaha, NE

This experiment examined whether the first few months of hearing aid use contribute to measurable differences in loudness perception. Six first-time hearing aid users compared the loudness of two noises in unaided and aided conditions across 2 identical test sessions: the first occurred prior to the hearing aid fitting and the second occurred 12-13 weeks following the hearing aid fitting. Unaided stimuli consisted of seven independent noise-bands randomly roved over a 12 dB range from a base level of 51 dB SPL. Aided stimuli were created on an individual subject basis by processing the unaided stimulus files through a computer program designed to amplify signals according to DSL 5.0 adult prescription targets. During a trial, two stimuli were randomly picked from a list of 500 unique waveforms and presented in succession. Subjects were asked to pick the louder of the two noises. Multiple regression analysis was used to obtain perceptual weights, a measure indicating the relative contribution of individual frequency bands to overall loudness. In the aided condition, results demonstrated good replicability across sessions and approximated perceptual weights obtained from listeners with normal hearing. In the unaided condition, listeners placed greater weight on the lowest-frequency band following experience with amplification [work supported by NIH].

Poster # 4 – AMP04

Home Use of Remote Microphones: Impact on Child-Directed Speech **T35 Research Trainee Poster**
Emily Thompson, BA; Carlos Bentez-Barrera, MA; Gina Angley, AuD; Anne Marie Tharpe, PhD, Vanderbilt University School Of Medicine, Nashville, TN

Remote microphone systems (RMSs) have been shown to enhance speech perception for children in school settings but have not been widely used in homes. As part of a larger investigation in RMS use in the homes of children with hearing loss (Bentez-Barrera et al., 2016), this study aimed to explore the amount of child-directed talk produced by caregivers when using and not using RMSs. Language Environmental Analysis' (LENA) recorders were used to record speech from the caregiver and that received by the child during two consecutive weekends (with and without the RMS [Phonak ROGER]). Nine families of children with moderate to profound hearing loss were enrolled. Analysis compared amount of child-directed speech produced by the caregiver when close to the child (approximately < 8 feet from the child) and speech produced by the caregiver when farther away from the child. On average, results indicated that children are unable to access a significant amount of child-directed speech during a typical weekend at home without RMS use. In addition, caregivers talk significantly more from a far distance when wearing the RMS, with at least part of that speech being child-directed, thus potentially enhancing communication in the family home. Data collection is ongoing. [Supported by NIH-NIDCD T35DC0008763]

Poster # 5 – AMP05

Development of an Open Source Hearing Aid Platform
William Audette, MS; Odile Clavier, PhD, Creare, Hanover, NH
Daniel Rasetshwane, PhD; Stephen Neely, PhD; Ryan Mccreery, PhD; Marc Brennan, PhD, Boys Town National Research Hospital, Omaha, NE
Joshua Alexander, PhD, Purdue University, West Lafayette, IN

Because hearing aids demand a very small footprint and low power consumption, amplification and noise management algorithms are often implemented on a dedicated integrated circuit, whose closed design hinders experimentation and optimization by researchers and clinicians. In this research, we develop an open source hardware and software platform to spur innovation in Hearing Aid research. The first prototype includes a Teensy 3.6 development board which leverages the Arduino software platform while providing powerful computational capabilities. This processor board is paired with custom-designed electronics for audio control, power management and wireless communication to enable users to manipulate algorithms easily. The software base is designed for multiple users: (1) 'experts' who optimize new algorithms directly in firmware through an interface to the basic features of the hardware; and (2) researchers who interact with the algorithms already implemented to modify parameters and evaluate their performance in a variety of conditions. Here we present the electro-acoustic performance results of this first prototype obtained in the laboratory, as well as several basic hearing aid algorithms implemented to demonstrate the accessibility of the platform to a variety of researchers. In keeping with our Open Source objective, all of our hardware designs and software are freely available.

Poster # 6 – AMP06

Hypersound Audio System Transmission Characteristics in an Anechoic Chamber
Shaum Bhagat, PhD; Anusha Yellamsetty, MS, University Of Memphis, Memphis, TN
Brian Taylor, AuD, Turtle Beach Corporation, San Diego, CA

The Hypersound Audio System uses ultrasonic technology to transmit a narrow beam of sound in a direct path to the listener, unlike conventional audio speakers. Recently, Hypersound became commercially available as a home audio device. In this study, the sound transmission characteristics of the Hypersound emitters were compared with conventional loudspeakers in an anechoic chamber. Subjects were placed in the path of the Hypersound narrow beam and a sample of speech was projected from the Hypersound emitters. The same sample of speech was then projected from the conventional loudspeakers, with the subjects placed in the same positions in the chamber. Comparisons of probe microphone measurements near the tympanic membrane of the subjects for speech samples projected by the Hypersound emitters and conventional loudspeakers were made. Trends in the data indicated that the Hypersound emitters produced higher probe-microphone levels in the mid-frequency range compared with conventional speakers when measurements occurred at a distance of 4 feet from the sound sources. Transmission of sound within the narrow beam of the Hypersound emitters was significantly enhanced compared to measurements made outside the beam. The underlying basis for these measurable differences between Hypersound-transmitted and conventional audio, as well as clinical implications, will be addressed.

Poster # 7 – AMP07

Comparison of Hearing Aids and PSAPs in Ecologically Relevant Situations
Lisa Brody, BA; Yu-hsiang Wu, PhD; Elizabeth Stangl, AuD, University Of Iowa, Iowa City, IA

Previous research has compared personal sound amplification products (PSAPs) to hearing aids (HAs) based on electroacoustic evaluations and speech recognition with a focus on device efficacy. However, data evaluating the effectiveness of PSAPs relative to HAs in the real-world is limited. The purpose of this study is to compare commercially purchased PSAPs to well-fit HAs in ecologically relevant situations in the laboratory to estimate their real-world effectiveness for adults with mild-moderate hearing loss. Six test environments were designed based on our previous research to simulate real-world listening situations. Speech recognition scores, subjective listening effort, and sound quality judgements were compared across three PSAPs, one individually-fit HA, and one unaided condition. In order to best simulate the real-world fitting process of PSAPs, participants selected volume levels and gain-frequency responses available for each device. The audibility provided by each device was quantified using Speech Intelligibility Index (SII). Results suggest all devices provide significant benefit compared to the unaided condition. HAs provide the best aided audibility based on SII. However, performance is similar across devices in each ecological test environments for all outcomes. Our data suggests PSAPs and HAs may provide comparable benefit in real-world settings for those with mild-moderate hearing loss.

Poster # 8 – AMP08

Integrated Directionality and Noise Reduction: Effects on Children's Masked Thresholds
Jenna Browning, AuD; Mary Flaherty, PhD; Lori Leibold, PhD, Boys Town National Research Hospital, Omaha, NE
Emily Buss, PhD, The University Of North Carolina At Chapel Hill, Department Of Otolaryngology/Head, Chapel Hill, NC

Children with hearing loss struggle in noise, requiring a more favorable signal-to-noise ratio (SNR) than their peers with normal hearing to achieve comparable masked speech recognition. Directional 'beamforming' technology counteracts effects of noise in adults, but children do not always face the target talker. Thus, directional hearing aid technology has not gained widespread use in the pediatric population. This study evaluated the influence of an integrated directionality and noise reduction algorithm, Oticon's OpenSoundNavigatorTM (OSN), which aims to recognize and preserve speech information regardless of the listener's position in space. Listeners were school-age children and adults with bilateral sensory/neural hearing loss. Testing was completed in the soundfield while listeners wore Oticon Opn hearing aids programmed with two separate settings: (1) omnidirectional or (2) OSN. An adaptive, open-set word recognition procedure was used to estimate 50% correct performance in spatially separated speech-shaped noise or two-talker speech. The target speaker was located directly in front of the listener or was located 60 to the left. Preliminary results suggest OSN improves speech recognition in speech-shaped noise for both age groups, even when listeners are not facing the target source. OSN does not appear to detrimentally affect speech recognition in two-talker speech.

Poster # 9 – AMP09

Predictors of Patient Preference of Hearing Aid Settings While Streaming
Courtney Coburn, AuD; Kevin Seitz, AuD, Starkey Hearing Technologies, Eden Prairie, MN

Wireless streaming accessories are used by hearing aid wearers to enhance their ability to hear and enjoy phone calls, television, and music. Many hearing aid products offer a memory environment that optimizes the hearing aid frequency response and feature settings for streamed inputs by taking into account the non-acoustic nature of the signal and compensating for the lack of direct path into ear. Although these streaming environments differentiate between acoustic and non-acoustic signals, they often do not distinguish between various types of streamed inputs, such as speech versus music. Previous work indicates that patients may prefer non-traditional signal processing for non-speech signals such as music (Croghan, Arehart, & Kates, 2014); this evidence suggests that patient preference for hearing aid settings while streaming may also vary depending upon the input type. This poster will present the results of paired comparison experiments conducted with streamed music, along with details of the hearing aid frequency response, the real-ear sound pressure level, and information about the fitting. The factors most strongly associated with patient preference while listening to streamed music will be identified, and accessory fitting recommendations for the practicing clinician will be presented.

Poster # 10 – AMP10

Are Hearing Aids and Alternative Devices Effective? Two Systematic Reviews
Melanie Ferguson, PhD; David Maidment, PhD; Padraig Kitterick, PhD; Derek Hoare, PhD, NIHR Nottingham Hearing Biomedical Research Unit, Nottingham, NA

Evidence-based practice requires the integration of clinical expertise, patient preferences alongside the best available clinical evidence. Systematic reviews including a meta-analysis provide the highest level of clinical evidence. A Cochrane Review on hearing aids and a systematic review of alternative devices to hearing aids, in adults with mild to moderate hearing loss have been conducted to assess effectiveness. Cochrane Review: a total of four texts met the inclusion criteria for data extraction and analysis, and two were included in the meta-analysis. For hearing-related quality of life (QoL) (HHIE), there was a significant effect in favour of hearing aids (Z=12.96, CI=-2.96, -1.52, p<0.00001). For health-related QoL (WHODAS II, SELF), the effect was in favour of hearing aids (Z=1.76, CI=-0.73, 0.004, p=0.08), but was not significant. Systematic review: registered published protocol (PROSPERO: CRD42015029582) considered alternative devices to hearing aids, such as made-for-smartphone hearing aids, smartphone-based 'hearing aid' apps, PSAPs, and remote microphone systems. Meta-analysis was not possible but alternative listening devices devices significantly improved speech intelligibility. Evidence concerning hearing-related QoL was not consistent. Both reviews have implications for clinical practice and service delivery models, particularly in light of the recent National Academies of Science report published in June 2017.

Poster # 11 – AMP11

Open Speech Platform Tools: A Realtime Master Hearing Aid Software
Harinath Garudadri, PhD; Chinghua Lee, MS; Swaroop Gadiyaram, MS; Justyn Bell; Bhaskar Rao, PhD, UC San Diego, San Diego, CA
Arthur Boothroyd, PhD, San Diego State University, San Diego, CA

The goal of this research is to develop an open source, wearable, speech processing platform that can be configured at compile time and at run time for audiologists and hearing aid researchers to investigate new hearing aid algorithms in lab and field studies. It is anticipated that this will accelerate translation of technology advances and hearing healthcare research studies into widespread clinical use. In this contribution, we present a realtime, master hearing aid software implemented in ANSI C that runs on a laptop. The system connects to ear-level assemblies via a custom printed circuit board and an off-the-shelf audio interface box. The software includes subband decomposition, input wide dynamic range compression and adaptive feedback cancellation. The system has an overall latency of 8 msec. The system connects to an android app for changing compression ratio, attack time and release time in all the subbands. The system is currently suitable for lab studies. Additional details of the system performance and features will be presented, with an explicit desire to get early feedback from audiology and hearing science community. We propose to incorporate this feedback in to the lab system and port it to an embedded, wearable platform suitable for field studies.

Poster # 12 – AMP12

Effects of the Noise Reduction of Hearing Aids on cABR

Yoon Sang Ji, PhD; Heesung Park, AuD; Hyun Jee Jung, Hearing Research Laboratory, Samsung Medical Center, Seoul, Korea
Il Joon Moon, MD; Yang-Sun Cho, MD, Department Of Otorhinolaryngology-Head & Neck Surgery, School Of Medicine, Sungkyunkwan University, Samsung Medical Center, Seoul, Korea
Sung Hwa Hong, MD, Department of Otorhinolaryngology-Head & Neck Surgery, School of Medicine, Sungkyunkwan University, Samsung Changwon Hospital, Changwon

Digital hearing aids technologies have been developed significantly in the past decade, because of the dramatically advancement of digital signal processing (DSP) technology. Especially one of the important strategies is the noise reduction algorithm for improvement of hearing aids user's speech perception. The purpose of this study was to identify difference in the brainstem processing of speech and speech with noise using noise reduction algorithm of hearing aids. Thirty adult participants were recruited from the Korean native speaker: 15 normal hearing and 15 moderate-severe hearing loss groups with age-/sex-matched condition. The stimulus was a 170ms [da] syllable and presented 70dB SPL and 0dB signal-to-noise ratio (SNR) with white noise using loudspeaker. As a result, normal hearing groups showed electrophysiological evidence of delay in time domain and decreased F0 amplitude in frequency domain with noisy environment. In addition, hearing loss groups showed different response between the characteristics of hearing loss in performance of noise reduction algorithms. The results indicate that the effect of noise reduction algorithm must need to consider personal characteristic of hearing loss.

ANATOMY AND PHYSIOLOGY

Poster # 13 – ANAT01

Time Course of Macrophage Numbers in the Developing Mouse Cochlea **T35 Research Trainee Poster**

Ashley Hinton, BA, University Of South Florida And Washington University School Of Medicine, Tampa, FL
Tejbeer Kaur, PhD; Mark Warchol, PhD, Washington University School Of Medicine, St. Louis, MO

Background: During development of the cochlea, auditory neurons and hair cells undergo a series of changes before achieving their final pattern of synaptic innervation. Normal development also requires coordination of cell proliferation, differentiation and programmed cell death (PCD). In many developing tissues, clearance of apoptotic corpses relies on resident macrophages. In addition, recent work in the developing CNS has demonstrated that selective synaptic pruning involves the activity of microglia (the resident macrophages of the brain). However, the numbers, phenotype and function of resident macrophages in the developing inner ear remain unknown. The aim of this study is to describe the time course of macrophage numbers in a neonatal mouse-developing cochlea. Results: Quantitative data indicate that the numbers of GFP-positive cochlear macrophages are higher during first two weeks of postnatal development, when compared to mature cochleae (P30). Macrophages in the sensory epithelium peaked at ~P7, while macrophages associated with the spiral ganglion peaked at P10. Conclusion: The enhanced numbers and distinct morphology of macrophages in the developing cochlea suggest that they may be actively involved during maturation and development, but the precise function of these macrophages during development is under further investigation.

Poster # 14 – ANAT02

Spatial Release of Masking in Macaques and its Neuronal Correlates **T35 Research Trainee Poster**

Maureen Virts, BA; Ramnarayan Ramachandran, PhD, Vanderbilt University School Of Medicine, Nashville, TN

Tones spatially separated from maskers are detected at lower sound levels than those colocalized with maskers (spatial release from masking, SRM). SRM has been well explored in humans but not in animal models. SRM, when measured in azimuth, may index temporal processing. We hypothesized that macaques would show significant SRM in azimuth, similar to humans, and that SRM would be worse after noise induced hearing loss in a manner correlated with ribbon synaptopathy, but not outer hair cell loss. We measured SRM for tones (0.5 - 32 kHz) and synthetic human vowels in normal and hearing impaired macaques for spatial separations between signal and masker of 0, 45, or 90 in azimuth. Signal detection thresholds were highest when signal and noise were colocalized and lower when the noise was separated from the tone (SRM), consistent with results in humans. SRM was not observed in macaques with hearing loss at frequencies where synaptopathy was observed, even though masked thresholds were higher than tone thresholds. Neuronal responses measured from the inferior colliculus (IC) simultaneously with behavior showed a strong neuronal correlate of SRM. These results suggest that SRM may be a good test for synaptopathy. Supported by NIH-NIDCD T35DC0008763 and R01 DC011092.

AUDIOLOGY / OTOLOGY

Poster # 15 – AO01

Ipsilateral and Contralateral Wideband Acoustic Reflex Thresholds in Adults **Mentored Student Research Poster Award**

Rebecca Burdine, BA; Xiao-ming Sun, PhD, Wichita State University, Wichita, KS

Acoustic reflex (AR) procedures are a part of the clinical acoustic immittance test battery, in which a single-frequency probe tone is used for detecting the middle-ear muscle reflex. A newly developed wideband acoustic immittance technique, utilizing wideband probe signals, has been investigated in testing the middle-ear muscle reflex, known as the wideband acoustic reflex (WAR). To promote clinical application of WAR measurements, this study tested both ipsilateral and contralateral WAR thresholds using clicks as the probe signal, and compared the results to ipsilateral and contralateral AR thresholds determined with a 226-Hz probe tone. Both WAR and AR thresholds were obtained in response to all commonly used AR activators: 0.5, 1, 2, and 4 kHz pure tones and broadband noise. Data were collected from 50 normal-hearing young adults screened with stringent subject inclusion criteria. The results showed that WAR thresholds were significantly lower than AR thresholds for both ipsilateral (5- to 16-dB difference) and contralateral (15- to 22-dB difference) measurements ($p<0.01$, paired t-test). WAR measurements had higher detectability (56.8% to 97.3%) than AR measurements (25.0% to 91.9%) for almost all procedural parameters. Our study suggests that WAR threshold testing has the potential to be a superior tool in clinical applications.

Poster # 16 – AO02

Reliability of the Home Hearing Test: Implications for Public Health **Mentored Student Research Poster Award**

Lauren Langley, BA; Cornetta Mosley; Kelly Tremblay, PhD, Department Of Speech And Hearing Sciences, University Of Washington, Seattle, Seattle, WA
Kathleen Pichora-Fuller, PhD, Department of Psychology, University of Toronto, ON, Canada
Adrian Davis, PhD, University College London, AD Cave Solutions
Catherine McMahon, PhD, Department of Linguistics, Macquarie University, Sydney, New South Wales, Australia

There is a growing need to meet the hearing healthcare needs of our aging population. However, there are too few audiologists to meet the demand. For this reason, there is a need to develop different ways of assessing hearing that can be conducted outside of the traditional audiology clinic. The purpose of this study is to evaluate the automated pure-tone air conduction test called the 'Home Hearing Test' (HHT). It measures air-conduction hearing thresholds at octave frequencies 500-8000 Hz. It was designed for home use, community based testing, as well as telehealth practice. Participants were 100 adults 60 years and older. All participants completed the HHT as well as standard audiometric testing at the University of Washington. The order of testing (HHT vs pure tone audiometry) was counter-balanced. Mean thresholds for each method were calculated and then compared using correlation analyses. Thresholds obtained using the HHT are highly correlated with thresholds obtained using traditional manual audiometry. Results indicate that the HHT is a reliable method of establishing pure-tone air conduction thresholds, when compared to manual audiometry, and therefore can be used to acquire hearing threshold information outside of clinical settings.

Poster # 17 – AO03

Clinical Procedures to Identify Hidden Hearing Loss in Humans **Mentored Student Research Poster Award**

Mackenzie Phillips, BA; Michelle Manning; Jason Sanchez, PhD, Northwestern University, Evanston, IL

A surprising complaint of some normal hearing individuals is difficulties understanding speech in noise (SIN). A proposed origin for SIN difficulties arise from damaged inner hair cell-auditory nerve synapses, termed cochlear synaptopathy, albeit normal hearing sensitivity (i.e., hidden hearing loss). Research shows that reduced wave I amplitudes of the auditory brainstem response (ABR) can serve as an assay for cochlear synaptopathy in animals. Recently, this was shown in humans with variable hearing sensitivity and SIN difficulties. The current study contributes to these findings. We asked if normal hearing individuals whom self-report SIN difficulties (experimental group) yield reduced wave I amplitudes compared to age-match subjects that report no SIN concerns (control group). Twenty-four normal hearing adults completed SIN testing (performance measure), a self-report SIN questionnaire (perceptual measure) and suprathreshold ABR testing (objective measure). We found no difference in wave I amplitudes between groups using a standard click rate. However, increased click rates revealed a larger percent reduction in wave I amplitude for the experimental group, suggesting asynchronous auditory nerve firing. Interestingly, this result was correlated with impaired SIN performance and self-reported SIN perception. We conclude that a battery of clinical procedures can be used to identify hidden hearing loss in humans.

Poster # 18 – AO04

Web-based Audiometric Threshold Estimation **T35 Research Trainee Poster**

Rebecca Howard, BA; Nikki Metzger; Jeffery Lichtenhan, PhD; Xinyu Song, MS; Braham Snyder; Kiron Sukesan, MS; James DiLorenzo, MS; Dennis Barbour, PhD, Washington University School Of Medicine, Saint Louis, MO

Audiologists rely on audiometric thresholds to inform every decision from diagnosing pathologies to cochlear implant candidacy. Conventional audiometry includes the presentation of air conduction pure tones in 5 dB steps to establish threshold across a discrete range of frequency octaves (250, 500, 1000, 2000, 4000, and 8000) and sometimes half-octaves (125, 750, 1500, 3000, and 6000). The current study investigates continuous-in-frequency web-based audiograms determined with Bayesian estimation and machine learning (ML) classification. Continuous thresholds obtained by ML were compared against discrete thresholds determined by an automated Hughson-Westlake (HW) procedure. Twenty native English speakers over the age of 18 were recruited from the Washington University School of Medicine Adult Audiology clinic and the nearby geographic area. Half the participants had documented hearing loss and the other half were members of the general population. All participants were tested using both the automated HW and ML procedures. Preliminary results from a small number of participants showed good correspondence between both paradigms. Estimated thresholds corresponded closely between the two methods and were repeatable, establishing the validity of the online ML method. This study has important implications for novel uses of the audiogram including clinical use of the underlying psychometric function.

Poster # 19 – AO05

Using Thresholds in Noise to Identify Hidden Hearing Loss in Humans **T35 Research Trainee Poster**

Courtney Ridley, BS, Department Of Speech, Language And Hearing Sciences, University Of Florida, Gainesville, FL
Judy Kopun, MA; Stephen Neely; Michael Gorga, PhD; Daniel Rasetshwane, PhD, Boys Town National Research Hospital, Omaha, NE

Synaptopathy may underlie hidden hearing loss (HHL). Noise exposure preferentially damages low spontaneous rate auditory nerve (AN) fibers, which are involved in the processing of suprathreshold sounds. Therefore, the effect of synaptopathy may be evident in suprathreshold measures of auditory function. This study developed a model of HHL in humans using thresholds in noise as the outcome variable and experimental measures that reflect the integrity of sites along the auditory pathway as predictors. Study participants included 13 and 20 adults with normal hearing and hearing loss, respectively. Distortion-product otoacoustic emissions (DPOAE), auditory brainstem response (ABR), action potential (AP), summating potential (SP) and categorical loudness scaling (CLS) were measured at 1 and 4 kHz. The residual of the correlation of thresholds in noise with quiet thresholds served as our estimate of HHL. HHL was correlated with SP/AP ratio and SP at 1 kHz and with gender and DPOAE at 4 kHz. In a second model, the ratio of variables at 4 kHz to variables at 1 kHz, HHL was correlated with ABR Waves I and V amplitudes. SP/AP ratio, SP, and ABR Waves I and V were significant indicators of HHL. The model predictions support our approach as being predictive of HHL. [Work supported by the NIH].

Poster # 20 – AO06

Detection of Atypical Differences in Wideband Tympanometry

Gregory Flamme, PhD; Hannah Mork; Stephen Tasko, PhD; Kristy Deiters, AuD, Western Michigan University, Kalamazoo, MI

Wideband tympanometry is a three-dimensional measure of energy absorbance as a function of frequency and static pressure. This measure has good reliability and clinical utility for the detection of middle-ear dysfunction. Disorders of the middle ear are often transient, and clinicians could benefit from an efficient method for determining whether two wideband tympanograms differ. In this poster, we present a method for identifying atypical differences based on a reference distribution (e.g., a histogram) of test-retest absorbance differences. The reference distribution was obtained from group of 129 adults with normal hearing and no signs of middle ear dysfunction. Substantial deviations from the reference distribution indicate that a detailed evaluation of differences is warranted.

Poster # 21 – AO07

Kindergarten Children's Working Memory is Differentially Sensitive to Acoustic Competitors

Tina M. Grieco-Calub, PhD; Maya-simone Collins; Hillary E. Snyder; Kristina M. Ward, Northwestern University, Evanston, IL

Children often need to listen and learn in the presence of acoustic competitors, such as other talkers or environmental sounds. Performance in these complex acoustic environments depends on the extent to

which the competitors interfere with the children's sensory and/or cognitive processes. Recent work (Osman & Sullivan, 2014) suggests that acoustic competitors interfere with auditory working memory, a cognitive function that is integral to listening and learning. The purpose of the present study was to extend this prior work to determine the effect of acoustic competitors on working memory in children after removing the auditory demands of the task. Five-year-old children participated in the Missing Scan Test in quiet and in the presence of an acoustic competitor, either a two-talker speech masker or speech-shaped noise. Memory span was calculated as the largest number of items that children recalled in each condition. The two-talker masker, but not the speech-shaped noise, disrupted children's memory span. These results suggest that acoustic competitors interfere with working memory in children even if there are no auditory demands associated with the target task. However, the interference appears to be specific to the acoustic signature and content of the competitor.

Poster # 22 – AO08

Ear Asymmetries in Clinically Normal-Hearing Individuals

Danielle Hojnicki, Northwestern University, Evanston, Il, Evanston, IL
Samantha Stiepan, AuD, Knowles Hearing Center, Northwestern University, Evanston, IL
Jonathan Siegel, PhD; Sumitrajit Dhar, PhD, Knowles Hearing Center, Roxelyn & Richard Pepper Dept. of Comm. Sci. & Dis, Northwestern University, Evanston, IL

The literature is replete with right and left ear asymmetries and gender differences in behavioral thresholds, particularly lower thresholds for right ears and females [1-4]. The purpose of this study was to investigate and compare measures of auditory function in right and left ears to interrogate the notion of an ear advantage. Air and bone conduction thresholds were analyzed from clinically normal-hearing participants under the age of 70 from two large-scale, cross-sectional studies (the National Health and Nutrition Examination Survey [5] and the Hearing Assessment Reformulation Project). Threshold estimates using coupler-calibrated and forward pressure level (FPL)-calibrated [7] signals were compared.In standard calibration, our results showed a right ear advantage for males and no ear difference for females, whereas, FPL-calibrated stimuli did not show an ear advantage in males nor females. Further analysis of ear canal acoustics was used to determine the source of the gender and ear differences seen in the coupler-calibrated measures. Our findings suggest that ear and gender differences reported in the literature may be due to the choice of calibration technique, rather than true biological differences between ears or genders. References: 1) Pirila, T., Jounio-Ervasti, K., & Sorri, M. (1991) Left-Right Asymmetries in Hearing Threshold Levels in Three Age Groups of a Random Population. Audiology, 31(3). 150-161. 2) Kei, J., McPherson, B., Smyth, V., Latham, S., & Loscher, J. (1996). Transient Evoked Otoacoustic Emissions in Infants: Effects of Gender, Ear Asymmetry and Activity Status. Audiology, 36(2). 61-71. 3) Sininger, Y. S. and Cone-Wesson, B. (2004). Asymmetric Cochlear Processing Mimics Hemispheric Specialization. Science, 305(2940). 1581 4) Keogh, T., Kei, J., Driscoll, C., & Smyth, V. (2001). Distortion-Product Otoacoustic Emissions in Schoolchildren : Effects of Ear Asymmetry, Handedness, and Gender. The Journal of the American Academy of Audiology, 12(10). 506-513. 5) Centers for Disease Control. National Health and Nutrition Examination Survey. 2015. 6) ANSI S3.6 2010. American National Standard Method for Coupler Calibration of Earphones. 7) Lee, J., Dhar, S., Abel, R., Banakis, R., Grolley, E., Lee, J., Zecker, S., & Siegel, J. (2012). Behavioral hearing thresholds between 0.125 and 20 kHz using depth-compensated ear simulator calibration. Ear Hear, 33(3). 315-319.

AUDITORY PROCESSING

Poster # 23 – AP01

Effects of Blast Exposure on Sensory Gating and Auditory Processing **T35 Research Trainee Poster**

Mary E. Duncan, BA, University Of Louisville, Louisville, KY
Frederick J. Gallun, PhD; Robert L. Folmer, PhD, National Center for Rehabilitative Auditory Research (NCRAR), VA Portland Health Care System, Portland, OR; Department of Otolaryngology/Head & Neck Surgery, Oregon Health & Science University, Portland, OR
Melissa Papesh, PhD, National Center for Rehabilitative Auditory Research (NCRAR), VA Portland Health Care System, Portland, OR

Sensory gating is the ability of the brainstem and early cortical centers to filter out irrelevant or redundant sensory information, thereby focusing limited cognitive resources on important stimuli. Blast-related brain injury in regions crucial to sensory gating may contribute to higher-order sensory issues such as difficulty understanding speech in challenging situations, a problem frequently reported by Veterans exposed to high-intensity blasts. The goals of this study were to determine if sensory gating is impaired in blast-exposed Veterans and to investigate potential contributions of poor sensory gating to auditory processing deficits. Data were collected from 16 blast-exposed Veterans and 16 control participants. Using an electrophysiological paradigm in which two identical clicks are presented with a 500 ms inter-stimulus interval, sensory gating was quantified by the decrease in amplitude in responses to the redundant second click compared to the initial click. Participants also completed behavioral tests of auditory processing and questionnaires probing performance in various auditory situations. Results indicated the blast-exposed group experienced significantly poorer sensory gating at the cortical level compared to the control group. Additionally, impaired sensory gating was strongly correlated with poorer behavioral and self-reported performance on tasks related to temporal processing and comprehension of multiple simultaneous auditory streams.

Poster # 24 – AP02

Variations in the Duration Pattern Test

Alyssa Everett, BS; Nicole Denny; Frank Musiek, PhD, University Of Arizona, Tucson, AZ

The Duration Pattern Test measures temporal processing at higher cortical levels and provides insight into the integrity of the central auditory nervous system. Subjects are instructed to verbally discern between a 3-tone-pattern of acoustic stimuli that differ only in duration (500ms long tones and 250ms short tones with an inter-stimulus interval (ISI) of 300ms). Recognition of these patterns requires complex interactions of audiologic and cognitive processes, making it sensitive to central auditory abnormalities. However, little is known about why certain test parameters were selected and how variations in the parameters can affect performance. The goals of this study are to 1) evaluate the DPT performance as a function of stimulus duration and 2) analyze effects of altering the ISI on test performance in 20 normal hearing individuals. 10 conditions were tested, 5 of which, the stimulus durations of each pattern were proportionally reduced by 60, 30, 20, 10 and 5%. ISIs were changed to 5, 10, 25, 50, and 75ms for each pattern in the other 5 conditions. Results indicate no marked difference for

performance in the conditions where the ISI was varied and a negative correlation in percent correct as a function of stimulus duration.

Poster # 25 – AP03

Diagnostic Accuracy of the GIN Test for Neuro-Auditory Lesions

Renata Filippini, PhD, University Of Sao Paulo, Sao Paulo, Brazil
Bryan Wong; Frank Musiek, PhD, University Of Arizona, Tucson, AZ

Background: There has been a body of research evaluating the clinical utility of the Gaps-In-Noise procedure for detecting confirmed central auditory nervous system lesions caused by specific central pathologies, but no review assessing overall effectiveness and accuracy across multiple central pathologies. Methods: A total of 6 studies were included in our review: three observed GIN thresholds in individuals with CANS lesions related to strokes and three related to epilepsy. Results: Overall Sensitivity and Specificity of the GIN procedure was 83% (95%CI=0.63-0.93) and 94% (95%CI=0.9-0.96), respectively. Likelihood ratios elicited an overall LR+ of 10.5 (95%CI=6.1-18) and an overall LR- of 0.17 (95%CI=0.08-0.34). This means patients with neuro-auditory lesions are 10.5 times more likely to have abnormal performance, and very low likelihood of having normal performance, on the GIN compared to neurologically normal individuals. The overall DOR was 48.3 (95%CI=21-109), meaning that the GIN has good accuracy in identifying people with neuro-auditory lesions. Conclusion: The GIN procedure is shown to be effective and accurate in identifying subjects with confirmed neuro-auditory lesions. The GIN procedure is thus a clinically effective measure that provides insight into CANS integrity and may aid in identifying populations at risk of neurological damage affecting the CANS.

