American Auditory Society Scientific and Technology Meeting
March 3-5, 2016

POSTER ABSTRACTS

Topic areas, poster numbers, and abstract codes:

Topic Area	Poster Numbers	Abstract Code
POSTER SESSION I – Thursday – Friday		
Amplification	Poster #1-9	(AMP01-09)
Cochlear Implants	Poster #10-17	(CI01-08)
Anatomy and Physiology	Poster #18-21	(ANAT01-04)
Otoacoustic Emissions	Poster #22-27	(OAE01-06)
Electrophysiology	Poster #28-36	(EP01-09)
Auditory Processing	Poster #37-41	(AP01-05)
Audiology / Otology	Poster #42-46	(AO01-05)
Speech Perception	Poster #47-58	(SPAD01-12)
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AMPLIFICATION

Poster # 1 - (AMP01)

Reverberation and Open-fit Hearing-aid Effects on Sound-localization Cues **Mentored Student Research Poster Award**

Anna C. Diedesch, AuD; G. Christopher Stecker, PhD, Vanderbilt University, Nashville, TN

Sound localization in the horizontal plane depends primarily on two acoustic cues: interaural time differences (ITD) and interaural level differences (ILD). These cues are susceptible to distortion in the presence of reverberation, which occurs in real rooms. Certain styles of hearing aids may additionally interfere with ITD and ILD cues. Open-fit hearing aids, for instance, mix two copies (processed and acoustic sound) with a slight processing delay (~2-5 ms). Here, we measured binaural recordings of broadband stimuli using probe-tube microphones on an acoustic manikin (KEMAR). KEMAR was fit with low-gain, linear behind-the-ear hearing aids. Noise reduction, microphone directionality and feedback suppression were disabled. Aids were coupled to comply tips with 0-3 vents, or to open domes. Sounds were presented in anechoic and simulated rooms. Binaural cross-correlation and intensity-difference calculation were used to estimate frequency-specific ITD and ILD, respectively. Consistent with previous research, ITD became erratic and ILD diminished in reverberant conditions, compared to anechoic. Effects of hearing aid venting were less clear. ILD cues remained fairly consistent with increased venting, while mid- to low-frequency ITD cues varied across vented conditions in the simulated rooms.
[Supported by NIH R01-DC011548]

Poster # 2 - (AMP02)

Validation of a Hearing Aid Program Designed for Music Listening

Eric McCabe, AuD; Amanda Wolfe, AuD; Alyson Gruhlke, AuD; Elizabeth Galster, AuD, Starkey Hearing Technologies, Eden Prairie, MN

Amplification in modern hearing aids is specifically designed to increase audibility for soft sounds, such as speech, while keeping loud sounds tolerable. While speech intelligibility is of most importance for most hearing aid users, it is also important to remember that non-speech situations, such as music listening, in which sound quality, rather than speech intelligibility, are important to many hearing aid users (Cohen, Bailey, & Nilsson 2002). Music and speech differ significantly in many dimensions (Chasin & Ruso, 2004), and these differences can create difficulties for hearing aid users while listening to music (Leek, Molis, Kubli, & Tufts, 2008). This research study was completed to evaluate a new music memory, consisting of a distinct compression architecture and fitting formula, designed to improve music sound quality and listening satisfaction for hearing aid users. The study consisted of 58 participants who were fit bilaterally with various styles of hearing aids. A forced-choice paired comparison task completed in the laboratory and subjective data from the field indicated participants significantly preferred the music compression architecture and fitting formula while listening to music over a system designed for listening to speech.