Poster # 26 – AP04

An Epidemiologic Study of Free Recall Dichotic Digits Test Performance

Mary Fischer, PhD; Karen Cruickshanks, PhD; David Nondahl, MS; Carla Schubert, MS; Barbara Klein, MD; Ronald Klein, MD; Ted Tweed, MS, University Of Wisconsin - Madison, Madison, WI

The Dichotic Digits Test with free recall (DDT-free) was administered in the Epidemiology of Hearing Loss Study (2008-2010) and Beaver Dam Offspring Study (2010-2013), using the same methodology. Twenty-five sets of triple-digit pairs were presented at 70 dB HL. There were 3655 participants (ages 21-100 years). Adjusting for age, sex, education, hearing loss and cognitive impairment, participants with diabetes had a significantly lower mean DDT-free score (-1.66%; $p<0.01$) whereas participants who exercised at least once per week demonstrated a significantly higher mean DDT-free score (+ 1.05%; $p<0.01$). In this multivariable model, greater weekly alcohol consumption level was associated with higher DDT-free scores (+0.15% per 25 grams ethanol; $p < 0.01$). Smoking, hypertension, history of cardiovascular disease and obesity were not related to DDT-free performance. In a similarly adjusted model, the right-left ear difference in DDT-free scores was larger for participants with cardiovascular disease (+3.58%; $p < 0.01$) and greater carotid-femoral pulse wave velocity (+0.33% per m/s, $p=0.018$), but smaller for higher levels of non-HDL cholesterol (-0.25% per 10 mg/dL; $p < 0.01$). Diabetes, exercise, obesity, and alcohol consumption were not related to the right-left ear difference. These results suggest that vascular factors may be associated with central auditory function.

Poster # 27 – AP05

Perception of Backward Speech
Robert Margolis, PhD; George Saly, Audiology Incorporated, Arden Hill, MN
Erica Williams, PhD; Angela Huang, BA; Sara Jensen; Ingrid McBride, PhD; Aparna Rao, Arizona State University, Tempe, AZ
Richard Wilson, PhD, U.S. Office of Veterans Affairs, Phoenix, AZ

The first stage in processing speech, spectro-temporal analysis, produces features that are analyzed by the brain to produce linguistic events. Impaired Listeners have deficits in spectro-temporal analysis causing comprehension difficulties despite normal higher functioning. Clinical speech-recognition tests invoke peripheral and central processes even though only the first stage is of interest for evaluating SNHL. This requires materials in many languages. A test that employs stimuli with the spectro-temporal properties of speech without linguistic content, such as words that are played backwards, may be useful regardless of language. Backward stimuli were created by temporally reversing digitized words. Listeners matched a target to one of three foils that was a copy of the target. The same words spoken by male and female speakers were used. Stimulus levels were precisely controlled. Normal-hearing listeners matched the target to the identical foil without difficulty. Backward stimuli are distinctly different even without linguistic content. Errors occur at levels < 20 dB HL. Although the levels were precisely matched, there were more errors on stimuli produced by the female talker than those produced by the male talker. A search for acoustic properties that might explain this and the development of a language-independent clinical speech-recognition test are underway.

COCHLEAR IMPLANTS

Poster # 28 – CI01

Effect of Signal Processing Strategy on Speech and Auditory Perception **Mentored Student Research Poster Award**
Susan Reynolds, BS; Rene Gifford, PhD, Vanderbilt University, Nashville, TN

Objectives: The primary objective was to investigate effects of signal processing strategy on speech understanding and auditory function. Methods: This study utilized a within-subjects, repeated measures design with eight experienced CI users. Each subject completed baseline assessment on speech understanding, music perception, and basic auditory function with their everyday processing strategy as well as five additional processing strategies utilizing a combination of simultaneous (current steering) and non-simultaneous (continuous interleaved sampling) stimulation. All subjects were given two weeks' experience with the five new strategies. Results: Preliminary data demonstrated that sequential strategies (1-2 electrodes stimulated at a time) yielded higher performance than paired strategies (2 to 4 electrodes stimulated at a time) for speech understanding and qualitative judgments of sound quality. The mean difference between sequential and paired strategies was 14-percentage points for speech understanding and 1.3 points on a 10-point quality scale. No notable differences were noted across strategies for music perception nor spectral/temporal resolution. Discussion: Many patients are utilizing paired strategies despite the fact that sequential strategies may yield higher outcomes. This study holds

significant clinical relevance to provide an evidence base for recommendations as to which processing strategy may provide the best outcomes for our cochlear implant (CI) patients.

Poster # 29 – CI02

Voice Emotion Production by Children with Cochlear Implants **Mentored Student Research Poster Award**

Jenni Sis, BS; Sara Damm; Monita Chatterjee, PhD, Boys Town National Research Hospital, Omaha, NE

Despite their successes, cochlear implants (CIs) do not restore normal hearing to the patient. Limitations include insufficient transmission of harmonic pitch, causing deficits in recognition of prosody, lexical tones, music perception, etc. Relatively little is known about how children with pre-lingual deafness implanted with CIs (CCI) produce prosodic elements of speech. The focus of the present study is to investigate happy and sad emotions produced by children (ages 6-18 years) implanted by 2 years of age. Stimuli were 20 sentences, each spoken with a happy and sad emotion by 7 CCI talkers and 9 child talkers with normal hearing (CNH). No training or feedback was provided to the talkers. Listeners were NH children and adults, who listened to each production in turn and indicated which emotion it was associated with. Listeners participated in either a single-interval, two-alternative forced task procedure (response choices: happy or sad) or a single interval, five-alternative forced task procedure (response choices: happy, sad, neutral, angry, scared). Preliminary analyses show that the CCIs' productions of happy and sad emotions were more often mis-identified than their NH peers', and that younger NH child listeners had the greatest difficulty identifying the intended emotion in the CCIs' speech.

Poster # 30 – CI03

Inter-rater Reliability of the Cochlear Implant Skills Review (CISR) **Mentored Student Research Poster Award**

Alexandra Snyder, BS; Matthew Bakke, PhD; Claire Bernstein, PhD, Gallaudet University, Washington, DC

Purpose: The inter-rater reliability of a new, unpublished, assessment scale, the Cochlear Implant Skills Review (CISR) was assessed. The CISR consists of 20 tasks in which cochlear implant (CI) recipients are asked to demonstrate their knowledge and skills, serving as a guide for further counseling or training. Method: Eleven adult cochlear implant recipients performed all applicable tasks from the CISR and were video recorded. Videos were scored independently by two CI audiologists. Results: Data analysis indicated that all but two tasks show a level of agreement between clinicians that is statistically significant ($p < .05$). The results of this study suggest that the majority of CISR tasks indicate high inter-rater reliability prior to any revisions to the scale. Further interpretation of data is to come. Clinical implications and directions for future research will be presented.

Poster # 31 – CI04

Number of Electrodes Needed for Optimal Speech and Auditory Perception **T35 Research Trainee Poster**

Katelyn Berg, BA, Department Of Hearing And Speech Sciences, Vanderbilt University Medical Center, Nashville, TN
Jack Noble, PhD, Department Of Hearing And Speech Sciences, Vanderbilt University Medical Center; Department Of Electrical Engineering, Vanderbilt University; Department Of Otolaryngology, Vanderbilt University Medical Center, Nashville, TN
Benoit Dawant, PhD; Robert Labadie, MD, Department of Electrical Engineering, Vanderbilt University; Department of Otolaryngology, Vanderbilt University Medical Center, Nashville, TN
Rene Gifford, PhD, Department of Hearing and Speech Sciences, Vanderbilt University Medical Center; Department of Otolaryngology, Vanderbilt University Medical Center, Nashville, TN

Objectives: To investigate the number of electrodes needed for asymptotic speech understanding in cochlear implant (CI) recipients with current CI indications and technology. Methods: Using a within-subjects, repeated measures design with n=16 participants, CI programs were created for active electrode counts ranging from 4-22 in lateral wall and perimodiolar electrode recipients controlling for scalar location. Active electrodes were chosen based on image-guided cochlear implant programming (IGCIP) (Noble et al., 2013&2014) which recommends deactivation of electrodes based on potential spatial electrode interference. Measures of speech understanding, basic auditory function, and sound quality were assessed for each listener with each of the electrode conditions (4-22 electrodes active). Results: At the group level, performance reached asymptote with 16 electrodes for most measures ($p < 0.05$). Perimodiolar recipients achieved asymptotic performance on all measures with 20-22 channels whereas lateral wall recipients reached asymptote at 10 channels. Discussion: CI users have access to more independent channels than previously thought likely secondary to various subject and device related factors including the IGCIP approach to channel selection which may offer higher levels of electrode spatial selectivity and improved spectral resolution. This study holds potential for guiding clinical decision making regarding electrode selection and CI programming.

Poster # 32 – CI05

Evaluation of Automatic Directional Processing with Cochlear Implant Recipients **T35 Research Trainee Poster**

Soo Jang, BS; Lisa Potts, PhD, Washington University School Of Medicine, Saint Louis, MO

Automatic directional processing called Scan is now available to cochlear implant (CI) recipients in the CP900 speech processor from Cochlear Americas. Scan analyzes the acoustic environment and automatically activates one of three directionality options. Phase I evaluated four directionality options including omni-directional, Beam, Zoom, and Scan in a simulated restaurant environment (R-Space). Beam produces maximum suppression that roves between 90 and 270 degrees. Zoom provides maximum, fixed suppression at 120 degrees. Scan resulted in the lowest (best) Reception Threshold for Sentences score of 5.77 dB. Performance with Scan showed significant improvement ($p<0.05$) compared to Zoom (7.05 dB) and omni-directionality (9.04 dB). Phase II evaluated Scan combined with different signal processing options including Autosensitivity (ASC), Adaptive Dynamic Range Optimization (ADRO), and Signal-to-Noise Ratio Noise Reduction (SNR-NR). ASC adjusts the input according to the background noise floor. ADRO alters the input to place the output within the recipient's dynamic range. SNR-NR maintains frequency channels with higher SNRs while attenuating those with poorer SNRs. Performance was best and equivalent (0.1 dB difference) with Scan alone and all processing options

active with Scan+ASC+ADRO+SNR-NR (5.67 dB). These results support the use of automatic directional processing for CI recipients with or without additional processing options active.

Poster # 33 – CI06

Objective Measures: Implanted Children With and Without Cochlear Nerve Deficiency **T35 Research Trainee Poster**

Bahar S. Shahsavarani, MA; Katherine Gill, BS; Tyler C. Mcfayden; Shuman He, PhD, Boys Town National Research Hospital, Omaha, NE

Cochlear nerve deficiency (CND) is characterized by a small or absent cochlear nerve. This study aimed to compare responsiveness of the electrically stimulated auditory nerve between implanted children with cochlear nerve deficiency (CND) and implanted children with normal-size auditory nerves. Objectives: This study aims to evaluate responsiveness of the electrically stimulated auditory nerve in implanted children with cochlear nerve deficiency (CND), and compare to those measured in implanted children with normal-size auditory nerves. Rationale: Better understanding functional status of the auditory nerve in implanted children with CND is important for clinicians to select optimal programming parameters for these patients. Design: Study participants included 41 implanted children with Cochlear Nucleus devices (24 RE or N5) ranging in age between 2.5 and 16.6 years. Of the participants, 23 children were diagnosed with CND and 18 children had normal-size auditory nerves. The stimulus was a biphasic, charge-balanced electrical pulse presented at 15 Hz or lower. It was sent directly to up to 22 electrodes in children with CND and seven electrodes across the electrode array in children with normal-size auditory nerves. For each subject and each stimulating electrode, refractory recovery function and amplitude growth function were obtained by measuring the electrically evoked compound action potential (eCAP). The amplitude growth function was measured using the classic two-pulse forward masking paradigm. The masked response extraction paradigm was used to measure the refractory recovery function. The masker-probe-interval (MPI) — the time between masker stimulus and probe stimulus — was varied between 100 and 10,000 μs. Results: In children with CND, the percentage of electrode with a measurable eCAP decreased from 78.9% to 28.6% as the stimulating electrode moved in a basal-to-apical direction. Preliminary results indicated that children with CND had longer absolute refractory periods than children with normal-size auditory nerves, which is consistent with relative slow pulse rates required in their programming maps. Relative refractory recovery time-constants measured in these two groups were comparable. Slopes of amplitude growth functions measured in children with normal-size auditory nerves were significantly steeper than those observed in children with CND. Conclusions: Children with CND showed poorer responsiveness of the auditory nerve to electrical stimuli than children with normal-size auditory nerves. The degree of damage of the auditory nerve in CND patients is not uniform across the cochlea.

Poster # 34 – CI07

Effect of Polarity on Spread of Excitation in Cochlear Implants **T35 Research Trainee Poster**

Emily Spitzer, BS, University Of North Carolina Chapel Hill, Chapel Hill, NC
Michelle Hughes, PhD, Boys Town National Research Hospital, Omaha, NE

Commercially available cochlear implants (CIs) use symmetric, cathodic-leading, biphasic pulses. Recent evidence suggests that the anodic phase is most effective at stimulating the human auditory nerve. However, much of this work has utilized pseudomonophasic pulses intended to simulate the monophasic pulses used in animal research. For clinically relevant (i.e. standard biphasic) stimuli, the effects of polarity remain unclear. The current study investigated how stimulus polarity affects spread-of-excitation (SOE) measures recorded using the electrically evoked compound action potential (ECAP). SOE patterns were obtained for 16 adult CI recipients using cathodic-leading and anodic-leading symmetrical biphasic pulses. The following measures were compared between polarities: mean ECAP amplitude, peak electrode location, area under the curve, and spatial separation between SOE patterns. The forward-masking artifact-reduction method was used to derive the SOE patterns. Results showed that anodic-leading stimuli yielded ECAPS with larger average amplitudes, broader excitation patterns (greater area under the curve), and less separation between patterns. Polarity had no consistent effect on the location of the peak of the SOE pattern. The broader excitation patterns found with anodic-leading stimuli are likely due to the preferential stimulation of the central axon.

Poster # 35 – CI08

Cochlear Implant Depth of Insertion and Temporal Fine Structure Cues

Weston Adkins, MA; Douglas Sladen, PhD; Matthew Carlson, MD, Mayo Clinic, Rochester, Rochester, MN

Temporal fine structure cues may enhance spatial hearing, speech understanding in noise, and overall sound quality. Existing data suggest many, though not all, patients benefit from temporal fine structure processing. The purpose of this pilot data is to assess the relationship between cochlear implant depth of insertion and a cochlear implant user's ability to take advantage of temporal fine structure cues. A total of twenty-three implant subjects with thin lateral wall cochlear implant electrodes were programmed with a fine structure processing (FSP) strategy and assessed with behavioral methods. The assessment battery included consonant recognition in quiet, sentence recognition in noise, temporal modulation detection, and self-reported qualitative measures. Demographic information such as age of onset of hearing loss, duration of deafness, and pure tone averages both before and after implantation were also collected. A neurotologist measured the angular depth of insertion using postoperative X-ray and CT according to validated protocols. Multiple linear regression was used to determine if depth of insertion predicts behavioral results. Early results of ongoing data collection suggest that deeper insertion depth is associated with better overall consonant recognition as well as an increased ability to discriminate place, manner, and voicing features.

Poster # 36 – CI09

Consideration of Age at Implantation on Cochlear Implant Programming

Meredith Anderson, AuD; Margaret Dillon, AuD, University Of North Carolina At Chapel Hill, Chapel Hill, NC

Cochlear implant recipient's speech perception may be influenced by the coding strategy and/or stimulation rate. Of the multiple coding strategies available, there is not one strategy that consistently demonstrates improved performance. Similarly, reports vary as to whether speech perception is improved with a faster versus slower stimulation rate. Individual variables, including age at implantation, may influence speech perception with different cochlear implant programming manipulations. Older

adults as compared to younger adults have demonstrated requiring a longer duration of device use before a plateau in speech perception is achieved. Understanding the potential relationship between age at implantation and coding strategy and/or stimulation rate may improve early speech perception performance. The aim of this study was to compare the speech perception of younger and older adults listening with different coding strategies and stimulation rates. Both groups' speech perception was compared between the High Definition Continuous Interleaved Sampling (HDCIS) and Fine Structure Processing (FSP) coding strategies after 12 months of listening experience. Differences between groups and coding strategies were noted. Age at implantation may warrant consideration when programming cochlear implant recipients.

Poster # 37 – CI10

Using the Acoustic Signal to Time-lock Bilateral Cochlear Implants

Justin Aronoff, PhD; Hannah Staisloff, BA; Daniel Lee, University Of Illinois At Urbana-Champaign, Champaign, IL
Ann Todd, PhD; David Landsberger, PhD, New York University School Of Medicine, NY

Bilateral cochlear implant (CI) users are generally not sensitive to interaural time difference (ITD) cues when using their clinical processors. Such sensitivity may require synchronized processors. An alternative to physically synchronizing the left and right processors is to use the acoustic signal to time-lock the pulses in the two ears, delivering stimulation at each zero-crossing of the acoustic signal presented to each ear. The goal of this experiment was to determine a) if ITD sensitivity can be improved by using the acoustic signal to time-lock the pulse trains, and b) how that improvement is affected by the sampling rate. ITD sensitivity was measured using a four interval, two alternative forced-choice task. Preliminary data with five subjects indicated that ITD sensitivity was comparable when stimulation for the two ears was physically synchronized and when the acoustic stimulus was used to time-lock pulses in the two ears, but only when a high sampling rate was used. Performance decreased with decreasing sampling rates. The results indicate that it is possible to use the acoustic signal to time-lock the pulses in the two ears and yield good ITD sensitivity. However, high sampling rates may be needed to yield good performance.

Poster # 38 – CI11

Memory Strategies in Adults with Cochlear Implants

Lauren Boyce, BA; Irina Castellanos, PhD; Aaron Moberly, MD, The Ohio State University, Columbus, OH

A considerable amount of unexplained variability exists in performance outcomes following cochlear implantation that is not accounted for by patient factors and auditory sensitivity. The present study examines verbal learning and working memory in postlingually deafened adult cochlear implant (CI) users as compared to their age-matched NH peers. Twenty-seven postlingually deafened adults with CIs and twenty-eight age-matched NH controls were tested using a visually presented version of the California Verbal Learning Test-II. The CVLT is a standardized neuropsychological test that measures foundational cognitive processes by examining primacy and recency effects, proactive and retroactive interference, as well as organizational memory strategies such as serial, semantic, and syntactic clustering. Preliminary results found a relationship with the composite verbal learning score and speech

recognition of Harvard Standard, Anomalous, and PRESTO sentences. Results also suggest that CI users display significant differences in recall strategies compared to their NH peers. Significant differences were found between CI users and NH adults in memory strategy for recalling a word list after multiple presentations and recalling a second, novel word list. CI users were able to recall similar numbers of words overall; however, they differed in which words they recalled. These findings suggest that CI users are engaging in recall strategies that differ from their normal hearing peers.

Poster # 39 – CI12

Exploring Individual Differences in Spectrally Reduced Cochlear-Implant Hearing
Naomi Croghan, PhD; Sara Duran, PhD; Zachary Smith, PhD, Cochlear Ltd., Centennial, CO

Cochlear implants are restricted in the amount of useful spectral information they can provide. Previous work shows that increasing the number of stimulation channels beyond an established upper limit does not yield any additional gains in speech recognition across groups of subjects. However, some individual subjects may be able to utilize this limited spectral information better than others for tasks of speech recognition. This study explored how a range of cochlear implant listeners respond to speech signals that have been spectrally reduced by decreasing the number of channels. Experimental maps were created by allocating multiple channels to a single electrode, holding the frequency boundaries and total stimulation rate constant. Speech recognition was measured using matrix sentences with a background competing talker. The number of channels and target to background ratio varied within subjects. To understand individual differences in performance, a spectro-temporal ripple task and the reading span test of working memory were also conducted. The results of this study examine psychophysical and cognitive factors that may be associated with speech recognition under spectrally degraded conditions. The findings provide new insights into individual variability in the cochlear implant population.

Poster # 40 – CI13

Fine Structure Processing and Spatial Hearing with Bilateral Cochlear Implants
Timothy Davis, AuD; Rene Gifford, PhD, Vanderbilt University, Nashville, TN

Normal-hearing listeners are remarkably sensitive to interaural timing differences (ITDs) and interaural level differences (ILDs), using both to localize sound. Conversely, cochlear implant (CI) sound processors use envelope-based processing which limits ITD cues in the fine structure. Some CI processing strategies attempt to represent fine structure, potentially allowing listeners access to ITD information and improved spatial hearing. The current study evaluated the effects of fine structure processing strategies on spatial hearing abilities including localization, minimum audible movement angle (MAMA), and ITD/ILD tasks compared to an envelope-based strategy. Three noise stimuli (100-500 Hz, 1,500-8,000 Hz, 100-8,000 Hz) were used to assess ITD sensitivity and other spatial hearing abilities. Results from seven adult bilateral CI users revealed that fine structure processing did not lead to any significant benefits at the group level on localization, MAMA, or ITD tasks. Most participants had limited ITD sensitivity, but three participants demonstrated lower (i.e better) ITD thresholds with fine structure processing than envelope-based processing. No participants demonstrated poorer ITD thresholds with the use of fine-structure processing. In summary, like previous studies on a similar signal processing

strategy, fine structure processing was at least as good as envelope-based processing on a variety of spatial hearing tasks.

Poster # 41 – CI14

Effectiveness of Signal Enhancement Technologies in Pediatric Cochlear Implant Recipients
Michael Dorman, PhD; Sarah Natale, MS, Arizona State University, Tempe, AZ

Children undergo a large portion of their incidental and directed learning in noisy environments. Access to speech enhancement strategies like ClearVoice and adaptive directional microphones like UltraZoom has been shown to benefit speech understanding in adults with cochlear implants in noisy situations (refs). The present study aimed to evaluate the benefits of these signal-to-noise ratio improving technologies in pediatric cochlear implant users. Speech understanding was evaluated using pediatric AzBio sentences in steady state (ICRA) noise (S0N90). Three programs were created using participants' everyday program on Naida Q90 processors: (1) ClearVoice and UltraZoom deactivated (noCV/noUZ), (2) ClearVoice alone activated (CV/noUZ), and (3) both ClearVoice and UltraZoom activated (CV/UZ). M-levels in each program were adjusted to achieve comfortable loudness perception in presence of moderate ambient noise levels. Preliminary results (n=3) indicate significantly better speech understanding scores using the ClearVoice (19.4% benefit) and UltraZoom (58% benefit) programs. Findings from at least 10 participants will be presented at the meeting. Programming considerations for ClearVoice will also be discussed.

ELECTROPHYSIOLOGY

Poster # 42 – EP01

Release from Masking Measured Through Speech Evoked Cortical Potentials **Mentored Student Research Poster Award**
Sarah Faucette, BS, East Carolina University, Milwaukie, OR
Andrew Stuart, PhD, East Carolina University, Greenville, NC

Release from masking (RFM) can be described as a perceptual advantage in speech understanding evidenced in interrupted noise compared to continuous noise. This phenomenon exemplifies a temporal resolution phenomenon, as the only difference in the two noises is within their temporal structure. RFM has been illustrated in behavioral measures through both performance difference and signal to noise ratio (SNR) threshold differences of speech understanding with interrupted and continuous noises. The present study sought to demonstrate RFM through speech recognition measured behaviorally and electrophysiologically. Specifically, word recognition performance and reception thresholds for sentences (RTSs) were determined in both interrupted and continuous noise. Cortical auditory evoked potentials (CAEPs) were also recorded in response to a speech token /da/ presented in both noises. RFM was demonstrated behaviorally with better word recognition performance at equivalent SNRs and lower RTSs in interrupted noise. Shorter latencies and larger amplitudes were observed in interrupted noise compared to continuous noise at equivalent SNRs. Further, CAEP thresholds (i.e., the lowest SNR to evoke a measurable response) were lower (better) in interrupted versus continuous noise. Finally, behavioral

and electrophysiological performance and threshold measures were significantly correlated. This is the first demonstration of RFM using an electrophysiological response.

Poster # 43 – EP02

Toneburst and Frequency-Specific Chirp ABRs in Adults with SNHL **Mentored Student Research Poster Award**

Jordan Racca, BA, Department of Hearing and Speech Sciences, Vanderbilt University Medical Center, Nashville, TN; School of Behavioral and Brain Sciences, University Of Texas At Dallas, Dallas, TX
Carol Pang, AuD, Center For Early Intervention On Deafness, Berkeley, CA
Linda Hood, PhD, Department of Hearing and Speech Sciences, Vanderbilt University Medical Center, Nashville, TN; University of Queensland

Auditory brainstem responses (ABR) in persons with normal hearing demonstrate response amplitude and threshold advantages of chirp stimuli. The present study compared tonebursts and octave-band CE-chirps (OB CE-chirps) in adults with sensorineural hearing loss (SNHL). We hypothesized reduced ABR Wave V amplitude advantage with chirp stimuli in individuals with SNHL, due to the design of the chirp stimuli being based on individuals with normal hearing. Eighteen adults with flat or sloping SNHL participated in this study. ABRs were recorded using tonebursts and OB CE-chirps centered at 0.5, 1, 2, and 4 kHz. These results were compared to a previous study of participants with normal hearing (Stangl et al., 2013), completed with the same stimuli, equipment, and lab environment. The current study showed that the higher ABR Wave V amplitudes and lower physiological thresholds for chirps compared to tonebursts in the normal-hearing study were not observed for subjects with SNHL. The latency and amplitude changes were consistent with the stimulus type and the flat or sloping characteristics of the hearing losses. These findings suggest that frequency-specific chirp stimuli do not provide the amplitude or threshold benefit in adults with SNHL that is observed in persons with normal hearing.

Poster # 44 – EP03

Are Variations in Speech-In-Noise Thresholds Related to Central Inhibitory Function? **Mentored Student Research Poster Award**

Michael Smith, BA; Michael Lee, PhD; Christi Miller, PhD; Kelly Tremblay, PhD, University Of Washington, Seattle, WA
Yu-hsiang Wu, PhD; Ruth Bentler, PhD, University of Iowa, Iowa City, Iowa

Cortical alpha activity (~7-12Hz) is an indirect measure of central inhibition, and relates to speech understanding in noise. Much is known about the effects of alpha rhythms during speech in noise tests, but less is known about how an individual's resting alpha state relates to speech-in-noise performance. The purpose of the study was to examine if an individual's inhibitory function, defined by their resting state alpha activity, would predict the threshold at which they correctly repeated 50% of the sentences in noise (e.g., signal-to-noise ratio; SNR-50). Participants were adults with mild-to-moderate hearing loss who used bilateral hearing aid amplification. Hearing aids were not worn during testing. Resting state brain activity was measured using EEG with eyes closed. Alpha power was calculated using FFT analysis. Then, SNR-50 was adaptively determined using 4-talker babble and sentences with the noise held constant at 65 dB SPL. Results suggest that people who have higher SNR-50 thresholds (poorer

perception in noise) have lower resting state alpha activity. Resting state Alpha activity may therefore be predictive of an individual's internal capacity to inhibit noise in the presence of speech, thus correlating to individual SNR-50 performance. Funded by NIH R01 DC012769-05.

Poster # 45 – EP04

Simultaneous Air and Bone Conduction ASSRs at Multiple Frequencies **T35 Research Trainee Poster**

Sarah Camera, BA, University Of Connecticut, Storrs, CT
Linda J. Hood, PhD, Vanderbilt University, Nashville, TN
Rafael E. Delgado, PhD, Intelligent Hearing Systems Corp., Miami, FL

Current newborn hearing screening protocols use air conduction (AC) stimuli to assess hearing. Clinically, bone conduction (BC) is used in conjunction with AC to differentiate sensorineural and conductive hearing losses. The addition of BC testing to newborn hearing screening would provide more accurate information about reasons for referral. Furthermore, simultaneous presentation of AC and BC stimuli could improve efficiency of diagnostic evaluation. The current studies investigate Auditory Steady State Responses (ASSR) for intensity ramped, frequency-specific stimuli presented simultaneously via AC and BC. The first experiment compared stimulus combinations where the same frequencies were delivered via AC and BC or different frequencies were presented to each transducer. Results indicated that simultaneous presentation of different frequencies yields higher amplitude and lower thresholds. For the second experiment, multi-transducer intensity-ramped techniques for frequency-specific testing were compared with traditional ASSR using tonal stimuli centered at 0.5 and 2kHz. ASSRs to paired combinations of AC and BC stimuli were recorded from 15 normal hearing adults, with and without simulated conductive hearing loss. Traditional versus ramped ASSR methods showed comparable response amplitudes. Conductive hearing loss results in an expected shift in thresholds and response amplitude for AC, with minimal changes for BC conditions. [Supported by NIH-NIDCD T35DC0008763]

Poster # 46 – EP05

Discrimination of English /r/ and /l/: Mismatch Negativity (MMN)

Lee Jung An, PhD, Grand Valley State University, Grand Rapids, MI
Brett A. Martin, PhD, The Graduate Center Of The City University Of New York, New York, NY

The effects of native language on the discrimination of English intervocalic /r/ and /l/ by American, Korean, and Japanese listeners were investigated using the mismatch negativity (MMN) and behavioral measures. Stimuli falling within- and across-phonetic category selected from an /iri/-/ili/ continuum were presented using an oddball paradigm. Behavioral discrimination across-phonetic category was significantly better for Americans and Koreans compared to Japanese. When stimuli crossed the phonetic boundary, an early MMN (400-650 ms) was present only for Americans and Koreans; however, a late MMN (655-905 ms) was present for all three language groups. There was no significant difference in early MMN latency or amplitude for Americans and Koreans. For late MMN responses, Americans showed significantly larger amplitudes compared to Japanese or Koreans. The presence of an intervocalic [l]-[ll] contrast in Korean may facilitate active behavioral discrimination as well as automatic, pre-attentive discrimination of English /r/ and /l/ relative to Japanese who do not have a partial phonemic model for

this contrast. The results suggest that native language can facilitate the processing of acoustic information important for phonetic processing and discrimination.

Poster # 47 – EP06

Human Frequency Following Response to Vocoded Signals
Saradha Ananthakrishnan, PhD, Towson University, Towson, MD
Xin Luo, PhD, Arizona State University
Ananthanarayan Krishnan, PhD, Purdue University

Vocoded signals can be used to simulate the effects of cochlear implant speech processing strategies in normal hearing listeners. The amount of spectral and temporal cues available in the vocoded signal can be varied by manipulating the number of channels and the temporal envelope low-pass cutoff frequency respectively. Relative contributions of spectral and temporal cues on vocoded speech perception have been studied extensively, but little is known about the contributions of these cues in neural representation of vocoded signals in normal hearing listeners. In this study, the scalp-recorded Frequency Following Response (FFR) was used to study effects of varying channel number (1,2,4,8,16,32) and low-pass envelope cutoff frequency (50 vs. 500 Hz) on brainstem neural representation of fundamental frequency (F0), and formant-related frequencies, as reflected in the phase-locked neural activity in response to vocoded speech. FFT analyses indicated that brainstem neural representation of F0 improved when number of channels increased from 1-4, plateaued between 8-16, and dropped at 32 channels; no change was seen for brainstem representation of F1-related spectral peaks. Increasing the temporal envelope cutoff frequency from 50 to 500 Hz resulted in an improvement in brainstem F0 representation with no change in brainstem representation of F1-related spectral peaks.

Poster # 48 – EP07

Toward Clinical Application of Electrophysiologic Measures in Assessing Synaptic Integrity
Rebecca Bieber, BS, University Of Maryland, College Park, College Park, MD
Katharine Fernandez, PhD; Kelly King, PhD; Christopher Zalewski, PhD; Carmen Brewer, PhD, National Institute Of Deafness And Other Communication Disorders, Bethesda, MD

Recent findings in the field of hearing science have shown that noise exposure, even when causing only a temporary pure-tone threshold shift, can cause permanent damage to synaptic connections between the sensory hair cells and the auditory nerve. Reliable measures of this synaptic damage - or 'hidden hearing loss' - are not yet available for clinical use. It has been proposed that suprathreshold auditory evoked potentials (AEPs) may be a reliable non-invasive measure of synaptic integrity in humans. The focus of the present study is twofold: first, to examine across-session stability of various components of the early AEP with a focus on amplitude measures; second, to examine the effect of protected noise exposure on early components of the response. Young adults with normal hearing were evaluated up to 4 points in time, with protected fMRI noise exposures occurring prior to the 3rd and 4th evaluations. Testing included pure tone thresholds, DPOAEs, and AEPs. Our data indicate that absolute and relative measurements of the AEP are stable across 2 sessions with no interim noise exposures. These measures remain stable following 1-2 sessions of protected noise exposures in which there was also no evidence of cochlear damage.

Poster # 49 – EP08

Employing the Acoustic Change Complex for Vowel Discrimination
Diane Cheek, BA; Barbara Cone, PhD, The University Of Arizona, Tucson, AZ

A change occurring within an acoustic stream evokes the cortical potential known as the acoustic change complex (ACC). The present study in adults addressed the effects of level and vowel contrast type on ACC amplitudes and latencies and the comparison of ACCs in adults to infants (Cone, 2015). Nineteen normal-hearing adults were tested with vowel tokens, /a,i,o,u/, of 500 ms duration presented at 2/s, at 40 and 70 dBA in the sound-field. ACCs were obtained with the IHS Smart-EP System. ACC amplitudes were significantly larger at 70 dBA but latencies were not affected by level. ACC amplitudes varied with vowel pair, but not latencies. ACC amplitudes for control conditions were 4-6 times smaller than contrast conditions. Contrast versus control amplitude ratios were larger in adults than in infants, and varied as a function of initial vowel. The ACC for vowel contrasts are robust even at low levels (40 dBA), i.e., 25-30 dB SL. Post hoc analyses showed a significant effect of first formant magnitude and direction change, further confirming ACC's sensitivity as a measure of speech feature discrimination. These data set a baseline for a larger study of ACC in infants, children, and adults with hearing loss.

Poster # 50 – EP09

Envelope-Following Response Amplitude and Cochlear Traveling Wave Delay
Christopher Clinard, PhD; Nicole Jones, James Madison University, Harrisonburg, VA

Vowels are frequently used to elicit envelope-following responses (EFRs), and EFR amplitude is examined at the vowel's fundamental frequency (Fo). The purpose of this study was to use simple representations of vowel formants to examine a potential role of cochlear traveling wave delay on EFR amplitude in young, normal-hearing adults. Stimuli were 60 dB SPL amplitude-modulated tones that served as simple models of first and second vowel formants. Two tones were presented simultaneously. One carrier frequency was fixed at 353 Hz. Additional, higher carrier frequencies were selected using a model of cochlear delay; Fo phase delays between pairs of carrier frequencies targeted 90 through 180 by varying their inter-frequency distance. Fundamental frequency was 103 Hz. As expected, EFR amplitude was significantly larger at shorter phase delays (~90) than in conditions where there was only the single 353 Hz carrier frequency. At phase delays close to 180, EFR amplitude was both significantly smaller than at ~90 and was equivalent to the single-frequency 353 Hz condition. These data indicate that cochlear traveling wave delay may affect both amplitude and phase coherence measurements of EFRs. These findings have implications for the interpretation of vowel-elicited EFRs and their potential clinical application.

HEARING DISABILITY

Poster # 51 – HD01

Auditory Function of Blast-Exposed Service Members with TBI
Melissa Kokx-Ryan, AuD; Tricia J. Kwiatkowski, MD; Jaclyn Schurman, AuD; Julie Cohen, AuD; Ashley Zaleski-King, AuD; Douglas S. Brungart, PhD, Walter Reed, Bethesda, MD
Jo Manette Nousak; Sarah E. Kruger, National Intrepid Center Of Excellence, Bethesda, MD

The auditory system is among the most frequently damaged in modern warfare, second only to the musculoskeletal system. Auditory disability accounts for 2.2 million unique service connected disability claims across all Veterans, with over 950,000 new compensation recipients from 2010-2014 alone. While sensorineural hearing loss from noise exposure continues to be a pervasive problem in our military force, recent evidence suggests that blast- and/or noise-exposure without permanent hearing loss can have negative ramifications previously undetected. These exposures can cause difficulties processing auditory information in complex listening environments with impacts on communication and activities of daily living. Here we present the results of peripheral and central auditory tests on active duty Service Members (SMs) with a history of blast exposure and a diagnosis of traumatic brain injury (TBI), and compare them to a group of active duty SMs with no history of blast exposure or TBI. Both groups performed similarly on single-source auditory localization and non-auditory visual reaction time tasks, but the blast-exposed group reported higher levels of hearing difficulty and scored worse in speech-in-noise tests. These differences were not correlated with pure-tone average thresholds. The results are consistent with other studies that have identified functional hearing problems in blast-exposed listeners.

HEARING HEALTH

Poster # 52 – HH01

Community Training on Hearing Loss and Mental Wellbeing Increases Awareness
Laura Coco, AuD; Nicole Marrone, PhD, CCC-A, University Of Arizona Department Of Speech, Language And Hearing Sciences, Tucson, AZ
Rachel Peterson, MA, University Of Arizona Center On Aging, AZ
Floribella Redondo, BS, Arizona Community Health Workers Association, Yuma, AZ

Aging Americans disproportionately live in rural areas where hearing health services are limited. Evidence suggests Community Health Workers (CHWs), in their role as educators, can help promote healthy aging and improve quality of life for those with age-related hearing loss in underserved communities. To date, there is no systematic training for CHWs to raise awareness and sensitivity for hearing loss. In this study, we provided a 2-day training for 12 CHWs from the Arizona-Mexico border to increase knowledge of hearing loss and mental wellbeing, and increase comfort working with older adults who may have hearing loss. The training was assessed using a pre/post questionnaire. Participants who attended both training days reported post-questionnaire improvements in all competencies, including knowledge of hearing loss risk factors, associations with mental health issues, and communication strategies. Participants credited the training with increasing their self-confidence in helping individuals with hearing loss and their families to communicate. This project demonstrated an effective training exercise for frontline public health workers on hearing loss and mental wellbeing. Future efficacy testing is planned to establish this training as an evidence-based approach for increasing

CHW knowledge and skills for identifying and educating individuals and families struggling with age-related hearing loss.

Poster # 53 – HH02

The Effects of Self-Reported Alcohol Use on Hearing Sensitivity
Rachael Cook; Amanda Kaae; Carlee Michaelson; Mallery Eppler; Peter Torre, PhD; Mark Reed, PhD, San Diego State University, San Diego, CA

The effects of alcohol consumption are on the auditory system are not well understood; there is research to show moderate alcohol use is protective whereas heavier alcohol use can be a risk factor for hearing. These data, however, are from older adults; therefore, the purpose of this study is to explore possible hearing sensitivity differences in regards to alcohol use with college-aged adults. Thresholds were measured (0.25-8 kHz) in 23 men and 38 women with an age range from 18-30 years (mean age = 21.3 yrs; SD = 3.0). Otoscopy and tympanometry were completed ensuring normal outer and middle ear function. A survey was also administered to obtain basic participant characteristics and self-reported alcohol use. Low-frequency (0.25, 5, 1, 2 kHz), clinical (0.5, 1, 2, 4 kHz) and high-frequency (3, 4, 6, 8 kHz) pure-tone averages (PTAs) were calculated. Reported drinks per last month (DPM) were categorized as low (<10) and high (>10). Most PTAs had small differences between men and women and across DPM categories. High-frequency PTA in high DPM men was 1.5 dB poorer than low DPM men ($P > 0.05$). This warrants further examination into other possible exposure risks encountered by men.

HEARING LOSS

Poster # 54 – HL01

Risk Factors Associated with Childhood Hearing Loss: A 3-Year Review **Mentored Student Research Poster Award**
Kelsey Dumanch, BS; Lenore Holte, PhD; Elizabeth Walker, PhD, University Of Iowa, Iowa City, IA
Tammy O'hollearn, Iowa Department of Public Health, Des Moines, IA

In their 2007 position statement, the Joint Committee on Infant Hearing identified risk factors associated with childhood hearing loss; however, studies demonstrating the associations are mixed. Iowa's Early Hearing Detection and Intervention legislation mandates reporting of these risk factors and reporting of audiologic evaluations for children up to 3 years of age. This retrospective study analyzed data for the 115,039 children born in Iowa from 2010 through 2012. Data analyses included prevalence rates, odds ratios, and Fisher's exact test of statistical significance. 90% of children were born with no risk factors for hearing loss; of those, 99.9% demonstrated normal hearing by three years of age. Of the 10% of children born with risk factors, 96.3% demonstrated normal hearing by age 3. Factors that placed children at the highest risk of congenital hearing impairment were neurodegenerative disorders, syndromes, and congenital infections. Factors that placed children at the highest risk of developing permanent postnatal hearing loss were congenital cytomegalovirus, syndromes, and craniofacial anomalies. Results suggest certain risk factors place a child at significantly greater risk of hearing loss. This demonstrates the need

for continued risk monitoring and diagnostic testing to remain a priority for children with certain risk factors for hearing loss.

Poster # 55 – HL02

Intra-Individual Differences in Working Memory for Speech in Listeners With Hearing Loss
Mentored Student Research Poster Award
Sam Hester, BS, East Tennessee State University, Antioch, TN
Sherri Smith, PhD, Auditory Vestibular Research Enhancement Award Program, Mountain Home Va, Mountain Home, TN
Kathy Pichora-fuller, PhD, University of Toronto, Mississauga, Ontario

Difficulty understanding speech in the presence of background noise is a top complaint of individuals with hearing loss. This difficulty seems to be due to auditory (namely type and degree of hearing loss) as well as cognitive (namely working memory capacity) processing abilities. Many researchers have measured inter-individual differences in working memory capacity, but little is known about intra-individual differences. Gaining insight into these differences could give way to using a proposed auditory working memory test as an outcome measure of hearing aid benefit. In this study, we set out to examine such intra-individual differences across unaided-in-quiet, aided-in-quiet, and aided-in-noise conditions of the Word Auditory Recognition and Recall Measure (WARRM) of working memory capacity. We hypothesized that improved audibility and reduced processing load between unaided-in-quiet and aided-in-quiet conditions would correlate to improved working memory capacity. We predicted that reduced processing load between the aided-in-noise and aided-in-quiet conditions would correlate to improved working memory capacity as well.

Poster # 56 – HL03

Comparison of Methods for Evaluating Horizontal-Plane Sound Localization **Mentored Student Research Poster Award**
Erin Nelson, BFA; Ruth Reeder, MA; Laura Holden, AuD; Jill B. Firszt, PhD, Washington University In St. Louis, School Of Medicine, Saint Louis, MO

Binaural hearing allows listeners to take advantage of auditory cues necessary for horizontal sound localization, such as interaural differences in time and level. Patients with asymmetric or unilateral hearing loss receive degraded or absent binaural cues and often demonstrate decreased sound localization abilities in the horizontal plane. There is a growing need to evaluate localization, given the importance of sound localization for everyday function and for possible expansion of cochlear implant candidacy criteria. The goal of this study was to compare three methods for evaluating sound localization abilities in normal hearing (NH) listeners and listeners with unilateral hearing loss (UHL). Rear-facing localization performance with the Direct Connect (DC) Binaural Test System was compared to front- and rear-facing soundfield localization. Behavioral chance performance in rear-facing DC and soundfield testing was established, as well as test-retest reliability for all three localization test setups. Preliminary results suggest chance behavioral performance on rear-facing soundfield localization is comparable to previously reported front-facing performance, but different from direct connect. Localization performance for the UHL group was significantly poorer than for the NH group in all test conditions,

however, UHL performance was consistent across all test setups unlike the NH group. Future directions of this study include the expansion of testing to include adults with single sided deafness who have received cochlear implants.

Poster # 57 – HL04

Age Related Hearing Loss and Resilient Functional Capacities
Razan Al Fakir, PhD, Mayo Clinic Florida, Jacksonville, FL
Alice Holmes, PhD, Emeritus Professor At University Of Florida, Gainesville, FL

Untreated age-related hearing loss (ARHL) has become a national health concern (PCAST, IOM, and NIH). To approximate factors underlying ARHL we used the resilience perspective and approach. The goal of this study was to develop and validate a tool designed to assist the standard audiologic evaluation by documenting functioning from the body, person, and community perspective, individualize audiologic assessment plan, and predict sources of mismatch between objective and subjective outcomes measure and mismatch between magnitude of ARHL and concerns of the individual being evaluated. A self-rated questionnaire was created using the ICF framework, 17 selected categories from the ICF core sets for HL, and the ICF single-item scale. The rated problems were compared with scores of alignment outcome measure across a 131 older adults who complaining of speech understanding and listening-conversation difficulties. Collected data were analyzed using the exploratory factor analysis, regression, and structural equation modeling to identify factors and key elements that are responsible for positive or poor outcomes related to auditory function and disability. This poster will review the development and findings of this novel tool and discuss the pivotal future role of this tool in improving access and quality of hearing healthcare for adults and older adults.

Poster # 58 – HL05

Normal Hearing Thresholds in the VA **T35 Research Trainee Poster**
Lauren Dillard, BS, University Of Wisconsin-madison, Madison, WI
Tina Penman, AuD; Zach Hoskins, BA, National Center For Rehabilitative Auditory Research, Va Portland Health Care System, Portland, OR
Curtis Billings, PhD, National Center for Rehabilitative Auditory Research, VA Portland Health Care System & Oregon Health and Sciences University, Department of Otolaryngology, Portland, OR

Previous work has shown that patients with normal-hearing thresholds comprise a significant proportion of visits to audiology clinics, and that a subset of this population reports having difficulties hearing in a variety of listening environments. This study investigated the prevalence of normal-hearing Veterans visiting Department of Veterans Affairs (VA) audiology clinics and further analyzed this population's audiometric test results. Results may help to improve our understanding of auditory and non-auditory abnormalities associated with the normal-hearing population. Analysis was performed on data from the Denver Acquisition Logistics Center (DALC) Repository. Normal hearing was defined as thresholds -25 dB at all octave frequencies from .25-8 kHz. Results demonstrate that the prevalence of normal-hearing Veterans tested in VA audiology clinics in this dataset was approximately 10%. In addition, the prevalence of abnormal results within this sample are reported; these results include information on audiogram configuration, speech testing, and physiologic measures. Results from this study give some

indication that even within the defined range of normal hearing, there are complexities and potential abnormalities that may assist in understanding why patients with normal audiometric thresholds sometimes report hearing difficulties.

Poster # 59 – HL06

Deciphering 'Hidden Hearing Loss' Using Brain-Behavior Relationships
Saradha Ananthakrishnan, PhD; Danielle Yurjevich, Towson University, Towson, MD

'Hidden hearing loss' refers to difficulties in suprathreshold auditory perception, especially in adverse listening conditions, in listeners with clinically normal audiograms and a history of noise exposure. Cochlear neuropathy or synaptopathy has been implicated as a possible cause of hidden hearing loss in the animal model. The objective of the current study is to determine whether or not variability in suprathreshold auditory perception skills, particularly in difficult listening situations, can be mapped to specific neural metrics in human listeners. In order to examine these 'brain-behavior' connections, if they exist, we examine the relationship between suprathreshold tests of auditory processing (e.g. gap detection tasks, speech in noise tasks), otoacoustic emissions (OAEs), and the Frequency Following Response (FFR) in listeners with clinically normal hearing and varying degrees of noise exposure. Auditory processing tests provide information about behavior or percept, OAEs are a test of cochlear function, and the FFR indicates the strength and precision of neural phase-locking at the level of the rostral brainstem. Together, these metrics can be used to summarize and correlate auditory perception/encoding occurring at different levels in the auditory system.

Poster # 60 – HL07

Hidden Hearing Loss in College-age Musicians: Electrophysiologic Measures
Lata Krishnan, PhD; Elizabeth Marler; Erika Vannarsdall; Chandan Suresh, MS; Ananthanarayan Krishnan, PhD, Purdue University, West Lafayette, IN

Recent animal studies have shown that even moderate levels of noise exposure can lead to cochlear synaptopathy, a disruption of auditory nerve synapse structure and function. This has been described as hidden hearing loss because of preservation of normal hearing sensitivity in the presence of auditory nerve damage. We evaluated distortion product otoacoustic emissions (DPOAE) and auditory brainstem responses (ABR) in normal-hearing college-age musicians and non-musicians, to determine if recreational exposure to music produced changes in these responses consistent with hidden hearing loss. For the musicians, results showing larger DPOAE amplitudes above 2000 Hz; reduced SP amplitude; and reduced ABR Wave I and Wave V amplitudes across stimulus levels and rates are consistent with hidden hearing loss. Findings suggest intact or enhanced outer hair cell function (larger DPOAE amplitude); reduced inner hair cell drive (decreased SP) and disruption of synchronized neural activity generating both the auditory nerve response (Wave I) and the more rostral brainstem response (Wave V). Clinical implications of these results include the possibility of early identification of hidden hearing loss among young adults, and counseling regarding hearing protection to prevent hidden hearing loss.

Poster # 61 – HL08

Bayesian Network Approach to Estimating 'Direct' Hearing Loss Risk Factors

Chuan-Ming Li, PhD; Le Chen, MA; Howard Hoffman, MA, Epidemiology And Statistics Program, National Institute On Deafness And Other Communication Disorders (NIDCD), National Institutes Of Health (NIH), Bethesda, MD
Christa Themann, PhD, Hearing Loss Prevention Team, Division of Applied Research and Technology, National Institute for Occupational Safety and Health (NIOSH), Centers for Disease Control and Prevention (CDC)
Gudny Eiriksdottir, PhD; Vilmundur Gudnason, PhD, The Icelandic Heart Association, Kopavogur, Iceland
Lenore Launer, PhD, Intramural Research Program, Laboratory of Epidemiology and Population Sciences, National Institute of Aging (NIA), National Institutes of Health (NIH)
Hannes Petersen, MD, Department of Otolaryngology-Head and Neck Surgery, Landspitali-National University of Iceland, Reykjavik, Iceland

Logistic regression is often used to identify risk factors for hearing impairment (HI) with the implicit assumption of direct association. Bayesian network analysis can distinguish direct from indirect associations. The Age, Gene/Environment Susceptibility-Reykjavik Study (AGES-RS) is a population-based, longitudinal epidemiologic cohort study focused on age-related phenotypes. In AGE-RS I (2002-2006), 5172 older adults, 67+ years, completed air-conduction, pure-tone audiometric examinations; in AGES-RS II, 3409 completed re-examinations five years later. A two-stage model was used to identify 'direct' risk factors. First, stepwise logistic models were used to select risk factors across several variable domains. Bayesian network analysis was then used to distinguish direct from indirect risk factors. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated. In AGE-RS I, male sex (OR=1.39; CI:1.39-1.59), age in years (OR=1.18; CI:1.17-1.20), tinnitus (OR=1.77; CI:1.46-2.15), noise exposure (OR=1.78; CI:1.55-2.05), and renal failure (OR=1.51; CI:1.19-1.93) were identified as directly associated. In AGE-RS II, tinnitus (OR=2.03; CI:1.54-2.69), noise exposure (OR=1.48; CI:1.23-1.79), age in years (OR=1.18; CI:1.16-1.21), and fasting glucose (OR=1.01; CI: 1.001-1.012) were directly associated. The network analysis proved useful for distinguishing direct from indirect risk factors. Sex, age, tinnitus, noise, renal failure, and fasting glucose levels were found to be directly associated with HI.

IMMITTANCE

Poster # 62 – IM01

Improving Predictions of Real-Ear-To-Coupler Differences in Children Using Immittance

Ryan McCreery, PhD; Meredith Spratford, AuD; Marc Brennan, PhD, Boys Town National Research Hospital, Omaha, NE
Elizabeth Walker, PhD, University Of Iowa, Iowa City, IA

The real-ear-to-coupler difference (RECD) is an essential component of hearing aid verification for children. For children who cannot cooperate for an individual RECD measure, age-related average RECD measures are available in one-month intervals up to five years of age. Individual variability in RECD of +/- 10-15 dB for children who are the same age limits the accuracy of hearing aid verification using average RECD. The goal of this study was to incorporate measures of ear canal volume and middle ear function that are routinely collected during audiological evaluation to better characterize individual

variability in ear canal acoustics and improve the accuracy of hearing aid verification using average RECD. Measured RECD values from children who wear hearing aids were predicted using age-related average RECD values. Individual prediction errors were 10-20 dB. Adding ear canal volume improved predictions of the child's actual RECD and reduced errors, though the magnitude of improvement varied considerably across frequency, and the child's age and middle ear status. A clinical tool will be developed to allow clinicians to use age and ear canal volume to make more accurate predictions of RECD in children than using age-related averages alone. Work supported by NIH-NIDCD.

Poster # 63 – IM02

Publically Accessible Database for Wideband Acoustic Immitance Measures
Tinli Yarrington; Susan Voss, PhD, Smith College, Northampton, MA
Nicholas Horton, PhD, Amherst College, Amherst, MA

Wideband acoustic immitance measures (WAI) offer a noninvasive tool for identifying abnormal middle-ear function. In order to employ WAI for diagnostic purposes, a description of WAI from normal ears is needed; this work provides a platform for combining normative WAI data from different studies into a centralized database so that the effects of age, gender, measurement equipment, and race on WAI can be assessed. The database is structured as three tables: "Principal Investigator" records where the dataset is published; "Subject" records information on each subject including age, gender, race, ethnicity, and ear status; and "Measurements" contains instrument used, session number, ear-canal area, measurement frequencies, and measured absorbance & measured impedance (magnitude and angle) at each measurement frequency. The database is publically available online at http://www.science.smith.edu/wai-database/ to (1) download WAI data or (2) submit WAI data for approval and inclusion. Any peer-reviewed, published measurements are welcomed for submission to the database. This presentation will demonstrate how data can be selected from the database, plotted, and used for analysis. In the future, the database will be expanded to include data from abnormal ears and ears of minors. Additionally, this database provides an example platform for sharing biomedical measurements.

NOISE EXPOSURE

Poster # 64 – NE01

Adaptation of the Dangerous Decibels Program for an Adult Audience **T35 Research Trainee Poster**
Jolene Sletten, BA, University Of Colorado-boulder, Denver, CO
Gabrielle Saunders, PhD; Susan Griest, National Center For Rehabilitative Auditory Research, Portland, OR

Many individuals are exposed to noise levels occupationally, recreationally, and environmentally for durations that could place them at risk for developing a noise-induced hearing loss (NIHL; World Health Organization, 2015). In fact, about 26 million adults in the United States have a hearing loss that is potentially caused by exposure to unsafe levels of noise (National Institutes of Health, 2014). Despite knowing the damaging effects noise can have on hearing, many individuals do not use hearing protection

(Ivory et al., 2014) and/or other preventative strategies (Vogel et al., 2008). For this reason, public health campaigns such as the Dangerous Decibels (DD) program, have been developed in an effort to decrease the occurrence of NIHL. Currently, the DD program targets children and adolescents. It aims to increase knowledge, attitudes, and intended behaviors towards hearing and hearing-loss prevention in an entertaining, interactive, and inventive manner (Griest, 2008). The program has been shown to be effective in 4th and 7th grade populations (Griest et al., 2007). In this study we aim to determine how the DD program should be adapted for an adult audience because health messages are more effective when tailored or targeted to a specific audience (Kreuter et al., 2003).

OTOACOUSTIC EMISSIONS

Poster # 65 – OAE01

The Effects of Attention and Concussion on DPOAE Suppression **Mentored Student Research Poster Award**

Michael Mangini, PhD; Matthew Wilson, PhD, Northern Illinois University, DeKalb, IL

Distortion product otoacoustic emissions (DPOAEs), a measure of the automatic peripheral response of outer hair cells, can be suppressed via efferent pathways when a contralateral broadband stimulus is presented. The magnitude of suppression has been reported to modulate with central attention and neurologic disorders. Here we investigate whether concussive head trauma and its resultant diminished attentional resources might result in differential attentional modulation of DPOAEs. Thirty-three normal hearing (AC -15 dB HL) individuals participated in our study. Eighteen of the participants had a history of concussion (average concussions = 2.4) while fifteen reported no concussions. Participants performed five attention conditions while DPOAEs were measured in the right ear with a contralateral suppression stimulus. Attention conditions included: attend to DPOAE stimuli, attend to suppressor, and perform visual matching under low, medium, and high attentional demand. Consistent with previous studies, analyses of DPOAE measures showed a significant suppression effect, and that greater attentional difficulty resulted in lower DPOAEs. We additionally found that the concussion group produced lower DPOAEs in high frequencies. While a DPOAE attention effect does not appear to provide a marker for the effects of concussion, the unanticipated decrease in high frequency DPOAEs for concussed individuals should be further investigated.

Poster # 66 – OAE02

Efferent-Induced Changes to Synchronized-Spontaneous Otoacoustic Emissions **Mentored Student Research Poster Award**

Britney Ometz, BS; Rebecca Walston; James Lewis, PhD, University Of Tennessee Health Science Center, Knoxville, TN

Click-evoked otoacoustic emissions (CEOAEs) provide a non-invasive means to assay the influence of the medial-olivocochlear (MOC) efferent system on cochlear processing; however, detecting MOC-induced CEOAE changes is complicated by the small size of the effect. Subjects with synchronized-spontaneous otoacoustic emissions (SSOAEs) may be aptly suited for MOC studies due to higher CEOAE magnitudes

and signal-to-noise ratios, which facilitates detection of small MOC effects. CEOAEs and SSOAEs were measured in 19 normal hearing, female adults in quiet and in the presence of contralateral noise. OAE instantaneous magnitude and phase were compared across a time-window spanning the CEOAE and SSOAE to determine the temporal locations associated with the largest MOC effect. Three classes of OAEs were identified: fast-decaying (CEOAE only), medium-decaying (CEOAE + fast-decaying SSOAE) and slow-decaying (CEOAE + slow-decaying SSOAE). Frequency bands with slow-decaying and fast-decaying SSOAEs both exhibited largest MOC effects at latencies beyond those of the CEOAE. MOC effects in frequency bands lacking SSOAEs were smaller than those in frequency bands with SSOAEs. Given these findings, SSOAEs are expected to be useful when investigating top-down influences on the MOC response and/or evaluating the integrity of the efferent system.

Poster # 67 – OAE03

Two Birds, One Stone: Clicks Evoke Both OAEs and Efferents

Sriram Boothalingam, PhD; Sumitrajit Dhar, PhD; Julianne Kurke, Northwestern University, Evanston, IL

The auditory efferent system has been implicated in both typical auditory processing, including speech perception in noise, and in certain disorders. However, a standard test of efferent function currently does not exist. Typically, the efferents are activated using broadband noise and its effects on the cochlea are assayed using otoacoustic emissions (OAEs) in the ear contralateral to the broadband stimulation. This poses problems with artifactual elicitation of the middle-ear muscle reflex (MEMR) and complications for ipsilateral activation of the efferents. In an attempt to develop an artifact-free measurement of ipsilateral, contralateral and bilateral efferent inhibition OAEs we have designed a method that uses clicks to seamlessly evoke both efferent activity and obtain OAEs. This allows for near-simultaneous estimation of cochlear and efferent health. In the present study, we manipulated ipsilateral click rate and level to identify an optimal rate/level combination that evokes efferents while allowing recovery of OAEs. ,Initial findings (n=17) demonstrate reliable efferent inhibition of OAE for clicks presented at 62.5 Hz, and at levels typically used in clinical settings -- 80 dB peSPL. Similar results from contralateral and binaural stimulation will also be presented.

Poster # 68 – OAE04

MOCR Variability Across CEOAEs and DPOAEs

Kayla Ichiba, BS; Siena Schoelen; Alireza Pourjavid, MS; Barbara Cone, PhD, University Of Arizona, Tucson, AZ

The purpose of this research was to estimate the strength and stability of the MOCR for Click-Evoked (CEOAE) and Distortion Product (DPOAE) otoacoustic emissions in individuals. The OAE method yielding the higher amplitude and lesser variance may be suitable for clinical translation. 24 female college-aged subjects participated. The Otodynamics ILO-88 was used to obtain CEOAEs and DPOAEs using levels of 50 and 60 dB SPL CEOAEs and F1 and F2 primaries at 65 and 50 dB SPL for DPOAEs, in quiet and with contralateral broadband noise at 60 dB SPL. CEOAE and DPOAE amplitudes were reduced in the contralateral noise condition, consistent with the activation of the MOCR. DPOAE amplitudes were analyzed as a function of F2 frequency: low (1001 - 1831 Hz), mid (2002 - 3662 Hz) and high (4004 - 6165 Hz). The mean DPOAE-MOCR inhibition was 1.15, 0.99, and 0.24 dB in these ranges, respectively.

The mean CEOAE-MOCR inhibition was 1.67 and 1.39 dB at 60 and 50 dB SPL, respectively. CEOAE-MOCR values were larger than those for DPOAE and less variable. Instances of 'enhancement' due to MOCR activation were rare. A distinction between subjects who enhance rather than inhibit may be a useful starting point for clinical application.

Poster # 69 – OAE05

DPOAE Components and Alcohol Use in Young Adults
Amanda Kaae; Rachael Cook; Carlee Michaelson; Mallery Eppler; Mark Reed; Peter Torre, San Diego State University, San Diego, CA

Distortion product otoacoustic emissions (DPOAEs) have been shown to be significantly poorer in alcoholics. The purpose of this study was to evaluate how self-reported alcohol use affects DPOAEs in younger adults. Sixty-one undergraduate students, 38 women and 23 men (mean age=21.3 years; SD=3.0) participated. Survey data included self-reported alcohol use. Measures were otoscopy, tympanometry, and DPOAEs. DPOAE data were obtained from 1-6 kHz using stimulus tones (L1,L2=55,40 dB SPL, f2/f1=1.22; f2 >f1) swept in frequency at 8 sec/octave and subsequently separated into nonlinear and reflection components. One alcohol variable, reported drinks per last month (DPM), was categorized as low (<10) and high (>10). All DPOAE data were collapsed into third-octave bands (1, 1.5, 2, 3, 4, and 5 kHz) and considered present >-20 dB SPL. High DPM women had lower DPOAEs at most frequencies compared with low DPM women; conversely high DPM men had higher DPOAEs than low DPM men (sex-by-frequency interaction; p>0.05). Measurable nonlinear components were similar between high and low DPM groups. In the first four frequencies, the high DPM group had fewer measurable reflection components. For most frequencies, men in the high DPM category had higher nonlinear and refection levels than men in the low DPM category.

PSYCHOACOUSTICS

Poster # 70 – PSY01

Glimpsing Envelope and Periodicity Cues: Aging Effects and Competing Talkers **Mentored Student Research Poster Award**
William Bologna, AuD; Judy Dubno, PhD, Medical University Of South Carolina, Charleston, SC

Recognition of interrupted speech requires connecting speech glimpses over time and filling in missing information. Intelligibility improves when silent gaps contain temporal envelope and/or periodicity information from the missing speech segment. In multiple-talker environments, recognition of interrupted speech is more difficult, particularly for older adults. The extent to which younger and older adults can use envelope and periodicity cues to facilitate recognition of interrupted speech in realistic environments remains unclear. To address these questions, younger and older adults with normal hearing listened to interrupted sentences in quiet and with a competing talker. Sentences were interrupted with (1) silence, (2) envelope-modulated noise, (3) steady-state pulse trains, or (4) envelope-modulated pulse trains. Results indicated that intelligibility of interrupted sentences improved when silent gaps were filled with envelope and periodicity cues with and without a competing talker;

improvements in intelligibility were additive when both cues were present. Older adults performed poorer than younger adults overall, particularly with a competing talker, and benefited more from envelope cues than periodicity cues. These findings suggest that older adults may rely heavily on envelope cues to connect glimpses of speech across time in realistic environments. [Supported by NIH/NIDCD]

Poster # 71 – PSY02

Aging and the Additivity of Masking at the Cocktail Party **Mentored Student Research Poster Award**

Gabrielle R. Merchant, PhD; Richard F. Freyman, PhD; Karen S. Helfer, PhD, University Of Massachusetts Amherst, Amherst, MA

Multi-talker listening environments, like crowded restaurants, are highly complex. In addition to the target talker, the auditory scene may consist of a combination of one or two interfering talkers close to a listener that would likely be relatively high in level (e.g., from people at the same or a nearby table) and numerous additional masking talkers at greater distances whose voices reach the listener at lower levels. Our understanding of how these masking components combine is limited by the fact that most studies of multi-talker listening present all interfering talkers at the same level. The current study explored the extent to which interference of different level talkers may be independent of one and other, and whether aging would influence any effect, given that previous research has found that older adults have more difficulty in complex listening environments. This work considered whether error rates in a speech understanding task could be predicted from the error rates for two individual components of the masker, specifically from (a) two higher-level (closer) talkers and (b) four lower-level (more distant) talkers. The variables of age (younger vs. older listeners), hearing loss, angular location, and level difference of the 'closer' and 'farther' talkers were considered.