Poster # 3 - (AMP03)

Home Trial Evaluations of the Tonal AdaptivePhonakDigital Fitting Formula
Solveig Christina Voss, BS; Jinyu Qian, PhD, Phonak China, Shanghai
Shuo Wang, PhD; Ruijuan Dong, Otolaryngology - Head & Neck Surgery, Beijing Tongren Hospital, Beijing Institute Of Otolaryngology, Capital Medical University, Beijing
Volker Kuehnel, PhD, Sonova AG, Staefa, Switzerland, Staefa

A previous study has shown the first fit benefit of a new Tonal adaptation of the Adaptive Phonak Digital (APDT) fitting formula compared to the Standard version (APDS) for Mandarin speaking hearing impaired people. This study is to investigate in daily life the performance of the APDT fitting formula by conducting home trials. 19 Mandarin speaking subjects with moderate to severe hearing loss from Beijing were fitted monaurally with Phonak hearing aids using APDT. Subjects completed the first fit, Chinese Hearing Aid Outcome Questionnaire (CHAOQ) and Mandarin Hearing in Noise Test (MHINT) at the hearing center and were sent home with the aids for 4 to 6 weeks. Subjects were called back every two weeks to repeat the above questionnaire and speech test both in quiet and in noise. The comparison of the performances between the first and follow-up visits indicated the following: 1) significant improvement for MHINT in quiet over four weeks of APDT adaptation; 2) although not significant, twelve out of nineteen subjects showing improvement for MHINT in noise over four weeks of APDT adaptation; 3) significantly better ratings across all five different difficult listening situations over the adaptation period.

Poster # 4 - (AMP04)

Influence of Signal-Processing Strategy on Speech Recognition in Noise with Temporal Dips
Daniel Rasetshwane, PhD; David Raybine; Judy Kopun, MA; Michael Gorga, PhD; Stephen Neely, Boys Town National Research Hospital, Omaha, NE

In listening environments with fluctuating background noise level, listeners with normal hearing (NH) can ‘glimpse’ speech during dips in the noise and achieve better speech recognition than in equivalent steady-state noise. In contrast, listeners with hearing loss (HL) show less improvement in fluctuating noise. The purpose of this study was to evaluate whether an experimental hearing-aid (HA) signal-processing strategy that restores suppression and includes instantaneous compression (referred to as a suppression hearing aid, SHA) can improve outcomes for listeners with HL. Measurements of nonsense word recognition in temporally-modulated and steady-state noise were obtained in HL listeners following amplification with SHA and a generic HA (GHA) with fast compression (5 and 50 ms attack and release times) but without suppression. Gain was prescribed using either categorical loudness scaling (CLS) or desired sensation level (DSL), resulting in a total of four processing conditions: CLS-GHA, CLS-SHA, DSL-GHA and DSL-SHA. Measurements were made without amplification in listeners with NH. The largest improvements in speech-recognition scores, when modulated noise was compared to steady-state noise, were observed for CLS-SHA, followed by DSL-GHA. The present results suggest that CLS-SHA restores the ability to benefit from temporal modulation better than DSL-GHA. [Work supported by the NIH]

Poster # 5 - (AMP05)

Speech Intelligibility Differences Between Binaural and Monaural Telephone Listening Conditions
Amanda Wolfe, AuD; Alyson Gruhlke, AuD; Eric Mccabe, AuD; Elizabeth Galster, AuD, Starkey Hearing Technologies, Eden Prairie, MN

Hearing aid users often report difficulty understanding speech during telephone conversations. Given the many challenges hearing aid users experience while conversing on the telephone, as well as the known benefits of binaural hearing (McArdle, Killion, Mennite, & Chisolm, 2012), our hypothesis was that speech intelligibility scores on the telephone would be improved if the signal was presented through both hearing aids rather than one. The purpose of this evaluation was to determine if there were differences in speech intelligibility when comparing performance across different telephone listening conditions using the Connected Speech Test (Cox, Alexander, & Gilmore, 1987). Research using a direct ear-to-ear binaural telephone signal has not been widely published; therefore, three conditions were evaluated: unaided, a monaural acoustic phone memory, and a binaural (ear-to-ear phone streaming) acoustic phone memory, in which the phone audio was wirelessly streamed from one ear to the other ear. Data was collected from 41 individuals with mild-to-severe sensorineural hearing loss. Results indicated that speech intelligibility improved significantly with the binaural condition compared to the monaural and unaided conditions. By taking advantage of binaural hearing benefits using wireless streaming technology, patients may experience less difficulty when using the phone and greater satisfaction with hearing aids.