Poster # 72 – PSY03

Interaural Differences: Relationships of Binaural Sensitivity to Age and Hearing Loss **T35 Research Trainee Poster**

Samuel Bernhisel, BS, The University Of South Florida, Tampa, FL
Meghan Stansell, National Center For Rehabilitative Auditory Research, Portland, OR
Sean Kampel, AuD; Frederick Gallun, PhD, National Center for Rehabilitative Auditory Research, Oregon Health & Science University, Portland, OR

Binaural sensitivity is a crucial to the ability to benefit from spatially separated sound sources. Previous work that has examined this relationship has identified substantial individual variability in spatial benefit. The study was designed to provide an initial look at the question of how much variability would be observed in basic binaural sensitivity and the degree to which age and hearing loss contributed to that variability. Forty individuals varying in age and audiometric thresholds participated in the study and data were collected on five different conditions, with either time or intensity differences imposed on the envelope or fine structure of the dichotic signal. A psychometric task was used to find each participant's threshold for each of the conditions. Results revealed a wide range of thresholds in all five tasks, as had been hypothesized. Surprisingly, however, there were no significant differences in detection thresholds

between young normal hearing individual and older normal hearing individuals and older individuals with hearing impairment on any of the tasks. These results suggest that using bilateral amplification could allow some older hearing impaired listeners to make use of binaural cues previously thought to be inaccessible to this population.

Poster # 73 – PSY04

Effect of Level on Spectral Ripple Detection Thresholds in Adults **T35 Research Trainee Poster**

Erik Jorgensen, BA, University Of Iowa, Iowa City, IA
Emily Buss, PhD, University Of North Carolina
Benjamin Kirby, PhD, Illinois State University
Frederick Gallun, PhD; Michelle Molis, PhD, National Center for Rehabilitative Auditory Research
Ryan McCreery, PhD; *Marc Brennan, PhD*, Boys Town National Research Hospital

Listeners with SNHL show poorer spectral ripple detection thresholds (SRDTs) than listeners with NH. However, the effect of level on SRDTs has not been examined. SRDTs were measured in subjects with and without SNHL at three ripples per octave (RPO: 0.5, 2 and 4) and various sensation levels (SL: 10, 20, 40, and 60 dB SL, and 90 dB SPL). Due to broader auditory tuning, it was hypothesized that SRDTs would increase with increased level and RPO; these effects might be expected to be greater in listeners with than without SNHL. SRDT varied significantly with level, hearing status, and spectral density. For listeners with NH, thresholds improved with SL for .5 RPO. In contrast, for 2 and 4 RPO, thresholds decreased from low to mid SLs and then increased at higher SL. This effect was greater for 4 than 2 RPO. For the listeners with SNHL, a similar pattern was observed. Thresholds improved with SL for .5 RPO. Thresholds improved for 2 and 4 RPO from low to mid SL and then increased at high SL. The negative effect of SL on thresholds at 2 and 4 RPO occurred at a lower SL for the listeners with than without SNHL.

Poster # 74 – PSY05

Binaural Interference with Simulated Electric Acoustic Stimulation (EAS) **T35 Research Trainee Poster**

Chantal van Ginkel, BS, University Of Wisconsin-madison, Madison, WI
G. Christopher Stecker, PhD; Rene H. Gifford, PhD, Vanderbilt University, Nashville, TN

The prevalence of preserved low-frequency acoustic hearing in cochlear implant (CI) recipients is increasing due to expanded indications and FDA approval of electric and acoustic stimulation (EAS)/Hybrid systems. This study investigated the effect of simulated EAS spectral overlap on binaural sensitivity to interaural time (ITD) and level difference (ILD) cues. Various degrees of spectral overlap were manipulated with simulated monaural and binaural EAS conditions to determine the presence of binaural interference for lateralization abilities. Ten normal-hearing listeners lateralized a rectangular band of noise (100-1000 Hz), in the presence of a high-frequency interferer (complex Gabor click train). Degraded lateralization ability was observed in the monaural condition using either cue, which results suggest was caused by both binaural interference and physical spectral overlap. Providing an EAS gap, defined by an unstimulated frequency region from 1-3 kHz, resulted in the best performance. Listeners also displayed significantly lower thresholds with simulated bilateral electric stimulation compared to unilateral stimulation. Furthermore, mean ITD thresholds in the binaural EAS full condition were

significantly better than the monaural EAS gap condition. In conclusion, bilateral implantation with bilateral acoustic hearing preservation could allow for higher tolerance of spectral overlap in CI users and improved localization abilities over unilateral EAS. [Supported by NIH-NIDCD T35DC0008763]

Poster # 75 – PSY06

An Efficient Method for Deriving Band Importance Functions for Non-English Speech Materials
Md.Shariful Alam, MS; Msa Zilany, PhD; Hua-nong Ting, PhD, University Of Malaya, Kuala Lumpur
Evelyn Davies-venn, PhD, University of Minnesota, MN

Band importance functions (BIFs) are vital for predicting speech intelligibility for individuals using hearing aids as well as for those with normal hearing. While these functions are expected to vary for different speech materials, they are sparse for non-English speech. This study developed a method for determining BIFs for Malay speech using an efficient protocol that could be used for other languages. BIFs were derived using 21 band divisions for Malay consonant-vowel (CV) monosyllabic words. A compound technique was used to generate the BIF, where on a given trial a band of interest was presented along with four other bands, and in the corresponding trial, only the other four bands were present. The difference between paired band-present and band-absent trials was used to calculate the importance of the band of interest. Our results to date, show significant differences between the Malay and English BIFs which underscores the need for developing an efficient method of obtaining language specific BIFs. The noted differences may also have clinical implications for signal processing design, especially for hearing devices that are intended to improve speech understanding in noise for non-English speakers.

Poster # 76 – PSY07

Inherent Envelope Fluctuations in Forward Maskers: Effects of Compression Amplification
Marc Brennan, PhD, Boys Town National Research Hospital, Omaha, NE
Adam Svec, PhD, Resound, Bloomington, MN
Peggy Nelson, PhD, University of Minnesota Center for Applied and Translational Sensory Science, Minneapolis, MN

Previous research has demonstrated that adults with sensorineural hearing loss (SNHL) are more susceptible to the disruptive effects of inherent envelope fluctuations in a forward masker than listeners with normal hearing (NH). The mechanisms that contribute to this deficit but may include excess masking due to the loss of cochlear nonlinearity, listener age and abnormal persistence of listener uncertainty for SNHL listeners. Regarding reduced cochlear compression, restoration with compression amplification should minimize differences attributable to this deficit. The effect of inherent envelope fluctuations was examined by comparing forward-masked thresholds with Gaussian noise (GN) and low-noise noise (LNN) maskers followed by a pure-tone signal at 25-, 50- and 75-ms delays. Listener groups were young NH, older NH and older SNHL. Poorer thresholds were observed for GN than LNN in the older NH and older SNHL listeners at all masker-signal delays. Poorer thresholds were observed for GN than LNN in young NH listeners at 25-ms but not at longer masker-signal delays. When aided, the SNHL listeners did not reveal the excess masking associated with GN relative to LNN. These results suggest that both age and compression contribute to forward masking effects from inherent envelope fluctuations.

Poster # 77 – PSY08

Speech-On-Speech Masking: Perceptual Similarity and Observed Informational Masking
Lauren Calandruccio, PhD, Case Western Reserve University, Cleveland, OH
Emily Buss, PhD, University Of North Carolina, Chapel Hill, NC

Though it has consistently been shown that two competing talkers tend to cause a significant amount of informational masking for open-set sentence recognition tasks, the specific speech stimuli that are used can significantly impact the amount of informational masking that is observed. For example, a male talker is easier to understand if the background is composed of female talkers compared to other male talkers. Two questions will be explored in this presentation. The first will consider the contribution of each masker talker to the overall effectiveness of a two-talker masker, with consideration of the perceptual similarity between the target and masker speech. The second question will explore the importance of semantic meaning and rhythm of the masker speech and its contribution to informational masking observed for speech-on-speech masking. This question will be explored by utilizing several different maskers that vary in semantic meaning and syntax structure. Data from normal-hearing listeners will be presented exploring these two research questions.

Poster # 78 – PSY09

Top-down Control of Cochlear Mechanics - Bilingualism and Spontaneous OAEs
Sumitrajit Dhar, PhD; Tuan Lam, PhD; Viorica Marian, PhD, Northwestern University, Evanston, IL

The auditory efferent neural network descends from the cortex to the outer hair cells in the cochlea and can be the conduit for controlling active cochlear mechanics. By comparing changes in spontaneous otoacoustic emission (SOAE) levels and peak frequency during an audio-visual speech perception task, we explored the influence of cognitive function and language experience on the top-down control of cochlear mechanics. A group of 49 normal-hearing, young adults, divided into three groups (monolinguals, early bilinguals, late bilinguals) participated. Bilinguals exhibited statistically significant larger changes in SOAE level and frequency. SOAE changes were also significantly predicted by performance on the Flanker task and the Card-Sort task - both tasks requiring inhibitory control. An independent effect of bilingualism was found even when taking into account performance on the Flanker and Card-Sort tasks. These results indicate that language experience resulting from increased exposure to a wider array of phonemes in auditory input, as well as improved ability to focus attention onto relevant stimuli, both exert top-down control of cochlear amplification as evidenced by changes in SOAE levels. These results provide further evidence that top-down effects from cognitive function and linguistic experience influence physiological responses, and extend our understanding of auditory efferent function.

SPEECH PERCEPTION

Poster # 79 – SP01

Using an Auditory Attention Dual-Task Paradigm to Assess Listening Effort **T35 Research Trainee Poster**

Brianne Noud, BS; Chad S. Rogers, PhD; Jonathan E. Peelle, PhD, Washington University School Of Medicine, Saint Louis, MO

Listening effort is the mental expenditure of effort needed to comprehend a signal which may affect the ease or accuracy of speech processing. Unfortunately, there is a lack of diagnostic criteria for listening effort. This pilot study uses a dual-task paradigm to quantify listening effort. Fourteen young adults (ages 18-30) and 12 older adults (ages 65-85) with self-reported normal hearing were tested to determine if reaction time (reflecting listening effort) increases when listening to speech in noise. Participants were asked to recall a sentence as accurately as possible; sentences were presented in quiet, or in speech-shaped noise at signal-to-noise ratios (SNRs) of +15 dB or +5 dB. During each sentence, there was the possibility of hearing zero, one, or two tones. The participants were asked to respond by pressing a button as quickly as possible after the tone was heard. Listeners generally took numerically longer to identify the tones during the noisiest condition, although the increase was not statistically significant. Nevertheless, these preliminary results are broadly consistent with attentional mechanisms that underlie both tone monitoring and speech comprehension in noise, and suggest auditory dual-task paradigms may be an effective way of quantifying listening effort.

Poster # 80 – SP02

Effects of Asymmetric Hearing: Localization and Speech Understanding in Noise **T35 Research Trainee Poster**

Rixon Rouse, BA; Nol Dwyer, AuD; Ruth Reeder, MA; Jill Firszt, PhD, Washington University School Of Medicine Adult Cochlear Implant Program, St. Louis, MO

Unilateral and asymmetric hearing disrupts binaural processes, which lead to deficits in spatial hearing and speech understanding in noise. Theoretically, residual low-frequency hearing in the poor ear should mitigate these deficits by preserving important interaural timing information. This study examined the relationship between poor-ear residual low-frequency hearing and behavioral performance on localization and speech-in-noise understanding measures. A total of 12 participants with asymmetric hearing loss completed front and rear facing localization tasks, an adaptive task using sentences in diffuse restaurant noise, and the Speech, Spatial, and Qualities (SSQ) of Hearing questionnaire. Results indicated an association between poor-ear residual low-frequency hearing and horizontal localization ability but not speech-in-noise scores. Results from the SSQ indicated that participants perceived difficulty in both speech understanding and spatial hearing. Taken together, findings suggest that even with residual low frequency hearing in the poor ear to support increased accuracy in horizontal plane localization, those with asymmetric hearing still report subjective difficulty in spatial hearing.

Poster # 81 – SP03

Virtual Reality in Localization and Speech Perception Tasks in Children **T35 Research Trainee Poster**

Maeve Salanger, BS, University Of Maryland, College Park, MD

Dawna Lewis, PhD; Timothy Vallier; Tessa Mcdermott; Andrew Dergan, Boys Town National Research Hospital, Omaha, NE

The use of virtual reality (VR) is quickly becoming common in the modern world. One area where VR has not yet been utilized extensively is in hearing research. The primary purpose of this study was to determine the efficacy of using VR in research with children to provide virtual visual environments that simulate potential real-world environments. The study utilized a speech perception and localization task in auditory-only (AO) and auditory-visual (AV) conditions. Testing was completed both in a real room and in a virtual room where visual cues simulated a typical classroom (accessed using an Oculus Rift- VR headset). Overall, speech recognition and localization accuracy were better in the AV than in the AO conditions. However, the direction of change in performance from the real room to the virtual room differed depending on whether stimuli were presented in AO or AV conditions. These results suggest that, depending on the specific task, VR is capable of being used as part of research protocols with children to simulate real-world settings while maintaining a controlled acoustic environment in a laboratory setting. Continued research is needed to examine performance using VR with varying protocols.

Poster # 82 – SP04

Noise Sensitivity is Predominantly Influenced by Frequency Selectivity

Frederic Apoux, PhD; Brittney Carter; Eric Healy, PhD, The Ohio State University, Columbus, OH

Normal hearing (NH) listeners are believed to understand speech in noise by extracting only those region where the signal-to-noise ratio (SNR) is favorable. This glimpsing strategy relies primarily on the ability to divide the spectrum into narrow bands. Because hearing-impaired (HI) listeners exhibit poor spectral selectivity, their low performance in noise is not surprising. The present study compared the performance of NH and HI listeners in noise while controlling for the influence of selectivity. Pairs of sentences were added at a given overall SNR and divided into narrow frequency regions. Only those regions with the desired SNR were retained. By iterating this procedure at various overall SNRs, stimuli with the desired local SNR in each region were created. Because the frequency regions were narrower than the subjects' resolution, glimpsing was no longer possible. Intelligibility for sentences having this uniform (UNI) local SNR was compared to that for sentences having variable (VAR) local SNRs. The results showed that VAR sentences are more intelligible for NHs but not for HIs at the same overall SNR. More importantly, performance of NH and HI listeners was very similar in UNI, suggesting that both groups have similar noise sensitivity.

Poster # 83 – SP05

Does Familiarity with a Talker's Voice Improve Intelligibility in Noise

Madison Buntrock; Brittan Barker, PhD, Department Of Communication Disorders And Deaf Education, Utah State University, Logan, UT

Research shows that a listener's familiarity with a talker improves spoken language processing, particularly in challenging listening situations (e.g., Barker & Newman, 2004; Martin, Millennix, Pisoni, & Summers, 1989; Smith, Holmes-Elliot, Pettinato, & Knight, 2014). The aim of our study was to expand on

this research and determine whether or not a listener's familiarity with a talker improves intelligibility in the presence of complex, ecologically valid background noise. We used a mixed, 2 X 2 yoked design with talker familiarity as the between-subjects independent variable (familiar professor, novel professor) and noise (8-talker babble, restaurant noise) as the within-subjects independent variable. Keyword accuracy was the dependent variable. Results will be reported and discussed in the context of talker familiarity. We will focus on the role familiarity plays in facilitating intelligibility-particularly in background noise individuals face in real-life listening situations-and the implications for listening rehabilitation with people who have hearing loss.

Poster # 84 – SP06

Sequential Streaming of Speech Sounds Under Normal and Impaired Hearing

Marion David, PhD; Andrew J. Oxenham, PhD, Department Of Psychology, Minneapolis, MN
Olaf Strelcyk, PhD, Sonova U.S. Corporate Services, Warrenville, IL

Understanding speech in complex backgrounds relies on our ability to perceptually organize competing voices into streams. This study compared normal-hearing (NH) and hearing-impaired (HI) listeners' ability to segregate and stream sequentially presented speech sounds based on differences in fundamental frequency (F0) and vocal tract length (VTL). Each speech sound consisted of an unvoiced fricative consonant and a voiced vowel, and these sounds were concatenated into sequences that alternated in either F0, VTL, or both. A preliminary identification task showed similar scores for NH and HI listeners in their ability to correctly identify the speech sounds used in the study. The streaming task required listeners to detect whether a novel 'word' comprised of two random syllables was present in the sequence. The word (which was different in each trial) occurred either within or across the alternating streams. Preliminary results suggest that the HI listeners are able to use F0 differences between streams to perform the task, but that they show less effect of VTL than shown by the NH listeners. The results so far suggest that F0 but not VTL cues are sufficient to enable listeners with moderate-to-severe sensorineural hearing loss to perceptually segregate streams of speech sounds.

Poster # 85 – SP07

Perceptual Significance of Level Increments in Stop-Consonant Noise Bursts

Blas Espinoza-Varas, PhD; Jeremiah Hilton, MS; Shaoxuan Guo, MS, Ou Health Sciences Center, Oklahoma City, OK

Declines in recognition accuracy associated with speech-processing schemes (e.g., dynamic-range compression or enhancement of consonant-vowel ratio) have been attributed, partly, to distortion in the pattern of level differences between the sounds embedded in the word. Thus far, these distortions have been measured acoustically (e.g., envelope-difference index) but much less is known about their perceptual significance. Since a major acoustic effect of the above schemes is to increase the level of stop-consonant noise bursts, in normal-hearing participants we scaled perceptual significance in terms of discrimination thresholds for level increments (DTLs) in the pre- or post-vocalic consonant noise burst of the CVC words /pt/, /pk/, and /kt/, keeping the natural vowel-amplitude fluctuation. Rather than being equal for both bursts, DTLs were much higher for the pre- than the post-vocalic noise burst, meaning that the perceptual significance of level increments, /L, is much lower in the pre- than in the post-vocalic

burst. In the pre-vocalic burst, /L is followed by a large increase in vowel amplitude, but in the post-vocalic burst, /L is preceded by decay in vowel amplitude and the silence preceding the post-vocalic stop-closure release. The contrast between /L and the adjacent vowel-amplitude fluctuation seems to modulate the perceptual significance.

Poster # 86 – SP08

Linguistic Experience and Age Affect Recognition of Spanish-Accented English
Sandra Gordon-Salant, PhD; Grace Yeni-komshian, PhD; Peter Fitzgibbons, PhD; Rebecca Bieber; David Jara, MA; Maya Freund, University Of Maryland, College Park, MD

Older native speakers of English have considerable difficulty understanding Spanish-accented English compared to younger native English speakers. However, it is unclear if this age effect would be observed among native speakers of Spanish. It was hypothesized that native language experience with a syllable-timed language would minimize age-related deficits in recognizing accented English characterized by this stress pattern. Different English speech materials (words and sentences), recorded by native speakers of English and Spanish, were presented in quiet, noise, or with time compression to younger and older normal-hearing listeners whose native language was either English or Spanish. The effect of listeners' native language experience was apparent for unaccented and accented speech materials, even for younger adults. The native speakers of Spanish consistently recognized accented English more poorly than the native speakers of English, contrary to expectation. Older listeners in both native-language groups also performed more poorly than their younger counterparts. However, both younger and older native speakers of Spanish showed less decline in perception of Spanish-accented English than non-accented English, compared to the native speakers of English. The general pattern of results suggests that both native language experience and age limit the ability to recognize Spanish-accented English.

Poster # 87 – SP09

Dynamic Range Comparison Between Clear Speech and Citation-Form
In-Ki Jin, PhD; Kyungju Lee; Suyeon Shin, MS, Hallym University, Chuncheon

Background: Clear speech refers to a speaking as clearly as possible using techniques such as pauses, accurate articulations, and slow speech rates. Clear speech can improve speech intelligibility for people with hearing loss. Although various acoustic characteristics like formants were analyzed in English clear speech, Korean clear speech rarely has been analyzed. Purpose: The purpose of this study was to compare the Korean speech dynamic range, which is important for intelligibility between clear speech and a citation-form (normal speech). Research design: Dynamic ranges were compared using a research design that applied and analyzed observed datasets. Data collection and analysis: Twenty (10 male and 10 female) native Korean adults with normal hearing participated in this study. Each participant read Korean standardized sentence stimuli, once using clear speech, and once with citation-form speech. Their readings were recorded. Then, dynamic ranges for different styles were compared. Results: Across-speaking style, differences in dynamic range were evident in the frequency areas between 700 Hz and 2000 Hz in male and female participants. Conclusions: Because the clear speech dynamic range was wider than the citation-form dynamic range in mid-frequency bands, the Korean clear speech technique may provide benefits for intelligibility for Koreans with hearing loss.

Poster # 88 – SP10

Contribution of Selective Attention Ability to the Speech-In-Noise Understanding Performance
Sieon Kim, BA; Subong Kim, MS; Courtney Lansing, BA; Inyong Choi, PhD, Department Of Communication Sciences And Disorders, University Of Iowa, Iowa City, IA

Clinical speech-in-noise (SIN) understanding tests measure the listeners' ability to understand the target speech among competing sound sources. Studies have shown that both informational and energetic masking make it difficult to recognize speech in multi-source listening situations. However, the relative contribution of energetic and informational masking in the SIN test is poorly understood. Here, we investigate the role of the informational masking by quantifying the contribution of listeners' selective attention ability to the SIN performance. Listeners performed two behavioral tests. In the selective attention task, the listeners were asked to identify and discriminate a target stream of syllables while ignoring a distractor stream. On the other hand, SIN test required listeners to identify a target word amongst babble noise, loading both energetic and informational masking to the target. Results revealed a variance in the performance of selective attention task across listeners, indicating that individuals differ in their cognitive ability of selectively attending to target sound while ignoring competing sources. Additionally, a significant correlation was observed between performances of two behavioral tests, reflecting listener's selective attention ability contributes in SIN performance. Results suggest individual differences in supra-threshold ability should be taken into account when interpreting the result of clinical SIN tests.

TINNITUS

Poster # 89 – TIN01

Prevalence of Depression and Anxiety among Community-Dwelling Adults Reporting Tinnitus
Mentored Student Research Poster Award
Kelly Reavis, MS; Kathleen Carlson, PhD, Ohsu-psu School Of Public Health, Portland, OR

Tinnitus is a common auditory complaint among adults. It has been suggested that tinnitus is associated with poor mental health, including depression and anxiety, and this association is partially mediated by difficulty sleeping. However, these associations have yet to be demonstrated among a nationally representative sample of community-dwelling adults in the United States (US). We analyzed cross-sectional data from the US National Health and Nutrition Examination Survey with 5,550 adult participants (>19 years old) collected between 2009-2012. We examined associations between self-reported tinnitus, difficulty sleeping and poor mental health using multivariable logistic regression to estimate odds ratios and 95% confidence intervals (CIs). After controlling for demographic and health-related confounders, adults with tinnitus were 2.6 times more likely (95% CI: 1.9-3.5) to have depression and 1.6 times more likely (95% CI: 1.3-2.0) to report feeling anxious than adults without tinnitus. Analyses examining the relationship between difficulty sleeping and poor mental health also suggested an association between these conditions, but did not support the hypothesis that associations between tinnitus and poor mental health are mediated through difficulty sleeping. Frequent co-occurrence of

tinnitus with comorbid depression and anxiety suggests management in a multidisciplinary setting may improve outcomes among adults with tinnitus.

Poster # 90 – TIN02

The Tinnitus Screener: Data from 250 Research Participants
James Henry, PhD, NCRAR, Portland, OR

The NOISE Study (Noise Outcomes In Servicemembers Epidemiology Study) is a joint venture between the Veterans Affairs (VA) National Center for Rehabilitative Auditory Research (NCRAR) and the Department of Defense (DoD) Hearing Center of Excellence. Recently-discharged Veterans undergo comprehensive baseline assessment to initiate long-term monitoring of auditory function. To determine if Veterans experience tinnitus we developed the Tinnitus Screener, a one-page algorithm that determines if tinnitus is present and, if so, whether it is constant, intermittent, or temporary. Results from the first 100 participants in the NOISE Study have previously been published. The Tinnitus Screener has since been revised to differentiate acute (recent-onset) from chronic (persistent) tinnitus, and to identify 'occasional' tinnitus. We have also obtained measures to assess its test-retest reliability. Validation data from the instrument will be presented from the first 250 Veterans tested in the study.

Poster # 91 – TIN03

Reliability of Tinnitus Loudness Measures: Matching vs. Rating vs. Scaling
Candice Manning, PhD; Leslie Grush, AuD; Emily Thielman, MS; James Henry, PhD, National Center For Rehabilitative Auditory Research, 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 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 psychoacoustic measure used to evaluate outcome 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 100 participants will be presented.

TRAINING / REHABILITATION

Poster # 92 – TR01

Development of a Hearing Loss Toolkit for Self-Management
Michelle Arnold, AuD; Victoria Sanchez, PhD; Theresa Chisolm, PhD, University Of South Florida, Tampa, FL
Nicholas Reed, AuD, Johns Hopkins University, Baltimore, MD

The hearing health care needs of a growing and diverse aging population are imminent, with studies demonstrating an independent association between untreated hearing loss and cognitive decline. The most common treatment for hearing loss is hearing aids. However, hearing aid uptake by those who could benefit remains unchanged at approximately 25% since the 1980s. The lack of uptake is likely due to many factors, including lack of appropriate patient education materials that take into account health literacy levels. As part of a larger clinical trial planning grant investigating the potential for optimal hearing rehabilitation to reduce cognitive decline (Aging, Cognition, and Hearing Evaluation in Elders [ACHIEVE] PI: Lin, F.), we developed patient education materials that focused on individualized self-management of hearing loss and related problems. Using the Agency for Healthcare Research and Quality standards the 'Hearing Loss Toolkit for Self-Management' was developed. Language used is no greater than a 6th grade literacy level, infographics were used to relay complex information, and a self-management goal plan was included. The purpose of this presentation is to describe the procedures and resources used to create the Toolkit, as well as preliminary Toolkit feedback received from through the ACHIEVE planning grant.

Poster # 93 – TR02

Remote Microphone Use in Homes of Children with Hearing Loss
Carlos Benitez, MA; Gina Angley, AuD; Anne Marie Tharpe, PhD, Vanderbilt University, Nashville, TN

Although remote microphone systems (RMSs) are widely recommended in the classroom setting, few studies have examined the possible language benefits related to the use of RMSs in a home environment. The purpose of this project was to investigate the effects of home use of a RMS on the language production of ten families with young children who have hearing loss. In addition, caregiver perceptions related to the use of the RMS were documented. Language Environmental Analysis (LENA) recorders were used for an average of seven hours per day for two days (average total of 28 hours) during two consecutive weekends (RMS and no-RMS weekend). Number of words produced by the children and the caregivers were compared across both weekends. Furthermore, the number of words produced by caregivers from a distance (greater than approximately 8 feet from the child) was compared between RMS- and no-RMS weekends. Caregivers also completed two questionnaires that queried them about RMS use. Results suggested that although children and caregivers produced an equivalent number of words on both weekends, caregivers tended to talk more from a distance when using the RMS than when not. Results also revealed high levels of acceptance of RMS use by caregivers.

Poster # 94 – TR03

Towards a Personalised M-Health Hearing Programme for the Smartphone Generation
Melanie Ferguson, PhD; David Madiment, PhD, Nihr Nottingham Hearing Biomedical Research Unit, Nottingham, AK
Neil Coulson, PhD; Heather Wharrad, PhD, Nottingham University, Nottingham

Will Brassington, MS, Nottingham University Hospital's NHS Trust

Mobile phone-access to the internet more than doubled between 2010 and 2014 (24% to 58%). Opportunities for using m-health technologies to deliver hearing healthcare, education, and increase access to hearing-related interventions, are increasing year-on-year. An RCT of C2Hear, a series of multimedia videos (or reusable learning objects, RLOs) for first-time hearing aid users (n=203) showed multiple benefits. C2Hear Online, is now freely available online. In order to futureproof the concept, further developments of C2Hear are underway, which aim to (i) increase the user's interactivity with the programme, and (ii) personalise the programme by tailoring information to meet individuals' needs. Mobile-enhanced RLOs for communication partners in the form of a web-based app on communication tactics, understanding hearing loss, and the psychosocial aspects of hearing loss. The development of the next stage, a personalised m-health programme, involves the identification of the short 1-2 minute segments of C2Hear. This will be based on the theoretically driven health behaviour change model (COM-B), alongside an ecological approach that will use a synchronous, real-time Think Aloud analysis. Self-evaluation and text-messaging will also be incorporated to develop a self-management m-health programme. Future research will extend this underpinning m-health technology for non-audiological healthcare practitioners and the general public.

Poster # 95 – TR04

A Training Program for Scoring Korean Words for English-Speaking Audiologists

Heekyung J. Han, MS; Robert S. Schlauch, PhD, Department Of Speech-language-hearing Sciences, University Of Minnesota, Twin Cities, Minneapolis, MN

Audiologists find it challenging to accurately assess the speech-understanding ability of individuals with limited English-language proficiency. This study evaluates the effectiveness of an active-training (AT) program for native English-speaking examiners scoring standardized Korean word-recognition tests. Ten, native English-speaking examiners, without any knowledge of Korean, were randomly assigned to either an AT or passive-training (PT) group. For familiarization, AT participants watched audio-visual exemplars of spoken Korean words paired with the standardized recordings, while PT participants listened to CD recordings of words. Both had phonetic transcriptions. After familiarization, both groups watched test videos to judge whether native Koreans repeated words correctly. All of the Koreans' oral responses in these videos were obtained at -2 dB SNR for approximately 50% performance. The AT group was given correct answer feedback for their scoring. During a second session, all participants judged different Korean individuals to test for generalization. Participants rated their confidence level (0: not very confident - 5: very confident) for administrating the Korean word-recognition tests. AT produced higher confidence ratings than PT. The average scoring accuracy was 95.5% (range: 94.8-96.5%) and 90.9% (range: 89.5-92%) for the AT and PT groups, respectively, after the second session. These results show that the AT was effective.

Poster # 96 – TR05

Are Auditory Training Outcomes Related to Olivocochlear Efferent Function?

Ian Mertes, PhD, University Of Illinois At Urbana-champaign, Champaign, IL
Erin Wilbanks, AuD; Marjorie Leek, PhD, Va Loma Linda Healthcare System, Loma Linda, CA

Auditory efferent activity appears to be associated with auditory training outcomes in young normal-hearing listeners (de Boer & Thornton, J Neurosci, 2008). The current study examined this relationship in older adults with normal hearing or mild sensorineural hearing loss. Ten subjects were randomly assigned to an experimental or control group (5 subjects per group). Both groups participated in 12 laboratory visits. At each visit, auditory efferent function was assessed using contralateral suppression of transient-evoked otoacoustic emissions and speech-in-noise perception was assessed using a word and sentence task in noise. Additionally, the experimental group participated in 15 hours of computerized auditory training across visits 2-11. Training consisted of speech constituent discrimination and sentence recognition in noise using the Speech Perception Assessment and Training System [SPATS] (Miller et al., Semin Hear, 2015). Contrary to expectation, no subjects in the experimental group showed strengthening of efferent function across time. However, preliminary results from the SPATS training indicated improvements in sentence perception in noise over several weeks of practice. Observed improvements in constituent outcomes will also be discussed. Preliminary results suggested that auditory efferent function may not be related to auditory training outcomes, at least as examined in this study. [Work supported by NIDCD]

AMPLIFICATION

Poster # 97 – AMP13

Improving Clinical Outcomes for Single-Sided-Deafened Osseointegrated Device Users
Anne Harvey, BS; Jake Hillyer; Elizabeth Elkins, AuD; Jacky Tran; P. Cody Buchanan; Stacey Watson, AuD; Douglas Backous, MD; Alexandra Parbery-Clark, PhD, Swedish Medical Center / Cherry Hill, Seattle, WA

Individuals with single-sided deafness (SSD) report significantly greater listening difficulty in background noise than those with two normal hearing (NH) ears. To date, no definitive clinical recommendations exist for improving speech in noise (SIN) understanding for individuals with SSD who utilize an osseointegrated device (OI). To address this clinical need, we administered various SIN tests in a situation aimed to imitate everyday life (i.e., 8-speaker surround sound R-space) and in a traditional clinical two-speaker array. Participants' subjective reports of daily listening performance were also recorded. Participants included 16 OI users with SSD and a NH control group (6). As expected, OI users performed poorer on all SIN tests relative to NH controls; however, with certain microphone settings and environmental modifications, OI user performance was noted to improve. OI users demonstrated a keen ability for assessing their listening performance in subjective reports, when speech was presented on the device side in surround noise. However, the same result was not observed for the traditional two-speaker array more often used in clinical settings.

Poster # 98 – AMP14

What is the Evidence Supporting the Benefits of "Affordable" Hearing Aid Technologies?
Carole Johnson, PhD; Anna Marie Jilla, MA; Stevie Jeannont; Emily Lamp; Jin Hyung Park; James Connor Sullivan; Kristin Winkler, University Of Oklahoma Health Sciences Center, Oklahoma City, OK
Jeffrey Danhauer, PhD, University of California Santa Barbara, Goleta, CA

Recently, the National Academies of Sciences, Engineering, and Medicine released their Committee Report on Accessible and Affordable Hearing Healthcare for Adults. They recommended increasing the accessibility and affordability of hearing healthcare through the availability of Personal Sound Amplification Products (PSAPs) and/or over-the-counter (OTC) hearing aids for persons with mild and moderate losses. Entry-level digital hearing aids may also be a more affordable option for patients with all degrees of hearing loss. A systematic review (SR) with meta-analysis investigated the question: "Do patients with sensorineural hearing loss benefit from 'affordable' hearing aids?" A team submitted search strings to databases, retrieved over 20 peer-reviewed articles, assessed the quality of the investigations, and extracted their data for inclusion in the meta-analysis. A small effect size was found showing that patients with mild and moderate losses may benefit from PSAPs and/or OTC hearing aids. Alternatively, limited evidence supported the benefits of high-end digital hearing aids over more affordable entry-level devices. We will discuss how the results of this SR was pivotal in the design of a current randomized clinical trial assessing the benefits of entry-level digital hearing aids. (Work supported by the Oklahoma Center for the Advancement of Science and Technology HR16-188 [OCAST])

Poster # 99 – AMP15

Multiple Hearing Aid Programs in Modern Devices: Who Utilizes Them?
Jani Johnson, AuD, PhD, University of Memphis, Memphis, TN

Some modern hearing aids apply automatic signal processing changes according to acoustic characteristics of the environment. This feature is intended improve listening outcomes in a variety of complex acoustic scenarios without burdening the user with the need to manually access programs in different environments. On the other hand, some specialized signal processing strategies only can be accessed through selection of a dedicated program. These specialized programs often are found in the more advanced levels of hearing aid technology. Although some of these processing strategies have been demonstrated to be effective under certain real-world conditions, not all hearing aid wearers use and benefit from multiple memories. This research was designed to explore differences between hearing aid wearers who prefer to use specialized programs in daily listening and those who prefer mostly to use an automatic program. Forty-five older adults with mild-to-moderate hearing impairment wore examples of premium-feature and basic-feature hearing aid technologies with multiple programs in their daily lives for one month each. Relationships between more than 30 patient attributes and program use were examined. Of these, only cognitive ability was significantly correlated with program use. Explanations for this finding were explored. (Supported by NIDCD)

Poster # 100 – AMP16

Objective Detection of Cochlear Dead Region Using TEN-ACC
Soojin Kang, MS; Heesung Park, MS; Sung Hoon Yoon, MS; Hyungji Jung, Hearing Research Laboratory, Samsung Medical Center, Seoul, Korea, Seoul, NA
Il Joon Moon, MD; Yang-sun Cho, MD, Department Of Otorhinolaryngology-head & Neck Surgery, Samsung Medical Center, Sungkyunkwan University School Of Medicine, Seoul, Korea
Jihwan Woo, PhD, Department of Biomedical Engineering, University of Ulsan, Ulsan, Korea
Sung Hwa Hong, MD, Department of Otorhinolaryngology-Head and Neck Surgery, Samsung Changwon Hospital, Sungkyunkwan University School of Medicine, Changwon, Korea

This study develops an objective and neurophysiological method to identify cochlear dead region (CDR) by combining acoustic change complex (ACC) responses with threshold-equalizing noise (TEN) test. Ten NH listeners and 15 hearing-impaired (HI) listeners with/without CDR(s) participated in the study. ACC responses were recorded using a stimulus mixed with TEN and pure tone (the first part of each stimulus contained only the TEN and the second part contained pure tone embedded in TEN). Signal-to-noise ratios (SNRs) varied from 0 to 21 dB SNR and electrophysiologic techniques were used to record ACC responses evoked when pure tone embedded in TEN is detected. ACC responses were successfully recorded from all participants. Both behaviorally and electrophysiologically obtained masked thresholds (TEN threshold and TEN-ACC threshold) were similar and below 10 dB SNR in NH group and HI (non-CDR) group. However, for the CDR group, TEN-ACC thresholds were significantly higher than those in the NH and HI groups, indicating that CDR(s) can be objectively detected using ACC. Results of this study demonstrate that it is possible to detect the presence of CDR using an electrophysiologic method. Further studies are necessary to determine sensitivity and specificity of this procedure.

Poster # 101 – AMP17

Comparative Analysis of Personal Amplification Products and Hearing Aids

Peggy Korczak, PhD; Nicole Polyak, MS, Towson University, Towson, MD
Frank Lin, MD; Nicholas Reed, AuD, Johns Hopkins University School of Medicine, Baltimore, MD

Personal sound amplification products (PSAPs) are over-the-counter electronic products intended to amplify environmental sounds. These devices are not regulated by the FDA and have more limited acoustic features versus traditional hearing aids. The cost of PSAPs range from approximately $100 (low end) to $250 to $400 (high end). Recently, the President's Council on Advisors on Science and Technology (PCAST) initiated an effort to address the hearing health of the aging population. One of their primary recommendations was for the FDA to create a new category of 'basic hearing aids' which could be sold over-the-counter for significantly less than a traditional hearing aid. The aim of this study was to evaluate the objective benefit of five PSAPs devices versus a traditional hearing aid. Thirteen adults with mild to moderate sensorineural hearing loss were evaluated using electroacoustic analysis, real ear measurements and speech-in-noise testing. Results revealed the performance of a select group of high-end PSAPs was similar to the traditional hearing aid on electroacoustic and speech-in-noise testing. Real-ear findings revealed the traditional hearing aid met 94% of NAL targets across frequencies versus 54-69% of targets met with the high-end PSAPs. These findings suggest a promising role for high-end PSAPs in audiology.

Poster # 102 – AMP18

Comparison of Self-Adjusted Amplification and Own Hearing-Aid Response

Alexandra Lithgow, BA; Carol Mackersie, PhD; Arthur Boothroyd, PhD, San Diego State University, San Diego, CA

Research Question: When given the opportunity for self-adjustment of the amplitude and spectrum of amplified speech, do experienced hearing-aid users match the familiar characteristics of their existing aids? Thirteen experienced hearing aid users adjusted overall level, low-frequency cut (below 500 Hz)

and high-frequency boost (above 1000 Hz) while listening to pre-processed sentences spoken by a man. They were then given a speech-perception test under the self-selected condition and the process was repeated. Self-selected real ear outputs were computed at half octave intervals, using measured real-ear-to-coupler differences. The results were compared with real-ear measurements using their existing hearing aids, and both were compared with threshold-based NAL-NL2 prescriptions. The first and second self-adjustments produced outputs that were equal to or higher than those of their own aids from 350 through 8000 Hz. From 2 through 4 kHz the output from first adjustment matched that of their own aid whereas the output from second adjustment matched that of the prescription. The findings support the conclusion that participants' initial adjustment was influenced by familiarity with their own aids. The experience of taking the speech perception test, however, may have moved them closer to seeking optimal audibility of the higher speech frequencies.

Poster # 103 – AMP19

Comparison of Binaural Benefits: CROS Hearing Aids and BAHA
SunMi Ma, MS; Hyunji Jung; Wonho Jung, MD; Yangsun Cho, MD; SungHwa Hong, MD; IlJoon Moon, MD, Samsung Medical Center, Seoul, Korea

People with single-side deafness (SSD) experience difficulties in hearing due to lack of binaural benefits such as binaural squelch, binaural summation and head shadow effect. Despite existing numerous rehabilitative options, such as contralateral routing of offside signals (CROS) hearing aids, bone-anchored hearing aids (BAHA), and cochlear implants, examining and directly comparing the performance and binaural benefits of CROS and BAHA on patients with SSD is still lacking. Patients with SSD were enrolled in this study, and sound localization test (SLT), speech perception test (HINT, consonant test), and psychoacoustic measures were performed under the following three conditions; unaided, with CROS, and with BAHA (soft band). Subjective satisfaction was also evaluated using sound quality and preference tests. Binaural benefits were present in both CROS and BAHA conditions. No significant difference in consonant test and SLT ability between CROS and BAHA conditions. Participants had a tendency to prefer CROS over BAHA. In summary, both CROS and BAHA showed clear benefits in speech perception in challenging listening conditions for patients with SSD. Despite the limitation imposed on this study, lack of acclimatization, use of soft band BAHA and unmasked NH ear, we believe this study will be beneficial for SSD patients prior to rehabilitation.

Poster # 104 – AMP20

Individual Differences in Temporal Envelope Processing With Amplitude Compression
Varsha Rallapalli, AuD; Joshua Alexander, PhD, Purdue University, West Lafayette, IN

Temporal envelope (TE) modulation cues are critical components of speech perception, especially for hearing-impaired listeners. However, TE can be reduced due to amplitude compression settings (slow- versus fast-release time, RT) in hearing aids. Background noise and reverberation can further alter these modulations. This study was aimed at understanding the effects of different types of TE degradation on speech perception in normal-hearing and hearing-impaired listeners. Sentences mixed with steady or modulated speech-shaped noise at different signal-to-noise ratios (SNRs) were processed with a fast- or slow-RT. Preliminary acoustic analyses showed that TE was degraded with increasing reverberation time

and SNR, and depended on the type of background noise. Furthermore, the slow-RT generally preserved TE better than the fast-RT. Speech recognition scores were compared with the acoustic estimates of TE. It was hypothesized that listeners would respond differently to TE degradation; therefore, a novel task was used to estimate the degree to which listeners rely on TE for sentence recognition. Listeners were also tested on verbal working memory since it has been shown to influence how individuals recover information from distorted speech. Results will provide guidance for customization of traditional amplitude compression settings and will support the development of non-traditional amplitude compression methods.

Poster # 105 – AMP21

Comparing Two Hearing-Aid Noise Management Approaches in Noise (In)Tolerant Listeners
Sherri Smith, PhD; George Spanos, AuD; Jeanne Lilly, MA, Auditory Vestibular Research Enhancement Award Program, Mountain Home Va, Mountain Home, TN
Karrie Recker, AuD, Starkey Hearing Technologies, Eden Prairie, MN

Listeners with different levels of noise tolerance may prefer hearing-aid signal processing schemes that manage noise differently. The study aim was to determine if outcomes are affected by different noise management signal-processing schemes in listeners who differ in the amount of background noise they tolerate. We used the Acceptable Noise Level (ANL) test to determine the maximum amount of background noise a listener is willing to tolerate while listening to continuous speech, and categorized them into two groups (n = 27 each): (1) Low ANL (< 7 dB) group and (2) High ANL (> 13 dB) group. All participants were fitted with hearing aids that contained two programs: (1) high-frequency adaptive directionality with minimal digital noise reduction (HF program), and (2) broadband adaptive directionality with maximal digital noise reduction (BB program). The program order was counterbalanced across participants, who were blinded to the program differences. On the Device-Oriented Subjective Outcome (DOSO) Scale, there was not a significant effect of group, but there was for program. Participants reported significantly higher outcomes for the BB program on select DOSO subscales compared to the HF program. The results suggest listeners may prefer more aggressive noise management regardless of their (in)tolerance to noise.

Poster # 106 – AMP22

Self-Reported Listening Effort Predicts Real-World Amplification Outcomes
Elizabeth Stangl, AuD; Yu-hsiang Wu, PhD; Ruth Bentler, PhD, University Of Iowa, Iowa City, IA
Christi Miller, PhD; Kelly Tremblay, PhD, University of Washington, Seattle, WA

Listening effort (LE) has become an important amplification outcome measure. Recent literature has suggested the clinical usefulness of LE, although its value in predicting real-world outcomes is unclear. In this study the extent to which self-reported LE can predict real-world amplification outcomes is examined. Self-reported LE, as well as speech recognition performance, was measured from 111 hearing aid (HA) users during a speech perception test administered at two signal-to-noise ratios (SNRs; 0 and +8 dB) and in two modalities (with our without visual cues). Questionnaires were used to measure initial (unaided) disablement, residual (aided) disablement, and HA benefit (difference between initial and residual disablement). After controlling for age, hearing threshold and working memory capacity, results

indicated that, self-reported LE explained only 4% of the variance of initial and residual disablement. However, LE explained up to 16% of the variance of HA benefit. Speech recognition performance explained 6 - 10% of variance of real-world outcomes. Finally, LE measured in easier environments (+8 dB SNR and/or with visual cues) predicted real-world outcomes better than LE measured in more difficult environments.

Poster # 107 – AMP23

Relationships Between Subjective Outcome Measures and Aided Speech Intelligibility Index
Amanda Wolfe, AuD; Eric Mccabe, AuD; Ashley Hughes, AuD; Kevin Seitz, AuD, Starkey Hearing Technologies, Eden Prairie, MN

Providing optimal gain and output during hearing aid fittings using real-ear measurements, along with patient feedback, ensures hearing aids are providing audibility at a comfortable level. Outcome measurements such as the Device-Oriented Subjective Outcome (DOSO) Scale (Cox RM. Alexander GC. & Xu J., 2009) help demonstrate the subjective benefits of hearing aids. The relationship between hearing aid outcome measures and the Speech Intelligibility Index (SII) (ANSI, S3.5, 1997, p. 1) is of interest, as each provides valuable information. The SII provides a numerical value that is highly correlated with speech understanding, while outcome measures provide information regarding broader aspects of hearing impairment. The purpose of this study was to measure the aided SII in research participants, and determine if a correlation exists between measured SII and subjective hearing aid outcome ratings. It was hypothesized that higher SII ratings would result in increased hearing aid benefit as measured by the DOSO. Statistical analysis revealed the top quartile of SII fittings differ significantly on average DOSO scores compared to the bottom quartile of SII fittings for the speech cues, listening effort, and pleasantness subscales. Results indicate patients with increased speech intelligibility rate their hearing aids more favorably on these subscales.

Poster # 108 – AMP24

Effects of Nonlinear Frequency Compression on the Acoustic Properties and Recognition of Speech Sounds in Mandarin Chinese
Jing Yang, PhD, University Of Central Arkansas, Conway, AR
Xueqing Cheng; Yulin Li; Cuncun Ren; Beier Qi, Beijing Tongren Hospital, Beijing
Li Xu, PhD, Ohio University, Athens, OH

The present study examined the spectral properties and perception of Mandarin vowels and fricatives as a consequence of nonlinear frequency compression (NLFC). Speech materials, including a list of Mandarin monosyllables in the form of /dV/ (12 vowels) and /Ca/ (5 fricatives), were recorded from 20 native Mandarin speakers (10 males and 10 females). The speech materials were processed using the NLFC algorithms (i.e., SoundRecover by Phonak) which are designed to regain audibility of high frequency cues for hearing impaired subjects. Detailed acoustic analysis revealed that the high front vowel /i/ and certain vowels containing /i/ demonstrated positional deviation in certain processed conditions as opposed to the unprocessed condition. All 5 fricatives showed acoustic changes in spectral features in all processed conditions. However, when the speech samples from both original and all six processed conditions were presented to 14 Mandarin-speaking, normal-hearing adult listeners, these

NLFC processed configurations caused no noticeable confusion for all tested speech sounds, except for /s/ in conditions with the lowest cutoffs. Further discussion is provided regarding the discrepancy between the considerable acoustic changes in the speech samples and the negligible adverse effects on perceptual outcomes in normal-hearing listeners as a result of NLFC.

ANATOMY AND PHYSIOLOGY

Poster # 109 – ANAT03

Spiral Ganglion EGFR/XPA Pro-Survival Signaling
O'neil Guthrie, PhD, Northern Arizona University, Flagstaff, AZ

Spiral ganglion injury can occur with and without hair cell damage. Consequently, there is a need to develop targeted therapies for rescuing spiral ganglion neurons (SGNs) from acquired neuropathies. One approach to achieve this goal is to identify endogenous defenses then engineer therapeutic approaches that could augment such endogenous defenses. As a first approximation to this goal, experiments were conducted in order to determine whether EGFR/XPA pro-cell survival signaling was constitutive of the endogenous molecular defense repertoire of SGNs. Design-based stereology was used to quantify the expression and distribution of EGFR/XPA expressing neurons in response to noise stress. The noise band was designed to stress SGNs within the apical and middle coils of the rat cochlea, with little or no stress to the basal coil. A cohort of animals also served as control by not receiving the noise exposure. The results revealed that SGNs within the apical and middle coils exhibited a coordinated response to the noise stress while neurons in the basal coil did not. These results suggest that EGFR/XPA pro-survival signaling might be part of the molecular defense repertoire of SGNs. Therefore, future attempts to augment EGFR/XPA signaling could be used to rescue SGNs from acquired auditory neuropathies.

Poster # 110 – ANAT04

Revisiting Anatomical Variability along the Sylvian Fissure: Its Impact on Central Auditory Research
Barrett St. George, BA; Andrew Demarco, MA; Frank Musiek, PhD, The University Of Arizona, Tucson, AZ

A detailed understanding of the central auditory nervous system is fundamental to auditory research and clinical audiology. However, cortical structures involved in auditory processing have considerable anatomical variability which complicates their localization in the human brain. The Sylvian fissure (SF) has been used as a proxy for measuring the dimensions of enclosed auditory structures, especially in terms of laterality differences. In addition to its main segment, the SF sometimes exhibits a posterior upward branch, known as the posterior ascending ramus (PAR). Previous studies have not reported clear criteria for what constitutes a PAR and thus have inconsistently included this branch in morphometric measurements of the SF. We first replicate earlier work in measuring the lengths and angles of left and right hemisphere SF. We then develop empirically motivated anatomical criteria for what constitutes a true PAR. Finally, we examine what effect the inclusion or exclusion of PAR have on measures of the SF. Our work also provides insight into the natural variability of this auditory region of the brain. This in turn

should provide a more accurate basis not only for further anatomical study but also for the application of fMRI, evoked potentials, and lesion localization.

Poster # 111 – ANAT05

Modern Views on the Anatomy of Planum Temporale

Barrett St. George, BA; Andrew Demarco, MA; Frank Musiek, PhD, The University Of Arizona, Tucson, AZ

Rational and Hypotheses: The planum temporale (PT) is a workhorse for auditory processing. This important brain region for audition has been studied extensively in both healthy and disordered populations (Shapleske et al., 1999). The PT demonstrates the most pronounced hemispheric asymmetry out of all structures in the human brain (Toga and Thompson, 2003), often larger in the left hemisphere. This anatomical asymmetry has been related to the left-hemisphere dominance of language function (Geschwind & Levitsky, 1968). Occupying the posterior portion of the dorsal plane of the superior temporal gyrus, the PT is concealed within the Sylvian fissure. It is bounded anteriorly by Heschl's gyrus, and posteriorly by the posterior ascending ramus (PAR) of the Sylvian fissure. However, these two anatomical boundaries are considerably variable in their morphology. PARs vary significantly in length and angle, and sometimes are absent (St. George et al., 2016). In addition, Heschl's gyrus often demonstrates a partial or complete duplication (Marie et al., 2015). Although previous literature attempting to quantify the anatomy of PT has considered some of these complexities, it has not considered the effects of new research refining its boundaries. Specifically, redefining of the boundaries of Heschl's gyrus, the PT, and the PAR has motivated the current research which allows an accurate view of this area of auditory cortex. Accounting changes in boundaries of Heschl's, angle and length of the PAR and newly developed anatomical criteria, the following are hypothesized: 1) duplication of Heschl's, and 2) the presence of a PAR will significantly reduce the size of PT and 3) explain sources of PT asymmetry. Methods: High-resolution T1-weighted MRIs of 28 healthy dextral adults were examined. The superior temporal plane was exposed via the traditional knife-cut method using modern neuroimaging software. The surface area of PT was measured on each hemisphere's cortical mesh, which accounted for the natural curvature of the surface of the brain. Presence of posterior ascending ramus was determined based on criteria from (St. George, DeMarco and Musiek, 2016). Heschl's gyrus patterns were identified via visual inspection of the superior temporal plane. Duplications of Heschl's gyrus were classified according to the three traditionally-recognized variants (Rademacher et al., 1993). The effect of posterior ascending ramus presence and Heschl's gyrus variant on PT surface area was examined as a linear model using statistical modeling software. Results and Discussion: We found that PT surface area was significantly larger in left compared to right hemisphere, consistent with previous literature. Additionally, PT area was significantly larger in hemispheres without posterior ascending rami compared to hemispheres with posterior ascending rami. Furthermore, PT area was significantly larger in hemispheres with single Heschl's gyrus morphology compared to hemispheres exhibiting Heschl's gyrus duplications. Our results confirm that the surface area of PT depends on the morphology of neighboring perisylvian structures which helps to explain its structural asymmetry. This type of translational research will affect how we look at site of lesion (particularly with aphasia patients), topographic evoked potential mapping and how we draw structure-function correlations to MRI and fMRI.

AUDIOLOGY / OTOLOGY

Poster # 112 – AO09

ABR Heralds the Initial Diagnosis of Neurofibromatosis Type II

Robert Ivey, PhD, Private Practice, Las Cruces, NM
Diane Cheek, BA; Frank Musiek, PhD, The University Of Arizona, Tucson, AZ

Neurofibromatosis type II (NF2) is a genetic condition characterized by the growth of noncancerous tumors within the nervous system (National Institute of Neurological Disorders, 2011). Symptoms are dependent on tumor location, however patients often report hearing loss, tinnitus, imbalance or dizziness as their initial symptoms (Asthagiri et al., 2009). NF2 is diagnosed using magnetic resonance imaging (MRI), but symptom heterogeneity often leaves patients undiagnosed for years after symptom onset. Audiologists may be the first professional to assess patients with NF2 given these initial symptoms. The purpose of this case study is to highlight the audiologist's role in facilitating NF2 diagnosis by employing tests sensitive to neural dysfunction. A 21-year-old patient presented to an audiologist with imbalance and hearing difficulties. Pure tone testing revealed a mild unilateral sensorineural loss while auditory brainstem response (ABR) revealed only Wave I, bilaterally. The audiologist recommended the patient seek imaging given ABR results. The patient was soon diagnosed with NF2 with six tumors identified, including bilateral vestibular schwannomas. Literature supports ABR's sensitivity and usefulness in NF2 while pure tone testing often fails to yield contributory diagnostic value (Pikus, 1995). While audiologists cannot diagnose NF2, astute clinical decision-making and test selection can herald its initial diagnosis.

Poster # 113 – AO10

Videos to Supplement the Infant-Toddler Meaningful Auditory Integration Scale

Hannah Jones, BS; Brittan A Barker, PhD, Department Of Communication Disorders And Deaf Education, Utah State University, Logan, Ut, Logan, UT
Chelsi Gibbons Daquanno, MA, Livingston Parish School Board, LA

The Infant-Toddler Meaningful Auditory Integration Scale (IT-MAIS; Zimmerman-Phillips, et. al., 2000) is used to assess auditory development in young children with hearing loss. Despite being widely used, recent research (Barker, et al., in press) showed that its psychometric properties are not ideal, in particular its intra-rater reliability. For this study we aimed to create videos with strong face validity that could be used to supplement the IT-MAIS questions and ultimately improve its psychometric properties. First, we created 6 video scenarios to accompany each IT-MAIS question. Ten pediatric audiologists were surveyed to determine how representative each scenario was of its corresponding IT-MAIS question. Second, we created videos based on the top, two written scenarios. Next we surveyed 25 pediatric audiologists and 25 nave caregivers to determine how representative each video was of its respective question. The results indicated that 1 corresponding video was deemed most representative by both the audiologists and caregivers for 8 IT-MAIS questions. Thus suggesting that each video had strong face validity. The audiologists and caregivers disagreed as to which of the videos best represented the remaining 2 IT-MAIS questions. Our results call into question the validity of the remaining videos and the accompanying IT-MAIS questions.

Poster # 114 – AO11

A Consumer Questionnaire to Assess the Risk for Ear Disease

Samantha Kleindienst, PhD, Mayo Clinic Arizona, Scottsdale, AZ
David Zapala, PhD; Larry Lundy, MD; Razan Al Fakir, PhD, Mayo Clinic Florida, Jacksonville, FL
Donald Nielsen, PhD, Don Nielsen Consulting, LLC, Dublin, OH
Sumitrajit Dhar, PhD; James Griffith, PhD; Niall Klyn, PhD, Northwestern University, Evanston, IL
Deborah Carlson, PhD, The University of Texas Medical Branch, Galveston, TX
Dania Rishiq, PhD, University of South Alabama, Mobile, AL

Federal regulation that requires a medical examination prior to hearing aid procurement is a significant barrier to hearing aid access. An efficacious consumer-administered questionnaire would provide a method for estimating risk for serious ear disease while increasing accessibility to hearing healthcare. The goal of this study was to develop and validate such a tool to be used with individuals complaining of hearing loss. The questionnaire was created using established methods of expert medical opinion to validate questions, and cognitive interviews to assess usability. Blinded neurotologist examination was used to evaluate the sensitivity and specificity of the questionnaire in 307 participants from the departments of Otorhinolaryngology/Audiology at Mayo Clinic Florida. Exploratory factor analysis, structural equation modeling, and logistic regression were used to develop a scoring algorithm in a training subset, which resulted in 94% sensitivity and 61% specificity. This poster will review the development and findings of this novel, consumer tool designed to assess an individual's risk for ear disease, as well as discuss this tool's potentially pivotal role in improving the affordability and accessibility of hearing healthcare while efficiently detecting public risk for serious ear diseases.

Poster # 115 – AO12

Evaluating Red Flag Criteria for Surveillance of Ear Diseases

Niall Klyn, PhD; Sumitrajit Dhar, PhD; James Griffith, PhD, Northwestern University, Evanston, IL
Samantha Kleindienst, PhD, Mayo Clinic Arizona, Scottsdale, AZ
Razan Al Fakir, PhD; David Zapala, PhD; Larry Lundy, MD, Mayo Clinic, Jacksonville, FL
Donald Nielsen, PhD, Don Nielsen Consulting, LLC, Dublin, OH
Deborah Carlson, PhD, The University of Texas Medical Branch, Galveston, TX
Dania Rishiq, PhD, University of South Alabama, Mobile, AL

The red flag criteria designed by the FDA and the AAO were proposed to provide surveillance of medically treatable ear diseases in individuals seeking hearing aids. However, the ability of these red flags to effectively screen patients has not been well-established. Using a pool of 307 patients from the Mayo Clinic Florida with a disproportionate prevalence of ear disease (75%), we evaluated the sensitivity and specificity of both sets of red flag criteria. Blinded neurotologist opinion was used as the gold standard for the presence or absence of an ear disease, and data for each of the red flags were pulled retrospectively from examinations performed by audiologists. The conservative nature of the AAO red flag criteria resulted in relatively high sensitivity and very low specificity, with many patients being flagged for referral unnecessarily. The FDA red flag criteria were less sensitive than the AAO's, but were substantially more specific. As the prevalence of these diseases is thought to be quite low in the hearing aid-seeking population (~5%), the high rate of referrals due to false positives would lead to substantial unnecessary costs. Possible solutions that provide adequate surveillance while reducing the rate of false positive referrals will be discussed.

Poster # 116 – AO13

Auditory Access and Behavioral Outcomes for Children with Hearing Loss
Clairissa Mollak, BS; Elizabeth Walker, PhD, University Of Iowa, Iowa City, IA
Meredith Spratford, AuD; Ryan Mccreery, PhD, Boys Town National Research Hospital, Omaha, NE

Functional auditory assessments are designed to examine listening behavior in real-world contexts such as the classroom. The Screening Instrument for Targeting Educational Risk (SIFTER) Questionnaire is a functional assessment developed to measure teacher perception of children's behavioral outcomes in the academic setting. To date, few studies have examined the behavioral outcomes in the classroom for children who are hard of hearing. In the current study, kindergarten through third grade teachers completed the SIFTER. We predicted that 1) we would find an effect of hearing status on the SIFTER, in that children with normal hearing and mild HL would demonstrate higher scores than children with more severe HL, and 2) children with mild HL who used hearing assistive technology (HAT) would have higher scores on the SIFTER than children who did not use HAT. We also examined trends in SIFTER scores over time for children with HL and children with normal hearing. Preliminary findings indicate an effect of hearing status but in an unexpected direction: children with HL showed significantly better classroom behavior compared to children with NH. These findings will be discussed in terms of the influence of auditory access on classroom behaviors.

Poster # 117 – AO14

Integration of Audiologic Test Results into the Electronic Health Record System
Rajarshi Pratihar, AuD; Diana K Weissbeck, AuD; Denise A Barringer, MS; Jan S Lewin, PhD, The Ut Md Anderson Cancer Center, Houston, TX

The electronic medical record (EMR) converts the traditional paper-based medical chart into a digital format to improve efficiency and communication between healthcare providers. Although, current EMRs facilitate record sharing within a single institution, they lack the capacity to share information among healthcare specialists outside the institution. Therefore, the subsequent development and implementation of the electronic health record (EHR) has allowed clinicians to capture patient information, billing activity, outcome data, as well as to share information with approved health care providers between facilities. Unfortunately, current audiologic instruments continue to rely on manual entry of patient information and lack the seamless, automatic 2-way interface between the audiology instrument and the EHR that negatively impact cost, effort, and information accessibility. This presentation provides an innovative process for the integration of audiologic test results and data into the EHR. We have found that this new system is cost effective and readily available to approved healthcare providers within and outside the institution. Our new EHR provides a model for future data management that comprehensively captures and shares patient specific information in both a clinical and research setting.

Poster # 118 – AO15

Consequences of mTBI on Central Auditory Function

Christina Roup, PhD; Julie Powell, BA, Ohio State University, Columbus, OH
Elizabeth Leigh, PhD; Lindsey Byom, PhD, William S. Middleton Va Medical Center, Madison, WI
Rocio Norman, MA, University of Wisconsin-Madison, Madison, WI

Mild traumatic brain injury (mTBI) can result in central auditory nervous system damage and auditory processing deficits. A common complaint of mTBI patients is difficulty with communication, specifically hearing; however, the audiogram, word recognition in quiet, and standardized cognitive tests often do not explain these complaints. We hypothesized that these communication complaints are an emergent property of subclinical auditory impairments and thus are not captured by standard clinical auditory or cognitive measures. The objective of this study was to identify and characterize hearing complaints using subjective auditory and cognitive communication questionnaires and measures of central auditory function. Two groups of adults with clinically normal hearing (thresholds - 25 dB HL) were recruited: 1) adults with a history of mTBI, and 2) adults without a history of mTBI (control group). Auditory function was measured behaviorally with: 1) the Revised Speech Perception in Noise test; 2) dichotic word recognition; and 3) the 500-Hz masking level difference. Electrophysiological measures included the binaural interaction component of the middle and late latency responses. Results suggest that individuals with mTBI have poorer performance relative to the control group on both subjective and objective measures of auditory function.