Poster # 6 - (AMP06)

Efficacy of PSAP in Patients with Mild Hearing Loss
Jinryoul Kim, PhD; Heesung Park, MS; Ji Eun Choi, MD; Sung Hwa Hong, MD; Il Joon Moon, MD, Samsung Medical Center, Seoul, Korea

Personal Sound Amplification Products (PSAPs) have been developed to amplify environmental sound for normal-hearing subjects. PSAPs operate a small amplification on a couple of modes. PSAPs can be a good rehabilitation option for patients with mild hearing loss, but the clinical efficacy has not been demonstrated so far. Thus, objective of this study is to evaluate an efficacy of PSAP as compared with hearing aids (HAs) in patients with mild hearing loss. Ten adults with mild sensorineural hearing loss were enrolled. All participants did not experience any HAs. Following experiments were performed wearing either PSAP or HA: Korean Hearing in Noise Test (KHINT), Korean Speech Audiometry (KSA), speech quality test (ITU-T P800 or P835), word Recognition test, and acceptable noise level (ANL) test in quiet or in noise. Additionally, structured questionnaire was administered for evaluation of preference. Study results revealed PSAP showed overall improvement in most experimental condition, and the improvements with PSAP was comparable to those with HAs. Moreover, PSAP was preferred in noise session, while HA was preferred in quiet session. PSAP may provide considerable benefit and can be a good rehabilitation option for patients with mild hearing loss.

Poster # 7 - (AMP07)

Esteem® Middle-ear Implant Users' Perception of Own-Voice Relative Loudness
Liz Anderson, PhD, Envoy Medical Corp., St. Paul, MN
Dragana Barac-cikoja, PhD, Gallaudet University, Washington, DC
Peggy Nelson, PhD, University of Minnesota, Minneapolis, MN

The Esteem® active middle-ear hearing implant operates via the air conduction pathway of the auditory system. However, bone-conducted signals also receive some amplification, probably via the inertial mode of bone conduction, in which the vibration of ossicles is detected by the implanted Sensor. Some recipients of the Esteem implant report their own voices as uncomfortably loud, which can impact overall satisfaction with the device. To investigate own-voice perception in this population, an adaptive, two-track, two-interval, two-alternative forced-choice procedure was used to compare the loudness of speech feedback (listening-while-speaking interval) and its replay (listening-only interval) by Esteem recipients. The subjects' speech was recorded with a microphone placed above their Esteem ear, and both feedback and replay signals were presented in sequence via insert earphone to the Esteem ear. Subjects judged which interval was louder. Based on their responses, replay levels were raised or lowered adaptively in 1 dB steps until 20 reversals were obtained, determining the point of subjective equality (PSE). Relative loudness of the speech feedback was estimated from the difference in sound pressure level (SPL) of live and replay signals at the PSE, from the final 12 reversals. Results will be compared to hearing-aid users and normal-hearing listeners.

Poster # 8 - (AMP08)

Individualizing Microphone Technology in School-Aged Children **T35 Research Trainee Poster**

Arun Joshi, BS, The University Of North Texas Department Of Speech And Hearing Sciences, Denton, TX
Erin Picou, PhD; Gina Angley, AuD; Todd Ricketts, PhD, Vanderbilt University Medical Center Department Of Hearing And Speech Sciences, Nashville, TN

Microphone-based technologies, such as wireless microphones and directional hearing aids, have long been advocated for improving the SNR in noisy classrooms. The benefits from these technologies are limited, however, by a number of environmental factors, listening goals and individual listener differences. Indeed, research has demonstrated that the optimal microphone setting changes across the school day. Additional research has demonstrated that while school-aged children are capable of switching to microphone settings that provide the best SNR, they are unlikely to do so consistently. We propose that listening may be enhanced by individually optimizing settings, based both on performance and individual listener preferences. The current study sought to examine the relationship between children's preference for, and performance with, three microphone settings in simulated classroom listening environments. Participants included children between the ages of 9 and 17 years with symmetrical mild to severe hearing loss, who were fit with bilateral hearing aids for laboratory testing. Laboratory tasks included speech-recognition performance, listening effort, and subjective preference. Preliminary data suggest that many school-aged children have consistent preferences for microphone settings and these preferences differ based on individual factors. Clinical implications of the findings will be discussed. Supported by an NIH NIDCD T35DC008763 Short Term Research Traineeship.