Poster # 119 – AO16

Words-in-Noise Data from PHACS Perinatally HIV-infected and HIV-exposed Young Adults

Peter Torre, PhD; Alyssa Cook, San Diego State University, San Diego, CA
Jonathan Russell; Paige Williams; Tzy-Jyun Yao, Harvard School Of Public Health, Boston, MA
Sonia Lee, National Institute of Child Health and Human Development, Bethesda, MD
Howard Hoffman, National Institute on Deafness and Other Communication Disorders, Bethesda, MD
Renee Smith, University of Illinois, Chicago, IL

The Pediatric HIV/AIDS Cohort Study (PHACS) is following adolescents transitioning into adulthood. Previously, we showed that perinatally HIV-infected (PHIV) adolescents in PHACS had poorer hearing sensitivity than perinatally HIV-exposed, but uninfected (PHEU) adolescents. In the present PHACS study, Words-in-Noise (WIN) and cognition tests were performed on 241 PHIV young adults (mean [SD] age=21.6 [3.3] years; 56% female; 67% Black) and 51 PHEU young adults (mean [SD] age=19.2 [1.4] years; 65% female, 55% Black). Primary outcome measures were the signal-to-noise ratio (in dB, worse ear) for WIN, and cognitive function assessed as non-verbal and verbal composite scores (<70=cognitively impaired). One PHEU participant had verbal cognitive impairment. PHIV young adults with verbal cognitive impairment (n=12) had poorer WIN scores than those without (n=201)(mean [SD]=10.1 [5.3] and 7.6 [4.8], respectively; p=0.07). For those with non-verbal cognitive impairment, WIN scores were similar between 87 PHIV and 14 PHEU young adults (mean [SD]=7.9 [4.7] and 7.9 [4.6], respectively). Among those without non-verbal cognitive impairment, 25 PHEU had poorer WIN scores compared to 119 PHIV young adults (mean [SD]=9.0 [4.3] and 7.7 [5.0], respectively; p=0.07). PHIV and PHEU young adults have poorer WIN scores compared to the normative cutoff of 6.8, regardless of cognitive impairment.

AUDITORY PROCESSING

Poster # 120 – AP06

Aging Alters Attentional Modulation of Spatial Processing in Auditory Cortex
Erol Ozmeral, PhD; Madeleine Berg; David Eddins, PhD; Ann Clock Eddins, PhD, University Of South Florida, Tampa, FL

Recent work in younger, normal-hearing listeners indicates that attending to spatial location can have a marked enhancement to the electrophysiological response for stimuli that move to that attended location. Prior work suggests that older, normal-hearing listeners have poorer spatial hearing due to declines in both top-down and bottom-up processes. We measured evoked responses to changes in the location of continuous noise in the free field when older, normal-hearing listeners were either passively listening or explicitly attending to a given speaker location. Stimuli were presented from 1 of 5 frontal loudspeaker locations in the horizontal plane for 1.6 s before switching to another loudspeaker without pause. To ensure active attention for certain blocks, listeners were directed to press a button at the onset of a sound presented from the target location. Preliminary results show predicted hemispheric asymmetry in source-localized cortical activity based on spatial location but little evidence for either facilitation for attended locations or suppression for unattended locations when compared to passive listening. These data are mostly in contrast to results from younger listeners, which showed attentional modulation in both auditory cortices. Results suggest altered attentional modulation of early sensory processing of spatial location in older relative to younger listeners.

Poster # 121 – AP07

Neural Representation of Temporal Cues: Aging and Spectral Degradation Effects
Lindsey Roque, BS; Samira Anderson, PhD; Matthew Goupell, PhD, University Of Maryland, College Park, College Park, MD

Degraded temporal processing is a factor in older adults' decreased ability to understand speech in noise. For example, older adults have more difficulty detecting temporal cues distinguishing one word from another, such as voice onset time to cue initial voicing, or silence duration to cue the final affricate versus fricative. The present study examines the effects of aging and spectral degradation on electrophysiological responses to words containing a silent duration. Frequency-following response (FFR) and cortical measures were recorded in younger adults and older adults with normal hearing to the word 'ditch' in unprocessed and vocoded (tonal carriers, eight channels) conditions. Stimulus-to-response (STR) correlations and phase-locking factor were used to assess subcortical temporal processing. The younger listeners had higher phase locking and STR correlations than the older listeners, and these differences were more pronounced in the vocoded condition. When comparing cortical responses, the older listeners had exaggerated amplitudes compared to the younger listeners. Results suggest differences in how younger and older individuals encode word containing silent duration cues, providing evidence for age-related degradation in temporal processing. Increased susceptibility to spectral degradation in older adults suggests a mechanism for poorer speech perceptual performance observed in older compared to younger cochlear implant users.

Poster # 122 – AP08

Preadolescent Musical Training Influences Spatial Listening and Temporal Processing Skills
Brett Schneiderman, BS; Erin Dula; Saravanan Elangovan, PhD, East Tennessee State University, Johnson City, TN

We examined the hypothesis that neural plasticity following preadolescent musical training improves spatial listening and temporal processing. Two groups of children with (>2 years) and without (< 6 months) significant musical training were assessed on binaural processing, spatial memory, and gap detection. Results demonstrated the musician group had an advantage in spatial listening and auditory memory. These findings suggest an early emergence of listening benefits and also support musical training as a rehabilitative strategy to ameliorate specific auditory processing deficits.

Poster # 123 – AP09

Jackson Heart Study: Central Auditory Processing Deficits and Normal Hearing
Christopher Spankovich, PhD; Lauren Mcnichol, AuD; Mary Frances Johnson, AuD; John Schweinfurth, MD; Charles Bishop, AuD, University Of Mississippi Medical Center, Jackson, MS

Normal pure tone threshold sensitivity does not necessarily indicated normal hearing. The auditory processing of a sample of 1322 participants of the Jackson Heart Study, a prospective epidemiological study of cardiovascular disease and health disparities in African Americans, was assessed between 2008 and 2013. Here we present cross-sectional data on participants with normal pure tone thresholds with and without perceived hearing loss and relationship to central auditory processing outcomes, Quick Speech-in-Noise (SIN) and Dichotic Digits. The results suggest that perceived hearing problems, despite normal threshold sensitivity are associated with central auditory deficits.

Poster # 124 – AP10

Auditory Processing Difficulties in Older Adults
Nirmal Kumar Srinivasan, PhD; Alexis Staudenmeier; Kelli Clark, BA, Towson University, Towson, MD

Auditory Processing Disorder (APD) refers to a deficit in the perceptual processing of auditory stimuli and the neurobiological activity underlying that processing. Central auditory processes are the auditory system mechanisms and processes responsible for sound localization and lateralization, speech perception with degraded acoustic signals and in complex listening environments, auditory discrimination and temporal aspects of audition. Estimating the prevalence of APD in adults is complex, as there is no common definition of the disorder and there is no agreed upon test battery. Here, we will present data from a set of behavioral tests that have great potential to distinguish the effects of hearing loss from the effects of APD since the hearing complaints of the listeners with APD are similar to those of individuals with peripheral hearing impairment. Gap detection thresholds, localization acuity, spatial release from masking, speech perception in complex listening environment such as time compression and reverberation, and speech recognition threshold was measured for older listeners with varying hearing abilities. The data presented would provide further insight into the difficulties in perceiving

speech encountered by older listeners across various types of degradation and interference. [Work supported by Hearing Health Foundation Emerging Research Grants]

Poster # 125 – AP11

Auditory Temporal Processing Tests: An Indicator of CANS Pathology
Bryan Wong, BS; Frank Musiek, PhD, University Of Arizon, Tucson, AZ
Renata Filippini, PhD, University Of Sao Paulo, Sao Paulo, Brazil

Background: Performance on auditory temporal processing tests (ATP) has shown to be decreased in subjects with lesions affecting the central auditory nervous system (Musiek & Pinheiro, 1987; Musiek et al., 1990; Musiek et al., 2005). The goal of this review is to evaluate and compare ATP performance for different populations with a variety of centrally mediated pathologies. The Gaps-In-Noise, Frequency Pattern and Duration Pattern tests were used. Methods: A total of 15 studies on 329 subjects with Epilepsy (N=6), Stroke (N=3), Multiple Sclerosis (MS; N=1), Dyslexia (N=3) and blast exposure (N=2) were included. Results: For all five conditions, the groups with neuro-auditory lesions performed below the norms, for all three tests, with significant poorer performance than their corresponding control groups. Moderate to large Effect Size were obtained for all studies and measures, with Cohen's d ranging from 0.47 to 2.64. Conclusion: ATP test performance for all three measures seem to be negatively affected by a broad range of central pathologies affecting the CANS. These tests have the capability to clinically evaluate CANS integrity for a wide range of central auditory pathologies, and it is strongly encouraged that clinicians consider applying them to fully assess hearing in neurological populations.

COCHLEAR IMPLANTS

Poster # 126 – CI15

Improving Speech Understanding in Complex Listening Environments for CI Listeners
Michael Dorman, PhD; Sarah Natale, MS, Arizona State University, Tempe, AZ

In a series of experiments, we have explored the value of monaural noise-reduction technologies for improving speech understanding in complex listening environments. In Experiment 1 (n=10), we evaluated the value of an adaptive beamformer (UltraZoom from Advanced Bionics) relative to the value of (i) bilateral CIs and (ii) bilateral low-frequency acoustic hearing in patients with a single CI (hearing preservation surgery). In Experiment 2 (n=10), we evaluated the value of a wireless microphone (Roger Pen) relative to value of an omnidirectional T-Mic (Advanced Bionics) and UltraZoom. In Experiment 1 the beamformer produced a 31 percentage point improvement in performance. That gain was equal to the gain produced by bilateral CIs and by bilateral low-frequency acoustic hearing with a single CI. In Experiment 2, performance with the Roger Pen was better than with the UltraZoom, which was better than performance with the T-Mic. The Roger Pen in noise allowed scores equivalent to scores with the T-Mic in quiet. To summarize: Current monaural noise reduction technologies can restore levels of speech understanding in moderate levels of noise that approximate the level of speech understanding in quiet achieved with conventional microphones or in noise with bilateral CIs.

Poster # 127 – CI16

Effects of Cochlear Implant Microphone Location for New Generation Processors
Robert T Dwyer, AuD; Rene H. Gifford, PhD, Vanderbilt Bill Wilkerson Center, Nashville, TN

This study evaluated the effect of processor mic location for roving sentence recognition in the following mic conditions: T-mic, processor mic, processor mic plus T-Mic, unilateral beamforming, and bilateral beamforming. TIMIT sentences were randomly presented at 0, 90 or 270 degrees in a diffuse restaurant noise originating from the R-SPACE 8-loudspeaker array. SNR was determined individually to achieve approximately 50% correct in the best-aided condition with the target at 0 degrees. Both bilateral CI and bimodal listeners were recruited for participation with a target enrollment of 12 participants. Preliminary data revealed that, like previous studies, mic location significantly affected sentence recognition as a function of source azimuth ($p<0.05$). Bilateral beamforming yielded significantly higher performance at 0 degrees as compared to all other configurations ($p<0.05$). For speech presented at +/- 90 degrees, the following results were observed: 1) no difference across the non-beamforming mic configurations, 2) both beamformers yielded significantly poorer outcomes, and 3) speech understanding was highest with speech presented to the better hearing ear. In group environments, speech originates from multiple source azimuths. Thus the clinical implications of these results are significant for CI and bimodal programming as well as for patient counseling regarding uses of microphone configuration.

Poster # 128 – CI17

Hearing Abilities in Osseointegrated Implant Users Following Daily Experience
Elizabeth Elkins, AuD; Stacey Watson, AuD; Douglas Backous, MD; Alexandra Parbery-Clark, PhD, Swedish Medical Group, Seattle, WA
Jacky Tran; Jake Hillyer, Swedish Health Services
P. Cody Buchanan, MD, St. John Medical Center, Broken Arrow, OK

Osseointegrated implants (OIs) are a treatment option for single-sided-deafened (SSD) patients. However, OIs do not restore the binaural hearing cues that are known to contribute to speech in noise (SIN) understanding and localization for SSD patients. While SSD patients subjectively report continued difficulty with these auditory tasks despite using an OI, it is unknown if daily listening experience with an OI is adequate to improve one's hearing abilities over time. To address this, we assessed whether gaining daily listening experience with an OI, over a 12 month span, improves SIN understanding and localization abilities of SSD patients. Ten SSD OI users with at least 6 months consistent device use prior to the study were recruited. At the initial visit and 12 months post-initial visit, SIN and localization tests were administered through a surround sound, multi-speaker array to assess performance. Result show that following 12 months of daily OI device experience, SSD patients demonstrate no significant performance increase in SIN understanding or localization ability. As such, targeted auditory training programs should be considered to improve hearing performance in SSD patients with OI devices.

Poster # 129 – CI18

Cochlear Implant Simulations of Reduced Current Spread Improve Phoneme Identification

Kelly Jahn, AuD; Julie Bierer, PhD, University Of Washington, Seattle, WA

Objective: In cochlear implant (CI) listeners, channel interaction likely limits speech perception performance. To study the role of channel interaction, this study employed simulations of CI hearing to examine speech perception as a function of number of processing channels and the degree of current spread in normal-hearing adults and children. Design: Vowel and consonant recognition was assessed. Stimuli were processed using a noise-band vocoder with 8, 12, and 15 channels and synthesis filter slopes of 15 (for adults), 30, and 60 dB/octave. Steeper filter slopes simulated less current spread and therefore less channel interaction. Results: Vowel and consonant recognition improved with increasing filter slopes. Young children, ages 8-10 years, continued to benefit from reduced current spread beyond the filter slope settings for which adult performance plateaued. For all listeners, consonant recognition improved with steeper filter slopes regardless of the number of channels. On the other hand, regardless of filter slope, vowel recognition improved when channel number increased from 8 to 12. Conclusions: Vowel recognition depends upon the number of channels and the filter slopes, whereas consonant recognition depends only on filter slope. Recognition of spectrally degraded speech can improve with reduced current spread, particularly for children.

Poster # 130 – CI19

Correlations Between ECAP, ECoG and Speech Perception in CI Users

Jae-Ryong Kim, MD; Paul Abbas, PhD; Carolyn Brown, PhD, Department Of Communication Sciences And Disorders, University Of Iowa, Iowa City, IA
Viral Tejani, AuD, Department Of Otolaryngology-head And Neck Surgery, University Of Iowa Hospital And Clinics, Iowa City, IA

The electrically evoked compound action potential (ECAP) reflects the response of the auditory nerve to electrical stimulation. Electrocochleography (ECoG) measures the response of the cochlea and auditory nerve to acoustic stimulation. The goal of this study was to determine the extent to which these two measures of peripheral function might predict speech perception in Hybrid L24 cochlear implant (CI) users. ECAP and ECoG responses were recorded from an intracochlear electrode in 25 adults. Speech perception was assessed using CNC words and AzBio sentences presented at a +5 dB SNR. Testing was conducted in both the hybrid (A+E) and electric (E) alone listening modes. A measure we call Acoustic (A) gain was derived by subtracting these two scores. We found ECAP amplitude to be correlated with CNC scores when testing was conducted in either the E or A+E conditions. ECAP amplitude was not correlated with AzBio scores. ECoG responses evoked using 500 Hz tone bursts were correlated with a metric that combined performance in the A gain condition on both the AzBio and CNC tests. It appears that the combination of ECAP and ECoG recordings may provide a more complete characterization of cochlear status than is provided by either metric alone.

Poster # 131 – CI20

Comparing Rapid and Traditional Spatial Tuning Curves in Cochlear-Implant Users

Heather Kreft, MA; Andrew Oxenham, PhD, University Of Minnesota, Minneapolis, MN
Lindsay Devries, AuD; Steven Bierer, PhD; Julie Arenberg Bierer, PhD, University Of Washington, Seattle, WA

Spectral resolution in cochlear implants (CIs) is thought to limit CI users' ability to understand speech and may reflect underlying physiological constraints. However, behavioral measures of spectral resolution are either not sufficiently detailed (e.g. spectral-ripple discrimination) or are very time-consuming (i.e. psychophysical spatial tuning curves, STCs). This study follows from an earlier report that validated a fast method for measuring absolute thresholds in CI users, using a variant of Bekesy tracking [Bierer et al., Trends in Hearing 19:1-12 (2015)]. The current study extends this sweeping procedure to the collection of STCs in CI users, to provide the detail of STCs but with a much more rapid procedure than the traditional adaptive forced-choice procedure. Twelve Advanced Bionics CI users were tested on 1 to 3 probe electrodes using the traditional adaptive procedure as well as with the sweep method. The STCs for both measurement procedures were determined and characterized by apical and basal slopes, tip shifts, and tuning curve width at 1 dB. Preliminary data show relatively good correspondence between the two measures. If successful, the new method may be utilized in clinical settings to identify regions of poor spectral resolution and thus aid in the programming of the CI.

Poster # 132 – CI21

Emotional Speech Recognition in Normal-hearing Listeners and Cochlear Implant Users

Xin Luo, PhD; Kathryn Pulling, Department Of Speech And Hearing Science, Arizona State University, Tempe, AZ

Speech conveying different emotions varies in pitch, duration, and intensity. Vocal emotions may affect speech intelligibility, especially in cochlear implant (CI) users with coarse spectral resolution. Here, 50 sentences were produced by a male and a female talker in each of the 5 basic emotions (angry, happy, neutral, sad, and anxious). Pilot studies in babble noise with normal-hearing listeners listening to the original speech or 8-channel noise-vocoded speech were used to decide the signal-to-noise ratios for 70% word recognition of neutral speech for each talker in each condition. Based on the pilot data, the 50 sentences were divided into 10 lists of 5 sentences with equal word number and recognition score. In formal test, each subject recognized the 50 sentences with each sentence list produced by a unique talker-emotion combination. The assignment of sentence list to talker-emotion combination varied for 10 subjects so that each list was tested once in each of the 10 talker-emotion combinations. Consistent with the normal-hearing data, pilot CI data showed different descending orders of speech intelligibility across emotions for the female (happy, angry, neutral, anxious, sad) and male talker (neutral, anxious, angry, happy, sad), which may be explained using the talker- and emotion-specific acoustic features.

Poster # 133 – CI22

Sound Localization and Speech Perception in Noise of Pediatric Cochlear Implant Recipients: Bimodal Fitting Versus Bilateral Cochlear Implants

Il Joon Moon, MD; Ji Eun Choi, MD; Won-ho Chung, MD; Chung Hwan Baek, MD; Hee Sung Park, MD; Yang-Sun Cho, MD, Department Of Otorhinolaryngology-Head and Neck Surgery, Samsung Medical Center, Sungkyunkwan University School Of Medicine, Seoul, Republic Of Korea
Sung Hwa Hong, MD; Jung Joo Lee, Department of Otorhinolaryngology-Head and Neck Surgery, Changwon Samsung Hospital, Sungkyunkwan University School of Medicine, Seoul, Republic of Korea

Objectives: to compare binaural performance of auditory localization task and speech perception in babble between children who use bimodal fitting and those who use bilateral CIs. Design: Thirteen children with bilateral CIs and nineteen children with bimodal fitting were recruited. Sound localization was assessed using a 13-loudspeaker array in a quiet sound-treated booth. Speech-in-babble perception was also measured in the sound field using target speech presented from the front speaker. Results: When the two groups of children were directly compared to each other, there was no significant difference in localization accuracy ability or hemi-field identification score under binaural condition. Performance in speech perception test was also similar to each other under most babble conditions. However, when the babble was from the first device side (CI side for children with bimodal stimulation or first CI side for children with bilateral CIs), speech understanding in babble by bilateral CI users was significantly better than that by bimodal listeners. Conclusions: Overall, the binaural performance was similar to each other between children who are fit with two CIs and those who use bimodal stimulation in most conditions. However, the bilateral CI group showed better speech perception than the bimodal CI group when babble was from the first device side.

Poster # 134 – CI23

Spectral Separation of Speech and Noise in Cochlear Implant Users
Erin O'Neill; Heather Kreft; Andrew Oxenham, University Of Minnesota, Minneapolis, MN

Poor spectral resolution is thought to underlie many of the difficulties experienced by people with cochlear implants (CIs) when listening to speech in noise. However, studies of individual differences between CI users have not always found a correlation between measures of spectral resolution and speech intelligibility. It may be that spectrally separating speech from noise enhances the role played by spectral resolution. This prediction was tested by presenting the speech and masker to interleaved spectral channels, creating separation between the speech and masker spectra. Results from normal-hearing listeners, presented with vocoded stimuli with varying degrees of spectral spread, showed that the overall benefit gained from spectral separation diminished with decreasing spectral resolution. Surprisingly, results from CI users did not follow the same trend. Almost all CI users gained no benefit from spectrally separated speech and noise, with no clear correlation between better spectral resolution (as measured by ripple discrimination thresholds) and speech understanding. The outcomes suggest that the degraded speech signal transmitted via a CI in combination with spectral smearing caused by spread of current across the electrode array causes a level of degradation that is too severe to be positively affected by the spectral separation of speech and noise.

Poster # 135 – CI24

Use of Direct-Connect for Remote Speech-Perception Testing in Cochlear Implants
Joshua Sevier, AuD; Sangsook Choi, PhD; Michelle Hughes, PhD, Boys Town National Research Hospital, Omaha, NE

Once an individual receives a cochlear implant (CI), several visits are required within the first year following surgery, and recipients are typically seen once or twice a year thereafter. Periodic speech-perception testing is important for documenting CI performance changes over time. In the clinical setting, speech perception is typically evaluated in a sound-treated booth. However, due to the limited number of

centers offering CI services in many states, it is not likely that sound booths will be available in settings where audiological services would be delivered remotely. Results from two recent studies in our laboratory showed that speech-perception scores were poorer in a remote testing room than in a sound booth (in person) due to differences in the acoustical environment (e.g., background noise and reverberation). This study investigated whether direct audio input (DAI) of speech stimuli to the speech processor can be used as a substitute for sound-booth speech-perception testing for remote service delivery. We hypothesized that DAI and sound-booth results will be equivalent. Preliminary data suggest that both DAI and sound-booth testing yield similar results in the evaluation of CI speech perception.

Poster # 136 – CI25

Comparing Methods for Pairing Electrodes Across Ears with Cochlear Implants
Hannah Staisloff, BS; Daniel Lee; Justin Aronoff, PhD, University Of Illinois At Urbana Champaign, Champaign, IL

Currently in clinics bilateral cochlear implant maps are created by pairing electrodes in the two ears based on the relative distance from the end of the electrode array. Better performance may result by pairing electrodes based on a bilateral task. The goal of this study was to determine if pairing electrodes based on interaural time differences (ITDs) would yield the same bilateral pairs as pairing them based on pitch matching. ITD sensitivity was measured using a four interval, 2 alternative forced choice task. This process was repeated with 5 reference electrodes and multiple comparison electrodes to determine the pair with the lowest ITD threshold for each reference electrode. These same subjects were asked to listen to a stimulation presented sequentially to each ear and then move the stimulation location in one ear using a dial until the stimulation in both ears had the same pitch. The preliminary results suggest that ITDs and pitch matching do not result in the same electrode pairing.

Poster # 137 – CI26

Evaluation of Subjective Benefit in Older Cochlear Implant Listeners
Jennifer Torres, MA, Denver Ear Associates, Englewood, CO
Christina Runge, PhD, Medical College Of Wisconsin, Milwaukee, WI
Meredith Anderson, AuD, University of North Carolina School of Medicine
Michelle Blanchard, AuD, Tampa Bay Hearing and Balance
Elizabeth Camposeo, AuD, Medical University of South Carolina
Michelle Montes, AuD, The Hospital of the University of Pennsylvania

Increasingly, older adults are obtaining cochlear implants and while many achieve high levels of speech understanding, we still lack a thorough understanding of why a subset of these patients do not perform as well. The purpose of this study was to compare whether poorer performing older adults experience similar subjective benefits as better performers after experience using their cochlear implant. A secondary goal is to assess the key areas in which implanted older adults report difficulty using their devices. Adults over the age of 60 were recruited at the time of cochlear implantation to participate in a multi-center study. CNC results, obtained at 6 months, were used to classify better and poorer performers, separated into two groups by a score of 50%. Validated self-assessment tools can provide information about sound quality and device satisfaction, potentially providing more insight into a

cochlear implant's impact on an individual patient. The Hearing Implant Sound Quality Index (HISQUI) and the Hearing Device Satisfaction Scale (HDSS) questionnaires were completed by participants prior to initial stimulation and after 6 and 12 months of device use, in order to evaluate changes in self-reported ability with increased listening experience. The subjective data will be presented here.

Poster # 138 – CI27

Simulation of Spectral Ripple Discrimination of Cochlear Implant
Jihwan Woo, PhD; Hyejin Yang, Department Of Biomedical Engineering, University Of Ulsan, Ulsan
Jong Ho Won, PhD, Division of Ophthalmic and Ear, Nose and Throat Devices, Office of Device Evaluation, Center for Devices and Radiological Health, US Food and Drug Administration, Silver Spring, MD

Spectral ripple discrimination (SRD) is used to evaluate the cochlear implant (CI) ability of discriminating spectral cues. However, because it is a behavioral test, SRD has obvious limitations when evaluating various types of sound-processing strategies and mapping parameters. In this study, we developed a computational approach to predict the SRD using a neural model. Noise stimuli rippled with 11 log-spaced densities was used and the advanced combined encoding CI sound processing strategy was employed to produce 22-channel electrical pulse-trains. An auditory nerve fiber computational model, which simulated neural activity, was used to construct a neurogram. The spectral and temporal representation of simulated neural activities in response to standard and inverted ripple sounds was used to compute the spectral ripple threshold. The predicted SRD score was similar to the data reported by CI subjects in the literature. The results suggest that this computational approach to predict SRD can be a useful tool in developing CI signal processing strategies.

ELECTROPHYSIOLOGY

Poster # 139 – EP10

ASSRs to Simultaneous Air- and Bone-Conducted Stimuli in Infants
Linda Hood, PhD; Lauren Roberts, AuD, Vanderbilt University, Nashville, TN
Rafael Delgado, PhD, Intelligent Hearing Systems, Miami, FL

The overall goal of this research is to develop a method to better detect mild hearing losses and differentiate sensorineural and conductive components. The study reported here utilized procedures, in an Auditory Steady State Response (ASSR) paradigm, that combine simultaneous presentation of air- and bone-conducted stimuli that are ramped in intensity. Click stimuli were presented simultaneously via air- and bone-conduction (dual transducer) with each stimulus modulated at a different rate. The responses obtained with simultaneous dual transducer stimulation were compared to conditions where air conduction and bone conduction stimuli were presented separately. Data from 36 infants from the NICU, Newborn Nursery and Lab, judged to have sufficiently low noise levels and present responses were included in the analysis. Findings indicated slightly higher amplitude responses when stimuli were presented individually; however, the intensity levels associated with response thresholds were similar across single and simultaneous dual transducer conditions. Response amplitudes were higher via bone conduction than air conduction, suggesting the possibility of a slight conductive hearing loss. These data

demonstrate that the proposed technique can be used in testing newborn infants, even in the NICU with monitoring equipment in the environment. [Supported by NIH-NIDCD R44DC011432]

Poster # 140 – EP11

Simultaneous Air- and Bone-Conducted Intensity-Ramped ASSRs in Adults

Linda Hood, PhD; Lauren Roberts, AuD, Vanderbilt University, Nashville, TN
Rafael Delgado, PhD, Intelligent Hearing Systems, Miami, FL

Auditory steady-state responses (ASSR), through use of multiple modulation rates, allow presentation of more than one signal simultaneously. Typically, multiple signals involve variable frequency or intensity. Here, the application of ASSR principles is extended to simultaneous presentation of stimuli via air conduction (AC) and bone conduction (BC). The long-term goal is to develop a method for infant testing that will better detect mild hearing losses and differentiate sensorineural and conductive components. This study utilized procedures, in an ASSR paradigm, where intensity-ramped click stimuli were presented simultaneously via AC and BC transducers with each stimulus modulated at a different rate. Subjects were adults with normal hearing, with a simulated conductive hearing loss, and with SNHL. The responses obtained were compared to behavioral thresholds and to conditions where air and bone stimuli were presented individually. Results demonstrated slightly reduced response amplitudes in the dual transducer condition, but similar ASSR thresholds across conditions. Expected threshold shifts occurred for AC but not BC in the simulated CHL condition. These data support the feasibility of using a dual transducer method to obtain ASSR threshold information. This method should reduce test time and improve the information available to clinicians. [Supported by NIH-NIDCD R44DC011432]

Poster # 141 – EP12

ABR Changes Over Time in Preterm Infants: The BabyEars Project

Linda Hood, PhD; Mary Edwards, AuD, Vanderbilt University, Nashville, TN
Beth Prieve, PhD, Syracuse University, Syracuse, NY

The long-term goal of the BabyEars Project is to relate auditory physiologic responses early in life to acquisition of speech and language in preterm infants. To accomplish this goal, infants born at or before 33 weeks gestational age (GA) are enrolled in a 2-year longitudinal study (current enrollment=122) where auditory physiologic testing is completed at four ages between 33 and 66 weeks GA. Physiologic measures include wideband acoustic absorbance, transient otoacoustic emissions and auditory brainstem responses (ABR). ABRs are recorded for click stimuli presented to each ear individually at two intensities using ipsilateral and contralateral montages. ABR data for infants tested at 33-66 weeks GA who meet criteria of normal peripheral responses based on absorbance, emissions, and present ABR for stimuli at 40 dB nHL are reported. Data are further divided according to 'early preterm' (23-29 weeks GA) and 'mid preterm' (30-33 weeks GA). ABR latency and amplitude change predictably over time, though differences exist between subgroups and ear tested. Waves I and II show particular changes during the early tests, evolving from a single peak to defined two-wave complexes. Early changes in ABR characteristics that may be sensitive to auditory system integrity will be discussed. [Supported by NIH-NIDCD R01DC011777]

Poster # 142 – EP13

Behavioral and Neural Plasticity Induced by Hearing Aid Use

Hanin Karawani, Department Of Hearing And Speech Sciences, University Of Maryland, College Park, MD
Alessandro Presacco, PhD, Department Of Otolaryngology, University Of California, Irvine, CA
Samira Anderson, PhD, Department of Hearing and Speech Sciences, Program in Neuroscience and Cognitive Science, University of Maryland, College Park, MD

Individuals with age-related sensorineural hearing loss (ARHL) can regain some lost auditory function with the help of hearing aids (HAs). However what remains unknown are the physiological mechanisms that underlie neural changes with exposure to amplified sounds during HA acclimatization. We examined behavioral and physiological changes induced by HAs. 38 older adults (ages 65-84) with moderate ARHL were fit with HAs, tested in aided and unaided conditions, and divided into experimental (n=21) and control (n=17) groups. The experimental group used HAs during an acclimatization period of 6 months. Both groups underwent identical testing 6 months apart. The experimental group was tested in 4 more sessions during acclimatization. Outcome measures included behavioral (speech-in-noise perceptual and cognitive) measures and electrophysiological midbrain recordings to the speech syllable /ga/. The experimental group experienced improvements in speech perception outcomes and in working memory as compared to controls. Physiological changes were observed in the experimental group, specifically decreased phase locking and amplitude for the fundamental frequency (100 Hz) and low harmonics, while no change was observed in controls. The findings suggest that HAs may alter subcortical processing and improve cognitive abilities; however, further investigation is needed to understand changes in cortical processing and correlations to behavior.

Poster # 143 – EP14

Neurophysiological Markers of Age-Related Hearing Loss in Speech-in-Noise Tests

Tess Koerner, AuD; Yang Zhang, PhD; Peggy Nelson, PhD; Edward Carney, PhD, University Of Minnesota, Minneapolis, MN

Listeners with hearing impairment show large variability in performance for speech-in-noise tests. Research has shown that auditory event-related potentials (AERPs) are promising objective neurophysiological markers of auditory and speech perception in various listening conditions. The present study was designed to determine whether AERPs from normal-hearing participants and individuals with varying degrees of age-related hearing loss in a passive listening double-oddball paradigm are able to predict sentence recognition in background noise. AERP responses were analyzed to obtain latency and amplitude measures for neural sensitivity to vowel discrimination and consonant discrimination, and time-frequency analysis was conducted to examine cortical oscillatory rhythms in frequency bands of interest. Speech perception was evaluated using phoneme- and sentence-level stimuli in noise. To account for the inherent relationship among repeated measures from the same participants, linear mixed-effects models were adopted to determine what neurophysiological measures were able to predict behavioral performance across speech stimuli, listening conditions, and participants. This analysis showed that several neural measures were good predictors of behavioral performance, including response amplitude, latency and the theta band power. Collectively, the results suggest that

AERPs and associated cortical oscillations represent potential clinical neurophysiological markers for the impacts of hearing loss on speech perception in noise.

Poster # 144 – EP15

Objective Measurement of Cognitive Systems During Effortful Listening

David Ryan, PhD; Smith Sherri, PhD; Kim Schairer, PhD, Auditory Vestibular Research Enhancement Award Program, Mountain Home Va, Mountain Home, TN
Eric Sellers, PhD, East Tennessee State University, Johnson City, TN
Mark Eckert, PhD, Department of Otolaryngology - Head and Neck Surgery, Charleston, SC

Adults with hearing loss who report difficulty understanding speech with and without hearing aids often also report increased mental or listening effort. Although speech recognition measures are well known and have been in use for decades, measures of listening effort are relatively new and include objective measures such as working memory tasks, pupillometry, heart rate, skin conductance, and brain imaging. This purpose of this study is to evaluate an electroencephalogram (EEG)-based method to assess cognitive states associated with high frequency alpha (10-13 Hz) and theta (4-8 Hz) during effortful listening. Changes in high frequency alpha have been associated with semantic memory and cognitive demands. In addition, changes in theta have been associated with encoding information and increased listening effort. Correlations between EEG frequency recordings, self-report, and behavioral measures in speech recognition and auditory working memory tasks will be described. Results will be presented demonstrating the extent to which high frequency alpha predicts word recognition in noise performance and self-reported listening effort.

Poster # 145 – EP16

Learning and Retention of Novel Words in Musicians and Non-Musicians

Elizabeth Stewart, AuD, Arizona State University, Scottsdale, AZ

Musical training is associated with more accurate perception of familiar words, as well as measurable physiologic changes in the auditory pathway. It is therefore possible that musicians also have an advantage when learning new information. The objective of this study was to determine whether highly complex auditory experience secondary to music training has the potential to advance the ability to learn and use novel information. It was hypothesized that musicians would demonstrate faster and more accurate learning as well as more robust evoked responses to contrasting speech stimuli compared to non-musicians. Cortical auditory evoked potentials quantified effects of musical experience on cognitive functions important for effective learning (auditory attention, memory). Musicians and non-musicians also completed a rapid word-learning task, in which they learned sets of nonsense words through a process of trial and error. Their retention of these words was assessed the following day to identify group differences in consolidation of newly-learned information. Finally, participants were tested on their ability to detect these newly-learned words in the context of spoken discourse. Correlational analyses were conducted to determine the relation between performance on each task, followed by regression analyses to determine the contribution of each to overall performance.

Poster # 146 – EP17

Induced Cortical Brain Oscillations Underlying Concurrent Speech Segregation in Noise
Anusha Yellamsetty, PhD; Gavin Bidelman, PhD, University Of Memphis, Memphis, TN

Parsing simultaneous speech exploits pitch (F0)-guided segregation and is also affected by the signal-to-noise ratio (SNR) in the auditory scene. The interaction of these two cues may occur at multiple levels within cortex. The aims of the current study were to assess the correspondence between induced (non-phase-locked) brain rhythms and determine how listeners exploit pitch and SNR cues for successful speech segregation. We recorded electrical brain activity while listeners heard two concurrent vowels whose F0 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 F0 benefit interacted with noise. Time-frequency analysis parsed induced EEG into frequency bands. At early low frequency bands (,) responses were elevated when speech did not contain pitch cues (0ST>4ST) and at high power, modulations were observed for changes in both pitch (0ST>4ST) and SNR (clean>noise), suggesting these bands carry information related to both the acoustic features of speech and the quality of the signal. Results demonstrate that induced brain responses reflect both automatic (pre-perceptual) and controlled (post-perceptual) mechanisms of speech processing that are largely divisible into low- and high- frequency rhythms.

HEARING HEALTH

Poster # 147 – HH03

Baltimore HEARS: An Affordable, Accessible, Community-Delivered Hearing Care Intervention
Carrie Nieman, MD; Frank Lin, MD, Johns Hopkins University School Of Medicine, Dept Otolaryngology-HNS; Johns Hopkins Center On Aging & Health, Baltimore, MD
Nicole Marrone, PhD, University Of Arizona Dept Of Speech, Language, & Hearing Sciences, Tucson, AZ
Sara Mamo, AuD, University of Massachusetts, Dept of Communication Disorders, Amherst, MA
Joshua Betz, MS, Johns Hopkins Center on Aging & Health, Baltimore, MD
Laura Gitlin, PhD; Hae-Ra Han, PhD; Sarah Szanton, PhD, Johns Hopkins University School of Nursing, Dept of Community Public Health, Baltimore, MD

Age-related hearing loss negatively impacts health outcomes, yet disparities in hearing care, such as hearing aid use, exist based on race/ethnicity and socioeconomic position. Recent national efforts highlight reduction of hearing care disparities as a public health imperative. The Baltimore HEARS study was a prospective, randomized control pilot, with a 3-month delayed treatment group as a waitlist control, that assessed feasibility, acceptability, and preliminary efficacy of a community-delivered, affordable, and accessible intervention for older adults with hearing loss. Outcomes were assessed at 3 months, comparing immediate and delayed groups, and pooled to compare the cohort's pre- and 3-month post-intervention results. All participants completed the study (n=15). The program was highly acceptable: 93% benefited, 100% would recommend the program, and 67% wanted to serve as future program trainers. At 3 months, the treated group (n=8) experienced fewer social and emotional effects of hearing loss and fewer depressive symptoms as compared to the delayed treatment group (n=7). Pooling 3-month post-intervention scores (n=15), participants reported fewer negative hearing-related effects

(effect size=-0.96) and reduced depressive symptoms (effect size=-0.43). The HEARS intervention is feasible, acceptable, low-risk, and demonstrates preliminary efficacy. HEARS offers a novel, low-cost, and readily scalable solution to reduce hearing care disparities.

Poster # 148 – HH04

Enhancing Transparency and Reproducibility of Hearing Science
Tim Schoof, PhD, Northwestern University, Evanston, IL

The National Institutes of Health have recently undertaken steps to enhance rigor and reproducibility of biomedical research. For example, grant applications are now required to explicitly address how the proposed research will achieve robust and unbiased results. Reproducibility is an integral part of science as it allows for research findings to be either validated or refuted and lets scientists successfully build upon previous research. However, many researchers are unsure how their methodological approach should be modified to satisfy the requirements of rigor and reproducibility. This presentation will review available tools and discuss some good practices that support data transparency and reproducibility. The focus will be on data integrity, reproducible data analysis, and transparent communication of research findings. Topics covered will include: open access, study pre-registration, web-based data management, version control, and applications which support automated embedding of statistical output in manuscripts. The tools presented, many of which may be new to hearing researchers, can increase efficiency, particularly in collaborative research settings. In addition, these tools also support recent calls for open access to de-identified data and statistical analysis scripts. [Work supported by NIH]

HEARING LOSS

Poster # 149 – HL09

Audiological and Genetic Database: Large Biomedical Informatics and Hearing Research
Jeffrey Pennington; Byron Ruth; Jeffrey Miller; Joy Peterson, AuD; John Germiller, MD; Ian D. Krantz, MD, Children's Hospital Of Philadelphia, Philadelphia, PA
Tamar Gomes, AuD; Derek Stiles, PhD; Juliana Manganella; Margaret Kenna, MD, MPH, Boston Children's Hospital, Boston, MA
Linda J. Hood, PhD, Vanderbilt Bill Wilkerson Center, Vanderbilt University, Nashville, TN

Recent developments in research and clinical practice have improved detection, management, and understanding of the genetic basis for childhood hearing loss. However, much of the data that support the evidence base and are needed to study rare disease are recorded in disparate written records, clinical systems, or database formats that are incompatible and, if in different institutions, often unknown to each other, and therefore difficult to compare or to use effectively in large-scale studies. To overcome these difficulties, the Audiological and Genetic Database (AudGenDB) project extracts, transforms, and loads data from these disjointed, incompatible information sources into a single relational database, and subsequently provides a powerful, web-based user interface for querying these data. Here, we discuss the acquisition of data from three large medical institutions into the relational database and describe the latest developments that expand the range and complexity of data within the database. The long-term

goal of AudGenDB is to build a national network for the exchange of patient-oriented data to facilitate research in pediatric hearing health. [Supported by NIH-NIDCD R24DC012207]

Poster # 150 – HL10

Young Adults - Attitudes Towards Noise-Induced Hearing Loss
Ann Perreau, PhD; Maeve Derrig, Augustana College, Rock Island, IL

Personal listening devices (PLDs) have become increasingly popular overtime. Research shows that PLDs can result in noise-induced hearing loss when the output and the duration of use exceed safe levels. In this study, we investigated young adults' attitudes towards noise-induced hearing loss. We recruited 51 young adults to complete a 20-item survey on their PLD habits, attitudes towards hearing loss and hearing prevention, and use of hearing protection. Although the majority of our study participants reported listening to their devices at safe output levels for 1-2 hours per day, approximately 10-15% of PLD users listen to their devices at exceedingly high output levels and for over four hours per day. Also, over half of the participants reported tinnitus and difficulty hearing others after listening to music or loud noises. Finally, most participants agree that they should use hearing protection to prevent noise-induced hearing loss, but less than 10% of participants use hearing protection consistently. When asked why they avoid hearing protection, most participants (86.3%) reportedly were not taught about its use. Therefore, this study indicates that young adults are willing to protect their hearing, but need to be properly educated about noise-induced hearing loss and its lasting effects.

Poster # 151 – HL11

Hearing Loss in the Community
Gabrielle Saunders, PhD; Melissa Frederick, AuD; Shienpei Silverman, MA; Tina Penman, AuD, NCRAR, Portland, OR
Michelle Arnold, AuD; Theresa Chisolm, PhD, University of South Florida, Tampa, FL

There are many individuals who could benefit from some form of hearing rehabilitation but who have not sought help. Some of these individuals are well aware of difficulties and yet choose not to seek help; others are unaware of their problems or choose to deny their existence. As part of a large NIH multisite observational study of hearing health behaviors, we have conducted hearing screenings in the community in Portland, OR and Tampa FL at which subjective (HHIE-S) and objective (pass/fail at 25dB HL for 1, 2 & 4 kHz) screening data were collected. Although the primary goal of these screenings was to recruit participants for the larger study, the screening data provide insight into the presence of hearing loss in the community, and the awareness people have about their hearing. Data from 1769 individuals were collected over the course of 18 months at 174 different screening events that took place at community centers, libraries, senior centers, churches, retirement communities, health fairs, golf courses, and local businesses. The subjective and objective screening results will be presented along with their relationship to demographic data, and their implications will be discussed. This work was funded by NIH NIDCD grant R01DC013761

Poster # 152 – HL12

Mild Gain for Normal-Hearing Adults with Difficulty in Background Noise
Jasleen Singh, BS; Karen Doherty, PhD, Syracuse University, Syracuse, NY

Many adults who have clinically normal hearing thresholds report difficulty listening in the presence of background noise. Although these individuals self-report having a hearing handicap, little is recommended for them because they are not a typical hearing aid candidate. The purpose of the present study was to investigate if a mild gain hearing aid with an external microphone could improve these individuals' ability to hear in challenging listening situations. A control group of aged matched adults who did not self-report having difficulty hearing in background noise was included. Hearing handicap scores were significantly higher in the experimental group. All participants were fit with a mild high frequency gain aid and asked to wear the aid for two weeks. Aided and unaided working memory in noise, hearing handicap, attitudes towards hearing aids, speech in noise testing, and motivation were evaluated pre and post the two week hearing aid trial period.

Poster # 153 – HL13

Cochlear Dead Regions in Subjects with WFS1 Nonsyndromic Hearing Loss
Susan Stanton, PhD; Amanda Morgan; Matthew Lucas, MS, Western University, London, ON
Anne Griffin, MS, Memorial University of Newfoundland, Grand Falls- Windsor, Newfoundland and Labrador
Ian Bruce, PhD, McMaster University, Hamilton, ON
Sarah Predham; Terry-Lynn Young, PhD, Memorial University of Newfoundland, St John's, Newfoundland and Labrador

In mice, the wolframin protein is expressed in inner hair cells, spiral ganglion and the auditory brainstem. However, the pathology associated with WFS1 mutations causing human nonsyndromic hearing impairment is unknown. A cochlear dead region is present when inner hair cells and/or auditory neurons are damaged to such an extent that off-frequency listening via neighboring regions are used to detect an acoustic stimulus. The aim of this study was to identify the presence and edge frequency of cochlear dead regions using psychophysical tuning curves (PTCs) in individuals with nonsyndromic sensorineural hearing loss (SNHL) caused by a WFS1 mutation. Seven subjects with the WFS1 missense mutation Ala716Thr (2146 GA) and progressive low-frequency SNHL participated in this study. The fast PTC method (Sek and Moore, 2011) was used to measure the narrow-band masker level required to mask a target tone, with a >15% shift in a PTC tip signifying the presence of a cochlear dead region. The frequency of a shifted PTC tip was used to indicate the edge of a cochlear dead region. Four subjects exhibited one or more mid-frequency cochlear dead regions with upward and/or downward shifts in the PTC tip identified relative to the target stimulus.

Poster # 154 – HL14

Developing a Community Health Worker Training Curriculum for Hearing Care
Jonathan Suen; Frank Lin, Johns Hopkins University Center On Aging And Health, Baltimore, MD
Carrie Nieman, Johns Hopkins University School Of Medicine
Sara Mamo, University of Massachusetts - Amherst, Dept. of Communication Disorders

Cindy Zonies, Weinberg Place Senior Living
Jen Sullivan; Becky Slogeris; Mike Weikert, Maryland Institute College of Art Center for Social Design

Hearing loss is independently associated with social isolation, increased utilization of informal and community supports, functional decline, and incident dementia. Treating hearing loss could potentially mitigate these effects and enhance communication and social engagement, but disparities in the uptake of hearing healthcare exist along racial/ethnic and socioeconomic lines among older adults. The Hearing Equality through Accessible Research and Solutions (HEARS) project is a first-in-kind community-based intervention aiming to provide affordable and accessible hearing care to older adults and their communication partners for improving well-being and social engagement. The HEARS intervention was previously piloted by an otolaryngology resident and results showed reduction in measures of negative effects from hearing loss across delayed-treatment groups, including self-reported hearing handicap. Through a community-engaged process, we developed a curriculum to train community health workers to provide the HEARS intervention. Six members from an independent senior living facility, the majority of whom previously participated in the HEARS feasibility study, participated in a series of focus groups and training sessions to guide the development of a comprehensive, practice-based curriculum. We will present qualitative results and analyses that demonstrate the relationship between the themes discussed by the community members and the curriculum.

Poster # 155 – HL15

Searching for Specificity in Cognitive Screeners: MoCA vs PNT
Viktoriya Zakharenko, BS, University Of Minnesota - Twin Cities, Minneapolis, MN
Karin Humphreys, PhD, Mcmaster University, Hamilton, ON
Jeff Crukley, PhD, Starkey Hearing Technologies, Eden Prairie, MN

The cognitive ability of patients may have important implications for hearing health and audiology. For example, Lin et al., (2013) suggest hearing loss and cognitive decline often co-exist. Therefore, clinical assessments of cognitive ability may be pertinent to audiology practice. Ongoing research suggests that the Philadelphia Naming Test (PNT) may be as sensitive to mild cognitive impairment as the Montreal Cognitive Assessment (MoCA) (Oliver et al, 2016). While the MoCA relies on verbal directions, the PNT does not. Therefore, the PNT may be a more suitable measure of cognitive ability for individuals with hearing loss. This research study consisted of 32 experienced hearing aid users (16 females, mean age: 68.4) randomly assigned to one of eight counterbalanced testing paradigms. Performance on the MoCA and PNT was assessed with and without participants' own hearing aids at two sessions, one month apart, to control for test learning effects. All hearing aids were verified using real ear measures on the Audioscan Verifit. Chart review from assessments within the last year provided audiometric data, including thresholds, word recognition and QuickSIN scores. Contrary to our hypothesis, initial analysis suggests no significant difference between MoCA and PNT scores. Additional results and clinical implications will be discussed.

OTOACOUSTIC EMISSIONS

Poster # 156 – OAE06

The Effects of Personal Music System Listening Level on DPOAEs
Carlee Michaelson; Amanda Kaae; Rachael Cook; Mallery Eppler; Peter Torre III, PhD, San Diego State University, San Diego, CA

The link between personal music (PM) systems and risk of vulnerability to hearing loss is unclear because studies included self-reported listening levels or fixed levels which may not be reflective of recreational listening levels. The purpose of this study was to evaluate how adjustable listening levels of a PM system after one hour of listening affects change in distortion product otoacoustic emissions (DPOAEs). There were 23 men and 38 women (mean age=21.3 yrs; SD=3.0; 63.9% white). Otoscopy, tympanometry, and pure-tone thresholds (0.25-8 kHz) were completed prior to DPOAE testing. DPOAEs at 1, 1.5, 2, 3, 4, and 5 kHz were measured before and after one hour of music. During music exposure a probe microphone was placed in the ear canal to measure equivalent continuous sound level (Leq). Pre-music DPOAEs for men were significantly lower (3-6 dB) compared to women, and men listened at significantly higher Leq (85.3 dB) than women (76.7 dB). After adjusting for Leq and pre-music DPOAEs, there was a significant sex by frequency interaction for change in DPOAEs; men had a mean increase (~2 dB) in post-music DPOAEs at 1 kHz, but greater mean decreases at 2 kHz and above of 0.3-2 dB.

Poster # 157 – OAE07

WAI Changes in Preterm Infants Over Time: The BabyEars Project
Beth Prieve, PhD; Kerry Walker; Stefania Arduini, AuD; Serena Hashem, Syracuse University, Syracuse, NY
Linda Hood, PhD, Vanderbilt University, Nashville, TN

Wideband acoustic immittance (WAI) is a term that includes measures of the outer and middle ear using broadband acoustic signals. The over-arching goal of the BabyEars Project is to relate early auditory characteristics in preterm infants to developmental and language outcomes at 2 years of age. The purpose of this presentation is to (1) analyze changes in WAI in preterm infants breathing room air with normal peripheral ears; (2) discuss the interpretation of WAI in preterm infants using assistive respiratory devices; and (3) describe WAI characteristics consistent with abnormal peripheral function. To date, 122 preterm infants are enrolled in the study. WAI is measured at 33, 35, 48-52 and 62-66 weeks gestational age (GA). Absorbance has a single peak in infants tested at 33 and 35 weeks GA. Three distinct patterns of WAI absorbance are seen between 48 and 52 weeks GA and by 66 weeks GA, absorbance is high over a wide range of frequencies. WAI can be measured in infants using respiratory devices in the NICU even though traces are noisy. Peak absorbance is decreased in the 1-2 kHz range in ears that have abnormal peripheral sound conductance. [Supported by NIH-NIDCD R01DC011777 and Syracuse University Gerber Laboratory Funds]

Poster # 158 – OAE08

TEOAE Changes Over Time in Preterm Infants: The BabyEars Project
Beth Prieve, PhD; Kerrilyn Mcgowan; Stefania Arduini, AuD; Serena Hashem, Syracuse University, Syracuse, NY
Linda Hood, PhD, Vanderbilt University, Nashville, TN

The over-arching goal of the BabyEars Project is to relate early auditory characteristics in preterm infants to developmental and language outcomes at 2 years of age. The purpose of this presentation is to (1) describe TEOAE and noise levels in preterm infants with normal peripheral ears and; (2) analyze TEOAE levels when outer/middle ear function is abnormal, as indicated by wideband acoustic absorbance. To date, 122 preterm infants have been enrolled in the study. TEOAEs are evoked by tonebursts centered at 2 kHz and 4 kHz. TEOAEs are measured twice for each toneburst when preterm infants are 33, 35, 48-52 and 62-66 weeks gestational age (GA). TEOAE levels between the two traces are highly correlated, suggesting TEOAEs are robust, even when preterms are cared for in the neonatal intensive care unit. TEOAE levels evoked by 2 kHz and 4 kHz tonebursts increase from 33 to 52 weeks GA. In ears with low absorbance in the 1-2 kHz range, TEOAEs are not measurable above the noise floor, or reduced in level. Relationships between WAI abnormality and the extent to which TEOAE levels are reduced will be explored. [Supported by NIH-NIDCD R01DC011777 and the Syracuse University Gerber Fund]

Poster # 159 – OAE09

Preliminary Comparison of Cochlear Reflectance and Distortion Product Emission Levels in Ears with Normal Hearing and Hearing Loss

Daniel Rasetshwane, PhD; Natalie Lenzen, AuD; Judy Kopun, MA; Michael Gorga, PhD; Stephen Neely, Boys Town National Research Hospital, Omaha, NE

Cochlear reflectance (CR) is the cochlear contribution to ear-canal reflectance. CR is equivalent to an otoacoustic emission (OAE) deconvolved by forward pressure in the ear canal. Similar to conventional OAEs, CR is related to auditory status and audiometric thresholds. The goal of this study is to initiate the process by which the clinical utility of CR is validated by comparing CR measurements with distortion-product OAE (DPOAE) measurements in ears with normal hearing and hearing loss. CR was elicited by a wideband-noise stimulus presented at levels of 30, 40 and 50 dB SPL. DPOAE measurements were made at primary frequencies of 1-16 kHz, in half-octave steps, and primary level of 55 dB forward pressure level, a level that has been shown to result in the most accurate identification of auditory status. For all CR stimulus levels, CR level was correlated with DPOAE level with better correlation from 1 kHz to 4 kHz. Correlations were also better when the stimulus level for CR was 50 dB SPL. Correlations were highly significant at all stimulus levels when the comparison was made with the data collapsed across frequency. Comparisons of test performance and threshold prediction are currently planned. [Work supported by the NIH].

Poster # 160 – OAE10

Psychophysical and Otoacoustic Emission-Based Tuning Estimates in Normal-Hearing Young Adults

Uzma S. Wilson, AuD; Amber Kadolph Kasten; Jenna Browning-kamins; Sriram Boothalingam, PhD; Sumitrajit Dhar, PhD, Northwestern University, Evanston, IL

Psychophysical tuning curves for assessing auditory frequency tuning are time-consuming. Otoacoustic emissions (OAEs) can provide an objective and faster alternative for estimating frequency tuning. However, the relationship between OAE-based tuning estimates and behavioral tuning has not been fully explored. Here we compared tuning estimates from traditional simultaneously-masked psychophysical

tuning curves to estimates derived from certain properties of OAEs such as phase delay of stimulus frequency otoacoustic emissions (SFOAEs) and tuning estimates obtained from distortion product otoacoustic emissions (DPOAE) amplitudes obtained varying f2/f1 frequency ratio at 1 and 4 kHz in 20 normal-hearing young adults. Our findings confirm that human cochlear tuning is sharper at 4 kHz compared to 1 kHz for all measures. SFOAE estimates unequivocally showed the largest estimate of tuning compared to other measures, especially at 4 kHz. However, estimates derived from DPOAE tuning functions were poorer than tuning estimates from PTCs and SFOAEs. Correlational analyses did not reveal any significant relationship between psychophysical and OAE-based tuning. We conclude that OAEs may be useful for estimating cochlear mechanical tuning sharpness in humans; however, they likely do not predict tuning across the entire auditory system as measured by simultaneously masked psychophysical tuning curves.

Poster # 161 – OAE11

A Taxonomy-Based Approach of Inferring Cochlear Compression from Ootoacoustic- Emissions
Anusha Yellamsetty, PhD; Shaum Bhagat, PhD, University Of Memphis, Memphis, TN

The critical process of basilar membrane (BM) compression contributes to the wide dynamic range of sound-pressure levels detected by listeners with normal hearing. Otoacoustic emission (OAE) input/output (I/O) measures are one of the indirect methods to infer characteristics of cochlear compression in humans. Current theory states there are different generation mechanisms for distortion-product OAEs (DPOAE) and stimulus-frequency OAEs (SFOAE). DPOAEs are categorized as primarily distortion source OAEs and SFOAEs are primarily reflection source OAEs. In this study, compression characteristics were inferred from both DPOAE I/O functions and SFOAE I/O functions in normal-hearing listeners at low and high test frequencies. I/O functions were fitted with two models (third-order polynomial regression model and three-segment linear regression model) to derive compression thresholds (CT) and compression slopes (CS). The results indicated no statistically significant correlations between DPOAE CT and SFOAE CT at any test frequency within both models and little redundancy between the models. Trends in the data indicated that high test frequencies had lower CT than lower test frequencies. The difference in inferred compression characteristics, with lower CT and higher values of compression at high test frequencies compared to low test frequencies, is consistent with physiological studies of BM compression in animal models.

PSYCHOACOUSTICS

Poster # 162 – PSY10

The Role of Interaural Differences on Speech Intelligibility
Rachel Ellinger, BA, Northwestern University, Evanston, IL
Kasey Jakien; Frederick Gallun, PhD, National Center For Rehabilitative Auditory Research/oregon Health & Science University, Portland, OR

Interaural differences in time (ITDs) and level (ILDs) play an important role in communication. They contribute to a listener's ability to achieve spatial release from masking (SRM) and help to improve

speech intelligibility in noisy environments. This experiment explored the extent to which ITDs and ILDs aid in SRM in complex multi-talker environments and the relationship with aging and hearing loss. Participants were asked to listen for the male spoken target sentence among male spoken masker sentences from the Coordinate Response Measure (CRM) corpus. SRM was examined by comparing co-located with five spatially separated conditions: consistent ITD and ILDs, ITD-only, ILD-only, and ITD and ILDs in conflict with each other. SRM was greatest when stimuli were presented with consistent ITD and ILDs, followed by ITD-only cues, and ILD-only cues, which all had greater SRM than opposing ITD and ILDs. These results support the hypothesis that speech intelligibility in multi-talker environments utilizes differences in perceived location to focus on the target talker. The pattern of performance across the condition was independent of age and hearing loss. Overall performance worsened, however, suggesting that as listeners age and/or hearing loss increases, the ability to understand speech in multi-talker environments becomes poorer.

Poster # 163 – PSY11

Psychometric Properties of the Modified Hughson-Westlake Technique

Eric Hoover, PhD; David Eddins, PhD, University Of South Florida, Tampa, FL
Frederick Gallun, PhD, Portland Va Medical Center And Oregon Health And Science University, Portland, OR
Anna Diedesch, PhD, Oregon Health and Science University, Portland, OR

In the era of self-fitted hearing aids, smartphone-based hearing tests, and new telehealth technology, methods of automated audiometry abound. The validity of automated audiometry must be evaluated with reference to the gold standard hearing test - the modified Hughson-Westlake (MHW) audiogram as administered by an expert clinician following standard procedures. A novel approach to simulating the psychometric properties of MHW was developed to evaluate threshold estimation accuracy and efficiency. MHW was modeled as a two-stage adaptive staircase with a ratio 2:1 for steps up and down in log units. Monte Carlo simulations were performed to determine the number of trials completed per threshold and the threshold error over a range of clinically-relevant pure-tone detection psychometric functions. Results indicated that MHW is highly efficient, achieving asymptotic accuracy in as few as eight trials. Error was primarily due to the method of computation of threshold, and was improved by using the mean of reversals. These results have important implications for the interpretation and design of automated methods. The approach developed to simulate MHW can be applied to future evaluation of the validity and clinical utility of alternative audiometric procedures. Work supported by NIH R01 DC015051.

Poster # 164 – PSY12

The Effects of Carrier Bandwidth and Intensity on Spectral Ripple Perception

Victoria Idowu; Evelyn Davies-venn, PhD, University Of Minnesota, Minneapolis, MN

Musical training often includes deliberate practice with high-intensity auditory signals. Such training has been shown to induce neural plasticity and enhance cognitive skills. This study evaluated whether musicianship influences spectral processing at high- intensities. Spectral modulation detection thresholds were measured using a noise carrier with varying bandwidths that were parametrically varied in octave-

wide steps from 1 to 4 octaves, to assess whether musicians were more robust to the deleterious effects of high-intensity effects. The intensity of the rippled test signal varied in 10 dB steps from 60 to 90 dB SPL. Results show that spectral processing degrades at high intensities, but musicians were more robust to the deleterious effect of high-intensities compared to non-musicians. Our findings suggest that spectral processing for broadband signals involve within and across channel resolution and both succumb to the negative effect of level-induced linearization of basilar membrane responses as well as broaden auditory-filter bandwidths. A better understanding of how experience mediates the influence of high intensities on auditory mechanism related to across-channel and within-channel spectral processing could prove useful for improving outcomes for individuals with hearing loss, whose only viable treatment option often involves listening to speech signals at high intensities.

Poster # 165 – PSY13

Validating a Rapid, Automated Test of Spatial Release from Masking
Kasey Jakien, BA; Sean Kampel, AuD; Samuel Gordon; Frederick Gallun, PhD, National Center For Rehabilitative Auditory Research, Portland, OR

We assess the reliability and consistency of the SR2, a spatial release from masking (SRM) task developed by the lab of Gallun et al. (2013). We describe the design and parameters of the SR2 and examine: 1) how listener performance changes over several testing sessions, 2) what thresholds tell us about certain populations (such as older or hearing-impaired individuals) and 3) how the headphone-based SR2 with non-individualized head-related-transfer-functions (HRTFs) compares to a test done over loudspeakers in an anechoic chamber (the SR2A) where listeners completed speech intelligibility tasks in the presence of speech maskers which were either colocated with the target (0) or spatially separated at +-15, +-30, +-45, +-90 and +-135. The SR2 produced thresholds at 45 that were similar to 30 thresholds in the anechoic chamber. We found that age and PTA affect SRM differently at different spatial separations.

Poster # 166 – PSY14

Dynamic Range for Words, Sentences, and Continuous Discourse
Kyungju Lee; Suyeon Shin, MD; In-ki Jin, PhD, Hallym University, Chuncheon, Korea

Background: Dynamic range (DR) of speech represents the range between the minimum and maximum speech levels and is an important component of the Speech Intelligibility Index (SII). In the SII, the prediction of intelligibility depends on speech stimuli. Although the effects of stimuli on the band-importance function (BIF), which is an important component of the SII, have been found in several studies, the effects of different stimuli on DR are not systematically analyzed. Purpose: The purpose of this study was to measure speech DR for different stimuli such as words, sentences, and continuous discourse. Research design: The DRs were compared using a research design that applied and analyzed an observed dataset. Data collection and analysis: Twenty young (20-28 years old) normal-hearing talkers who speak Korean as a native language participated in this study. The dynamic ranges were measured under four stimulus conditions (monosyllabic words, bisyllabic words, sentences, and discourse) and were compared. Results: In most frequency bands, DRs for monosyllabic and bisyllabic words were wider than DRs for sentences and continuous discourse in both male and female speakers.

Conclusion: The current results indicate that DR may depend on stimulus type. Thus, the DR for each stimulus may be considered for accurate predictions of the SII.