Poster # 9 - (AMP09)

Pre-Cochlear-Implant Amplification Profiles for Pediatric Recipients **T35 Research Trainee Poster**

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Background: Children with hearing loss (HL) have reduced audibility for all sounds, including speech, as a consequence of their hearing loss. Hearing aids (HAs) that are fit to prescriptive targets can reduce the impact of HL by improving the audibility of all sounds, and may facilitate good speech and language development. While some researchers have studied HA fittings for pediatric listeners predominantly with mild-to-severe HL, few have examined HA fittings for children with severe-to-profound HL. Purpose: To characterize HA fittings and audibility of speech for children who later received cochlear implants (CIs). We predicted, consistent with previous literature, that HAs of children with profound HL would be underfit to targets, particularly at the high frequencies. Additionally, we predicted that children with HA fittings below target will consequently have poorer audibility as quantified by the speech intelligibility index (SII). Research Design: A retrospective design. Study Sample: Forty children with severe-to-profound HL who are participating in a project examining the effects of early acoustic hearing for pediatric CI recipients; these 40 are the subset of children whose pre-implant audiological records included HA fittings. Methods: Audiological information (etiology, aided and unaided thresholds, age at 1st HA, age at CI surgery) was obtained from the participants' clinical centers. HA fitting data from these 40 children represent a total of 62 ears. Deviations of HA Output from Desired Sensation Level (DSL) targets were examined, [HAOutput - DSLtarget]. Deviations greater in magnitude than 5 dB were considered significant. For each of three speech levels (soft: ~50, conversational: ~60, loud: ~70 dB SPL), HA Outputs and SIIs obtained from Audioscan Verifit records were analyzed. Results: Children received their 1st HA(s) between 1 and 28 months of age (mean: 11; sd: 9), and their 1st CI between 10 and 54 months of age (mean: 25; sd: 13). For soft speech, the percentage of ears with HA Outputs within 5 dB of target were 32, 40, 47, 61 and 42, at 250, 500, 1000, 2000 and 4000 Hz respectively. For conversational speech, the percentages close to target were 54, 57, 62, 70, and 41, at the same five octave frequencies. Finally, for loud speech, the percentages close to target were 62, 49, 57, 38, and 29, for 250-4000 Hz. Mean (sd) SIIs for 50, 60 and 70 dB SPL were 23 (19), 34 (22), and 36 (22), respectively. Discussion: There was variation in the choice of speech levels used to examine HA fittings; not all centers tested fittings at all three speech levels. Overall, more HA fittings were close to target (|Deviations| < 5 dB) for conversational than for soft and loud speech levels. As expected, the audibility of speech estimated by SII was poorest for soft speech, better for conversational speech, and marginally greater for loud speech. However, all three mean SII values are low (< 40) and reflect relatively poor audibility even with the best-fit HAs due to the severe-to-profound HLs in these children.

COCHLEAR IMPLANTS

Poster # 10 - (CI01)

Vocoded Speech Recognition of Chinese and English AzBio Sentences **Mentored Student Research Poster Award**

Alexa Patton, BS; Li Xu, Ohio University, Athens, OH
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AzBio sentences were first created to overcome the ceiling effects in evaluating sentence recognition in hearing impaired listeners. The sentences contain less contextual information than HINT or CUNY sentences. A Mandarin Chinese version of AzBio sentences has recently been created based on the same principle of creating English AzBio sentences. The purpose of the present study was to compare sentence recognition under vocoder processing through 1 to 9 channels. Two types of vocoder processing were

used: noise excited vocoder and tone-excited vocoder. The study planned to recruit 20 native English-speaking and 20 Mandarin-speaking normal-hearing listeners. Preliminary results from a small number of subjects showed that English speakers performed better in both noise and tone vocoder conditions than Mandarin speakers. The English speakers showed no differences in speech recognition between the two types of vocoders, while the Mandarin speakers performed significantly better in the tone-vocoder condition than the noise-vocoder condition. The differences in performance between the vocoder conditions can be attributed to the fact that Mandarin speakers can utilize the tone information that passes through the tone vocoder to assist their sentence recognition. This study has important implications for future cross-language comparison of speech recognition in CI users.