Poster # 167 – PSY15

In Search of an Improved Hearing Test
Whitney Mast; Huanping Dai, PhD, The University Of Arizona, Tucson, AZ

In standard hearing testing, the signal level is increased or decreased based on listener's response. The step sizes for changing the signal levels, 10-dB down and 5-dB up, are probably too coarse to provide the most precise possible estimate of the true threshold. The amount of improvement for the precision of threshold estimate remains to be determined if a better procedure is used. The purpose of this study is to search for such a procedure in several directions. For this purpose, we estimated thresholds for 22 normal-hearing adults in three experiments. First, we used the standard procedure, which serves as the control. Second, we modified the standard procedure by reducing the step sizes (to as small as 1 dB). Third, we used a maximum-likelihood procedure, which is arguably statistically optimal. To evaluate the accuracy and consistency of the method in each experiment, we fit a psychometric function for each listener to data combined from all three experiments to create our best estimate of true threshold. By comparing the individual threshold estimates from each experiment to this best estimate, the accuracy and consistency of each method are determined and will be discussed.

Poster # 168 – PSY16

Listeners Prefer Self-Adjusted Gain Over Audiologist Settings in Blind Comparisons
Peggy Nelson, PhD; Melanie Gregan, PhD; Trevor Perry; Coral Hanson, MA; Kendra Day, University Of Minnesota, Minneapolis, MN
Dianne Vantasell, PhD, Bose Corporation

Self-adjustment technology can provide custom amplification parameters to accommodate listener preferences. Previous results (Nelson et al, AAS 2015, 2016) indicate that large inter-subject gain differences are observed in self-adjusted studies, and those differences are unexplained by age, hearing loss, or previous hearing aid use. Further, the gain changes had little effect on intelligibility. Data will be presented from 17 listeners aged 52 - 79 years with mild to moderate hearing loss. Participants listened through an iPod Touch running a real-time simulation of a multichannel compression hearing aid, with all gain/compression parameters adjustable via a simple user interface (EarMachine). Listeners adjusted amplification parameters while listening to music, television, movies, and restaurant conversations at signal levels of 65-70 dBC. Listeners rated their listening experience for each self-adjusted setting. Most self-adjusted settings were given high ratings (4 or 5 stars out of 5) for listening experience. Listeners also indicated preferences in blind A/B comparisons for judgments of annoyance, clarity, quality, and ease of listening. Listeners demonstrated strong preferences for the self-adjusted sound in paired comparisons, and Preference for the self-adjusted settings appeared strongest for sound quality of music, reduced annoyance, and ease of listening. Acknowledgements: NIDCD R01 DC013267, Ear Machine

Poster # 169 – PSY17

Auditory Stream Segregation in Cochlear Implant Users: A Preliminary Report
Yingjiu Nie, PhD; Alexandria Matz; Harley Wheeler, BA, James Madison University, Harrisonburg, VA

With broadband noise stimuli, Nie and Nelson [Front. Psychol, 6, 1151, (2015)] have shown that frequency and/or amplitude-modulation rate separations can elicit stream segregation in listeners with normal hearing (NH).Using the same method with modifications of replacing the broadband noise stimuli with narrowband noise, the current study investigated the aforementioned two differences on stream segregation for NH and cochlear implant (CI) listeners. Preliminary results showed that consistent with Nie et al, frequency separations between sequences of narrowband noise elicited stream segregation for both listener groups, with larger separations needed for CI listeners. However, unlike the findings obtained with broadband noise stimuli, AM-rate differences did not elicit stream segregation with narrowband noise stimuli for both listener groups. In addition, auditory streams were found to form over time for both listener groups, suggesting that build-up was necessary. The build-up segregation observed in NH listeners will be discussed in comparison with our previous findings [Wheeler and Nie, Senior Honors thesis, James Madison University, (2016)] that build-up may not be necessary when stimuli are unambiguously strong for segregation, but necessary when stimuli are ambiguous. Work supported by the CHBS Research Grant and Roger Ruth Memorial Grant from JMU.

SPEECH PERCEPTION

Poster # 170 – SP11

Evaluating Spatial Release from Masking Using Clinically Available Speech-In-Speech Materials
Grant King; Emily Buss, PhD, UNC Chapel Hill, Chapel Hill, NC
Lori Leibold, PhD, Boys Town National Research Hospital, Omaha, NE
Lauren Calandruccio, PhD, Case Western Reserve University, Cleveland, OH

In listeners with normal hearing, binaural cues improve listening performance in complex backgrounds. This phenomenon, known as spatial release from masking (SRM), demonstrates that the ability to use binaural cues is an important factor in real-world listening. The present study evaluated the effect of SRM in widely available speech-in-speech tests, including those used clinically. We selected five speech-in-speech sentence tests and evaluated thresholds for normal-hearing adults (ages 20-35). The target always came from a loudspeaker directly in front of the listener; the masker was either collocated or came from a second speaker 90 degrees to the right. The target was 50 dB-A SPL, and 3 or more masker levels were selected to produce a range of performance spanning 30%-70% words correct. Psychometric functions fitted to the results were used to estimate the 50%-correct threshold. Thresholds in the collocated condition ranged from 1 to -5.5 dB SNR among the five tests. When target and masker were spatially separated, thresholds improved by 7 to 11.5 dB SNR. We find that available speech-in-speech tests can be adapted for binaural use. However, measures of SRM depend on the test materials used. Ongoing research investigates the stimulus features responsible for variability in SRM.

Poster # 171 – SP12

Effects of Language and Cognition on Children's Masked Speech Perception
Heidi Lang, BA; Ryan W. Mccreery, PhD; Lori J. Leibold, PhD; Margaret K. Miller, AuD, Center For Hearing Research, Boys Town National Research Hospital, Omaha, NE
Emily Buss, PhD, Department of Otolaryngology/Head and Neck Surgery, School of Medicine, The University of North Carolina at Chapel Hill, Chapel Hill, NC

Children are more susceptible to masking compared to adults, with larger differences in speech recognition observed for informational than energetic masking. One hallmark feature of informational masking is large individual differences. This study evaluated linguistic and cognitive factors that affect individual children's abilities to identify masked speech. Children with stronger language and cognitive skills were expected to be more adept at understanding masked speech, and this association was expected to be stronger in complex than relatively simple maskers. This hypothesis was tested by having two age groups of children (5-6 and 9-10 years) and adults with normal hearing listen to sentences in three maskers: speech-shaped noise, amplitude-modulated noise, and two-talker speech. Children were tested at SNRs of +5 dB, 0 dB, and +15 dB, respectively. Adults were tested at SNRs of +5 dB, -5 dB, and +10 dB, respectively. In a second session, both groups of children were administered a battery of tests measuring language, working memory, and executive functioning (PPVT-4, TROG-2, AWMA Listening Recall and Odd One Out, and NIH Card Sort and Flanker). Cognitive and linguistic abilities were positively associated with speech recognition in noise for more complex maskers, but not for the speech-shaped masker.

Poster # 172 – SP13

Relationship Between Speech Acoustics and Speech Intelligibility in Complex Noise
Shea Long, BS; Brittan Barker, PhD; Madison Murphy, Utah State University, Logan, UT

Previous work from our lab showed that when listeners are presented with sentences from multiple talkers in the presence of restaurant noise the talkers' intelligibility is significantly higher than in the presence of 8-talker babble (Murphy et al., 2016). However, the study did not give insight into how or why intelligibility may have differed across talkers. For the present study we conducted acoustic analyses of the talkers' voices used in the aforementioned intelligibility study and explored how the acoustic characteristics of the talkers' voices contributed to intelligibility. Specifically, we compared global and fine-grained acoustic characteristics with the intelligibility scores obtained from the listeners in Murphy et al. These data provide new insights into the acoustic characteristics listeners rely on when faced with adverse listening conditions and have potential to later affect methods of intervention for improving effective communication and listening strategies for people with hearing loss.

Poster # 173 – SP14

Intelligibility of Multiple Talkers' Speech in Complex Noise
Madison Murphy, BS; Brittan Barker, PhD, Utah State University, Logan, UT

It is well understood that speech intelligibility in noise makes communication difficult. However, in order to better understand the perceptual degradation of speech in real-life, we need research that explores speech intelligibility across multiple talkers in the presence of ecologically valid background noise. In the

current study, 30 listeners were presented with Harvard Sentences spoken by 20 female talkers in the presence of 8-talker babble and restaurant noise. We used a write-down procedure to assess speech intelligibility. The results showed significant main effects of noise [F (1,29) = 1117.27; p < 0.0001; partial 2 = 0.98] and SNR [F (1,29) = 162.25; p < 0.0001; partial 2 = 0.85]. There was no significant interaction. A background of 8-talker babble presented at an SNR of -7 dB resulted in the lowest mean intelligibility across listeners (M = 23% correct). Our results suggest that in real-life noise intelligibility decreases. Specifically, restaurant noise resulted in significantly greater intelligibility compared to the 8-talker babble. Our findings provide new insights into speech intelligibility in the presence of ecologically valid complex noise.

Poster # 174 – SP15

Effects of Stimulus Lexical Status on Consonant Recognition in Noise
Kanae Nishi, PhD; Jennifer Schmaus, Boys Town National Research Hospital, Omaha, NE

Consonant perception can provide important information regarding possible difficulties in understanding speech. However, if assessed using meaningful materials, it is not clear how listeners take advantage of linguistic context to compensate for missing/distorted acoustic cues in the speech signal. To address this issue, this study examined whether consonant recognition in noise is more accurate in real words than in non-words. Using 200 consonant-vowel-consonant (CVC) real words from Computer-Assisted Speech Perception Assessment and 39 vowel-consonant-vowel disyllables (VCV) containing 13 English consonants, consonant recognition was assessed for 42 monolingual English speakers with normal hearing. Thirty-two participants were children (6-13 years old) and 10 were adults (19-49 years old). Using a listen-and-repeat paradigm, listeners heard VCVs and CVCs presented in four signal-to-noise ratio (SNR) conditions (-5, 0, 5 dB, and quiet). In general, consonant recognition became more accurate as SNR increased. Age effect was only significant in the 5 dB SNR condition. Contrary to the hypothesis, average consonant recognition was poorer in CVCs than in VCVs. Interestingly, recognition of individual consonants did not show sizable differences between materials and positions in words. These results will be discussed in relation to choice of real-word stimuli, acoustic salience, and possible application of consonant recognition task.

Poster # 175 – SP16

Objective and Subjective Speech-In-Noise Comparisons Among Listener's with Presbycusis
Celia Riffel, BA; Victoria Sanchez, PhD; Theresa Chisolm, PhD, University Of South Florida, Tampa, FL

The most common complaint of older adults with presbycusis is difficulty understanding speech, particularly in noisy environments. Thus, it is important for audiologists to assess speech understanding in noise in development of a comprehensive treatment plan. Objective speech-in-noise scores, however, often conflict with subjective reports of real-world performance. The purpose of this study was to examine the relationships between two clinically available objective speech-in-noise tests (QuickSIN; LiSN-S) with the Speech, Spatial & Qualities (SSQ) self-report measure. The Quick Speech-in-Noise test (QuickSIN) yields the signal-to-noise ratio for 50% correct speech recognition (SNR-50) and the Listening in Spatialized Noise-Sentence test (LiSN-S) yields the SNR-50 for listening conditions, differing in the availability of voice difference cues and/or spatial separation cues. The SSQ assesses self-perceived

auditory disability in three domains: speech understanding, spatial hearing (direction, distance, movement), and quality (ease of listening, naturalness, clarity). Results from 76 adults with presbycusis demonstrated a lack of significant relationships between the QuickSIN and the LiSN-S scores. Stronger correlations were found for the correlations between SSQ subscale scores and LiSN-S scores than with the QuickSIN scores. Clinical implications for use of the objective tools for the development of a comprehensive intervention plan are discussed.

Poster # 176 – SP17

Simultaneous Evaluation of Rate, Context, and Signal-To-Noise Ratio on Speech Perception
Jaclyn Schurman, AuD; Chelsea Carter, AuD; Sadie Coleman, AuD; Sandra Gordon-Salant, PhD, University Of Maryland, College Park, College Park, MD
Douglas Brungart, PhD, Walter Reed National Medical Center, Bethesda, MD

Multiple stimulus factors influence speech understanding in noise, including rate, context and signal-to-noise ratio (SNR) of the spoken message. The majority of clinical and research tools that aim to assess the impact of rate, context and SNR on speech perception performance are designed to hold two variables constant in order to determine the effect of the third variable. Therefore, the relationship between these variables is not entirely clear and it may be beneficial to have a comprehensive assessment tool that can evaluate all parameters simultaneously. In this study, normal hearing listeners of various ages were tested with a novel three-way adaptive speech perception test that simultaneously adjusted the time compression ratio (TCR), level of context, and SNR using R-SPIN sentences. The test was divided into eight trials per block, with each block containing combinations of fast and slow TCR, high and low SNR, and high and anomalous context. At the end of each block, overall SNR was adjusted to track the speech recognition threshold where listeners obtained 70% correct performance. A comparison of results to working memory measures and more conventional speech recognition tests suggest that the three-way assessment captures aspects of performance beyond what is measured by unidimensional assessments.

Poster # 177 – SP18

A Cross-Sectional Investigation of Peripheral Auditory Function and Speech Perception in Noise Performance
Samantha Stiepan, AuD; Sumitrajit Dhar, PhD; Jungmee Lee, PhD; Jungwha Lee, PhD; Jonathan Siegel, PhD, Northwestern University, Evanston, IL

Difficulty with speech perception in noise (SPIN) is one of the most common complaints expressed by patients in audiology clinics. Traditionally, elevated hearing thresholds are pegged as the barrier to the perception of speech sounds; yet, patients will often report difficulties with SPIN despite having clinically normal hearing thresholds. The purpose of this cross-sectional study was to critically evaluate the influence of various metrics of auditory function, such as behavioral thresholds, otoacoustic emissions (OAEs), and self-rating of hearing ability, on SPIN performance in a large sample of clinically normal-hearing individuals (n=916) under the age of 70. The Quick Speech-In-Noise (QuickSIN) test was used to provide an estimate of the functional signal-to-noise ratio (SNR) at which an individual could comprehend speech in the presence of background noise. Overall, aging effects, self-rating of hearing ability, and extended high frequency auditory function did not seem to be predictive of SPIN

performance. Intriguingly, we found that self-generated physiological noise levels, measured indirectly during OAE testing, were associated with elevated QuickSIN performance. Therefore, we propose that these elevated noise floors in the poorer SPIN performers could affect intrinsic SNR thereby negatively impacting SPIN performance as seen by poorer QuickSIN scores.

Poster # 178 – SP19

Preliminary CASPA Data in HIV+ and HIV- Adults

Peter Torre, San Diego State University, San Diego, CA
Gayle Springer; Christopher Cox, Johns Hopkins University, Baltimore, MD
Howard Hoffman, National Institute on Deafness and Other Communication Disorders, Bethesda, MD
Michael Plankey, Georgetown University, Washington, DC

Prior research on speech audiometry in HIV+ and HIV- adults has been limited to quiet environments. Speech-in-noise testing can be used to evaluate effects of HIV on hearing. The purpose of this study was to examine preliminary Computer-Assisted Speech Perception Assessment (CASPA) data in HIV+ and HIV- adults from the Multicenter AIDS Cohort Study (MACS) and the Women's Interagency HIV Study (WIHS). Ten consonant-vowel-consonant (CVC) CASPA words were presented from 45 to 75 dB SPL in 5-dB steps with a fixed babble noise at 55 dB SPL and performance-intensity functions were generated. Two outcome measures were obtained from phoneme scoring and consonants only scoring. Threshold, in dB, was the 50% score and Best, in dB, was the level when the score reached 95% of the functional asymptote. For phoneme and consonant scoring, HIV+ adults (n=37) had slightly poorer scores than HIV- adults (n=17). This difference was greater for HIV+ women (n=25) compared to HIV- women (n=6) whereas scores were similar between HIV+ (n=12) and HIV- (n=11) men. A small number of statistical outliers were observed in these preliminary data. Further analyses are required to evaluate these results; also, CASPA data collection is continuing in order to increase statistical power.

Poster # 179 – SP20

Cognitive Factors that Contribute to Children's Recognition of Degraded Speech

Kristi Ward; Tina Grieco-Calub, PhD, Northwestern University, Evanston, IL

Previous studies have demonstrated that children's recognition of spectrally degraded speech matures earlier in development than their recognition of speech in noise (e.g., Eisenberg et al., 2000; Leibold & Buss, 2013). These findings suggest that distinct cognitive processes may underlie degraded speech recognition depending on the acoustic information available in the signal. The purpose of the present study was to investigate cognitive factors that contribute to children's recognition of degraded speech. Elementary school-aged children repeated sentences that were degraded by either noise-band vocoding or a two-talker masker. Speech recognition accuracy and verbal processing time, a measure of linguistic processing efficiency, were measured in each condition. Children also completed a standardized measure of attention and inhibition. Multiple regression analyses revealed that children's attention and inhibition significantly contributed to their recognition of speech in a two-talker masker, though this effect was only observed in the younger children. In contrast, children's verbal response time solely contributed to their recognition of speech that was noise-band vocoded. These findings suggest that the method by which speech is degraded influences the cognitive processes involved in speech recognition. Furthermore, these

findings indicate that the primary cognitive processes underlying the recognition of degraded speech may change throughout childhood.

TINNITUS

Poster # 180 – TIN04

Effect of Gap Duration on the CAEP in Tinnitus Subjects
Kenneth Morse, BS; Kathy Vander Werff, Syracuse University, Syracuse, NY

Researchers have proposed impaired gap detection in tinnitus due to 'filling in the gaps' (Fournier & Hbert, 2012; Shadwick & Sun, 2014). Although behavioral gap detection (BGD) studies have not widely supported this theory, latency and amplitude changes in electrophysiological gap detection (EGD) might provide objective evaluation of this idea. The current study used the cortical auditory evoked potential (CAEP) in response to gaps in white noise to evaluate whether amplitude, latency, and area varied by gap duration in tinnitus subjects (n = 18) for 3 conditions: suprathreshold (20 ms), threshold (BGD threshold+2 ms) and subthreshold (2 ms). RMANOVA tests showed significantly delayed latencies for P1 ($p = 0.001$) and N1 ($p = 0.007$) and significantly reduced N1 ($p = 0.001$) and P2 ($p = 0.007$) and the N1-P2 amplitude difference ($p < 0.001$) for threshold vs. suprathreshold conditions. Response area was also significantly reduced both from suprathreshold to threshold and threshold to subthreshold conditions ($p = 0.010$ for each). These results confirm that the CAEP can be recorded to gaps in noise in tinnitus subjects and that gap duration significantly affects waveform characteristics. Additional data are being collected to compare these outcomes to matched (age and hearing loss) non-tinnitus controls.

Poster # 181 – TIN05

Characteristics of Patients with Somatic Tinnitus
Craig Newman, PhD; Sharon Sandridge, PhD; Gina Stillitano, AuD, Cleveland Clinic, Cleveland, OH

Somatic tinnitus occurs when at least one perceptual attribute of the tinnitus sensation (e.g., loudness) can be transiently modulated with contractions of head, neck, and/or jaw musculature. A retrospective chart review was conducted for a subsample of patients identified as having somatic tinnitus during the Tinnitus Management Clinic (TMC) at the Cleveland Clinic. The purpose of this poster presentation is to describe the characteristics of these patients including: perceptual features, duration, and quality of the tinnitus; modulation of tinnitus over time; factors affecting the reduction or exacerbation of tinnitus disturbance; dental history including temporomandibular disorders; and reported biomechanical problems of the head, neck, and/or jaw. The clinical assessment of somatic tinnitus conducted by the neurologist, dentist, and physical therapist during the TMC showing the physical maneuvers used to generate somatic tinnitus will be illustrated. Further, a representative case study of a patient with somatic tinnitus and otalgia will be presented. This case illustrates the modulation of somatic tinnitus during masticatory muscle contraction, jaw clenching, and manipulation of the neck and cervical spine. The relationship between somatic tinnitus, otalgia, and pressure applied to myofascial trigger points are described. Finally, clinical recommendations for management of patients with somatic tinnitus will be presented.

Poster # 182 – TIN06

Tinnitus and Hearing Loss: Not as Related as you Think!
Sharon Sandridge, PhD; Craig Newman, PhD, Cleveland Clinic, Cleveland, OH

Clinically significant tinnitus is commonly associated with hearing loss. In fact, hearing loss has been estimated to occur in approximately 85% to 96% of patients with tinnitus. The purpose of this retrospective study was to evaluate the audiometric thresholds of patients with bothersome tinnitus who attended the Tinnitus Management Clinic at the Cleveland Clinic. In a sample of convenience (n = 319), the mean pure-tone average (PTA1 = 500, 1000, 2000 Hz) was 20.5 dBHL and 18.8 dBHL, right and left ear respectively. The mean high-frequency average (PTA2 = 1000, 2000, 4000 Hz) was 26 dB and 24 dB HL, right and left ear respectively. Over 70% of patients had PTAs (1 and 2) of less than 25 dB HL. The mean Tinnitus Handicap Inventory (THI) was 50 with over 90% of patients reporting a score above 16 points (normal cutoff value). Analyses showed very weak correlation between THI and PTAs with $r < 0.18$. Our findings suggest that there is not as strong of a correlation between bothersome tinnitus and hearing loss as previous reported. The relationship between possible auditory nerve deafferentation, normal hearing sensitivity, and tinnitus generation will be presented.

Poster # 183 – TIN07

Assessing the Effectiveness of Tinnitus Masking Devices
Richard Tyler, PhD; Phillip Gander, PhD; Rachael Owen, University Of Iowa, Iowa City, IA
Ann Perreau, PhD; Alexandra Watts, Augustana College, Rock Island, IL

Despite the widespread use of tinnitus maskers to reduce tinnitus in clinical practice, there are several studies that have shown no significant advantage of tinnitus maskers with counseling, compared to counseling alone. The purpose of this study is to investigate the effectiveness of tinnitus maskers using an AB/BA single-subject design, where each participant serves as their own control. In this preliminary study, 15 adults were recruited with unilateral or bilateral tinnitus. Tinnitus masking devices were fit with several masking sounds aimed to reduce the prominence of tinnitus, and participants wore the masking devices during an at-home trial for 6 weeks. The participants also completed baseline measures of tinnitus loudness and pitch matching, minimal masking level and residual inhibition, as well as several questionnaires on tinnitus handicap and loudness and annoyance. During the 6-week at-home trial (phase A), the participants completed weekly ratings of tinnitus loudness and annoyance and overall masker effectiveness. In phase B, the participants completed the weekly ratings without any sound therapy. We hypothesize that, if successful, this study will be the first to clearly document the benefit of tinnitus maskers, encouraging patients to seek help and providing evidence for agencies to reimburse the devices.

TRAINING / REHABILITATION

Poster # 184 – TR06

Evaluation of a Hearing Loss Toolkit for Self-Management.
Preyanca Oree, BA; Michelle Arnold, AuD; Terry Chisolm, PhD; Victoria Sanchez, PhD, University Of South Florida, Tampa, FL

Epidemiological studies demonstrate the independent association between hearing loss and cognitive decline in older adults, highlighting the need to determine if best-practices audiological intervention could slow rates of cognitive decline. Such intervention involves successful use of hearing aids and the development of the ability to self-manage hearing and communication situations. To address these goals, we developed a manualized best practices hearing intervention, ACHIEVE-HI (Matthews et al. 2016). Self-management support was provided through I-ACE (I-ACE; Laplante-Lvesque, et al., 2010) written education materials and British C2Hear reusable learning objects (RLO; Ferguson, et al., 2016). ACHIEVE pilot study participant feedback indicated the need to modify the educational materials. Modifications included the use of infographics, Americanization of RLOs, and assuring accessibility of materials across various health literacy levels. Feedback from ACHIEVE pilot studies about our new Audiologist Toolkit, both as the sole source of support materials and in comparison to the original materials will be presented. The process of developing the Toolkit is discussed, along with recommendations for use of the Toolkit in future studies including an upcoming study designed to answer the question of whether or not best-practices hearing intervention slows the rate of cognitive decline (Matthews et al., 2016).

Poster # 185 – TR07

The Relationship Between Emotional Responses to Sound and Social Function
Erin Picou, PhD, Vanderbilt University Medical Center, Nashville, TN

People with hearing loss are at increased risk of reduced psychosocial function, as indicated by reduced general well-being and reduced social connectedness. One factor contributing to these findings may be how patients with hearing loss respond emotionally to sounds. Recent work suggest that, in the laboratory, listeners with hearing loss exhibit a reduced range of emotional responses, especially to pleasant sounds. The purpose of this study was to investigate the relationship between laboratory-based measures of emotional processing and global measures of psychosocial function. Adults aged 22 to 79 years with a range of hearing abilities participated. All participants rated their experienced valence and arousal in response to non-speech sounds in the laboratory. In addition, they completed questionnaires to assess their perceived hearing handicap, social function, anxiety and depression. Regression analyses revealed that participants with more hearing loss were more likely to exhibit more disrupted emotional responses in the laboratory and more social isolation. The relationship between emotional responses and social isolation was maintained even when controlling statistically for age and degree of hearing loss. These results have important implications for social function among adults with acquired hearing loss and for developing intervention strategies aimed at improved psychosocial function.

Poster # 186 – TR08

Audiologic Rehabilitation Needs of Adults with Hearing Loss
Chloe Robbins, BS; Nicole Marrone, PhD, University Of Arizona, Tucson, AZ

The Living Well with Hearing Loss Audiologic Rehabilitation Program for Adults at the University of Arizona has been in existence since 2010. Over 600 adults with hearing loss and their frequent communication partners have participated in the group audiologic rehabilitation (AR) program at various stages of the patient journey. This study has two aims: 1) to determine uptake of group AR from those receiving services through the University of Arizona Hearing Clinic and 2) to determine the rehabilitation needs of patients through in-person interview. The mixed methods research design included quantitative data collection from a retrospective chart review and qualitative data collection from in-person interviews. An exploratory analysis was conducted on demographic factors of patients seen in the hearing clinic between the years 2013-2015. Audio-recorded interviews were conducted prospectively with a sample of 30 hearing aid patients between May-October 2016. Content analysis methods were used to gain insight into perspectives of those with hearing loss. Interview response data were coded using the following categories: demographics, program-related factors, practical issues, health-related factors, and financial factors. Results provide insight into variables that would make group AR more accessible for adults with hearing loss and their families in Arizona.

Poster # 187 – TR09

CLARITY-1 Trial Results and Implications for Future Audiology-Related Pharmaceutical Trials

Victoria Sanchez, PhD; Theresa Chisolm, PhD, Auditory Rehabilitation & Clinical Trials Laboratory, University Of South Florida, Tampa, FL; Global Center For Hearing & Speech Research, University Of South Florida, Tampa, FL; Dept. Communication Sciences & Disorders, University Of South Florida, Tampa, FL
Robert Frisina, PhD, Global Center for Hearing & Speech Research, University of South Florida, Tampa, FL,; Dept. Communication Sciences & Disorders, University of South Florida, Tampa, FL
The Clarity-1 Consortium, Autifony Therapeutics Ltd., London, UK
John Hutchison, MD; Charles H. Large, PhD, Autifony Therapeutics Ltd., London, UK, Imperial College London

Advancements in potential pharmaceutical therapies for audiology-related disorders require audiologists to increase their ability to design and participate in clinical trials. Logistical lessons learned from a recent Phase IIa clinical trial (CLARITY-1; ID#NCT02345031) assessing the efficacy and safety of AUT00063, a novel small molecule that positively modulates voltage-gated potassium channels (Kv3), will be presented. Kv3 channels, which are important for auditory neuron function, decline with age in the auditory brainstem. AUT00063 may improve neural synchrony and temporal processing, and, thus is a promising therapy for age-related hearing loss (ARHL). CLARITY-1, a multi-site, randomized double-blind, placebo-controlled, parallel group study, examined AUT00063's efficacy and safety in 78 adults (50-89 years) with ARHL. From baseline to 28 days, both active and placebo groups improved on the primary outcome measure, Quick Speech-in-Noise test, but the between-group difference was not statistically significant (p=0.06). Additionally, there were no significant between-group differences on secondary behavioral or self-report measures. AUT00063, however, was found to be safe and well tolerated. The safety profile was commendable and the trial data were of high quality, with excellent compliance and retention, thus, allowing for a conclusive outcome. Implications for future pharmaceutical studies including design, recruitment, and outcome measures will be discussed.

Poster # 188 – TR10

Does Dynamic Pitch Aid Older Listeners' Speech Recognition in Speech Maskers?
Jing Shen, PhD; Pamela Souza, PhD, Northwestern University, Evanston, IL

Recent research evidence showed that younger listeners benefit from pitch variation in speech (i.e., dynamic pitch) for speech recognition in noisy environments. The effect of dynamic pitch was found to be stronger in speech maskers as compared to non-speech maskers (Binns & Culling, 2007; Laures & Bunton, 2003). Following our previous finding that temporal modulation in noise stengthens the dynamic pitch effect, the present study first seeks to determine whether the intelligibility of the masker influences the amount of dynaic pitch benefit. Futher, we ask the question whether older listeners with normal hearing benefit from dynamic pitch cues for speech recognition in speech maskers. Stimuli are low-context sentences with three levels of dynamic pitch strength, embedded in either two-talker speech babble or reversed speech babble. Speech reception thresholds are measured for younger and older listeners with normal hearing. Results to date suggest the intelligibility of the masker does not affect the dynamic pitch benefit for speech recognition in noise. Older listeners benefit more than younger listeners from dynamic pitch cues in speech maskers. Implications of evaluating the amount of benefit from dynamic pitch cues for speech recognition in speech masker will be discussed. [Work supported by NIH]

Poster # 189 – TR11

Reliability and Repeatability of the Speech Cue Profile
Pamela Souza, PhD; Paul Reinhart; Rachel Ellinger, Northwestern University, Evanston, IL
Richard Wright, PhD, University Of Washington
Frederick Gallun, PhD, National Center for Rehabilitative Auditory Research and Oregon Health Sciences University, Portland, OR

Researchers have long noted speech recognition variability that is not explained by the pure-tone audiogram. Previous work (Souza et al., 2015) demonstrated that a small group of hearing-impaired listeners varied in use of specific speech cues, such that a minority relied to a greater extent on spectral and a majority on temporal aspects of the signal. Consistent with recent calls by NIH for data rigor and reproducibility, the aims of this study were to replicate the pattern of cue use in a larger cohort and to verify the stability of cue profiles over time. Spectral and/or temporal dimensions of synthetic speech were manipulated along a continuum and recognition was measured for the manipulated stimuli. Discriminant function analysis was used to determine to what degree spectral and temporal information contributed to stimulus identification. Adults with sensorineural hearing loss demonstrated a balanced distribution of cue-use patterns, with nearly equal numbers of individuals relying to a greater extent on spectral or on temporal cues. The speech cue profile was not predicted by the audiogram. Individual cue profile was highly repeatable over a 1-6 month period. The relationship between the cue profile and speech recognition will be discussed. [Work supported by NIH.]

VESTIBULAR

Poster # 190 – VEST01

Normal Values for Cervical and Occular Vestibular-Evoked Myogenic Potentials (VEMP): Effect of Body position and Electrode Montage

Navid Shahnaz, PhD, University Of British Columbia, Vancouver, BC
Eytan David, MD, Lions Gate Hospital, North Vancouver, BC

This study investigated the effects of positioning and electrode montage on VEMP response rates on 44 participants (22 females and 22 males) with normal hearing and balance systems (mean age 23 yrs) using an Interacoustics system equipped with VEMP module. Each individual participated in a cVEMP experiment and an oVEMP experiment. Amplitude scaling was used for the cVEMP study. The response rate was similar when the head was elevated and centered in contrast to when the head was elevated and rotated away from the stimulated side. Absolute latencies for P1 N1 was comparable between the two position; however, the higher cut off for interaural amplitude difference was different. Normative data using amplitude scaling for cVEMP was somewhat comparable to previously published normative data. We also investigated whether oVEMP responses occur more frequently when participants are in the supine position gazing backward or when they are sitting upright gazing upward- and whether oVEMP responses occur more frequently when the active electrode is placed infraorbital and the inverting (reference) electrode is placed beneath the active electrodes, or when the active electrode is placed closer to inferior oblique muscle and reference electrode is placed on the fleshy part of the nose.