Poster # 11 - (CI02)

Fast Psychophysical Tuning Curves as a Measure of Electrode Position **Mentored Student Research Poster Award**

Lindsay DeVries, AuD; Julie Bierer, PhD, University Of Washington, Seattle, WA

Perceptual abilities vary widely among cochlear implant listeners. A potential source of this variability is electrode position; suboptimal placement has been associated with poorer outcomes. Insight into electrode position can be obtained via postoperative CT imaging, specifically distance of each electrode from the modiolus (inner wall of the cochlea). Additional information can be obtained with behavioral measures, which are sensitive to electrode position and neural integrity. Electrode-to-modiolus distance may explain some variability in behavioral thresholds with focused stimulation; however, this has not been evaluated with focused psychophysical tuning curves (PTCs), which may provide a more complete assessment of local variations in spectral resolution. Unilaterally implanted adults with the Advanced Bionics HiRes90K device participated. CT scans were obtained and 3D image reconstructions were created. For all available electrodes, fast PTCs were collected using the quadrupolar configuration within a forward-masking paradigm, and spread of excitation was quantified with an equivalent rectangular bandwidth (ERB). Preliminary data show a correlation between electrode-to-modiolus distance and the ERB of PTCs, suggesting poorer electrode placement may cause broader activation. The goal of this research is to develop a fast, non-radiologic method for estimating electrode position, which may lead to improved device programming that reduces unwanted channel interaction.

Poster # 12 - (CI03)

Effects of Interphase Gap and Polarity in Cochlear Implants **T35 Research Trainee Poster**

Erin Glickman, BA; Michelle Hughes, PhD; Jenny Goehring, AuD; Margaret Miller, AuD, Boys Town National Research Hospital, Omaha, NE

Recent evidence suggests that the clinically-standard cathodic-leading biphasic current pulse is less effective at stimulating the deafened human auditory system than an anodic-leading pulse. Modeling studies for humans demonstrate that both cathodic and anodic pulses are effective at eliciting an action potential when peripheral processes are intact; however, anodic polarity is more effective when peripheral processes are absent or degraded. Interphase gap (IPG) has also been shown to be a potential indicator of spiral ganglion cell survival in animal models. The goal of this study was to examine the individual and combined effects of polarity and IPG on electrically-evoked compound action potential

(ECAP) amplitude growth functions across the electrode array. If polarity and IPG demonstrate similar trends, then we hypothesize that both measures reflect more global aspects of auditory neural survival. However, if polarity and IPG exhibit different trends, then we hypothesize that each measure reflects different aspects of neural health. Outcome measures include ECAP thresholds, maximum amplitude, and slope differences among polarity and IPG conditions. Results show that effects for stimulus polarity and IPG are generally consistent with expected trends. Duration of deafness was used as a proxy metric of neural survival.

Poster # 13 - (CI04)

Auditory Cortical Activation with Image-Guided Cochlear Implant Programming: fNIRS **T35 Research Trainee Poster**

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Iliza M. Butera, BA, Vanderbilt University Brain Institute, Cochlear Implant Research Lab, Nashville, TN
Rene H. Gifford, PhD, Department of Hearing and Speech Sciences, Vanderbilt University; Vanderbilt University Cochlear Implant Research Lab, Nashville, TN

Objectives: 1) Quantify subjective reports of cochlear implant (CI) users with previous experience with an image-guided programming strategy. 2) Explore auditory cortical activation in response to speech and music stimuli using functional near-infrared spectroscopy (fNIRS), comparing an image-guided (IGCIP) and conventional programming strategy. Experiment: Speech recognition was assessed in CI users using CNC words, AzBio sentences in quiet and +5 SNR, and a vowel recognition task. Chord discrimination, MCI, and UW-CAMP Timbre tasks assessed participants' music perception. Spectral resolution and temporal resolution tasks were completed as psychoacoustic estimates of auditory function. Auditory cortical activation was measured using fNIRS in six adult CI users and six normal hearing (NH) listeners. Participants listened to speech of varying levels of intelligibility and alternating musical intervals, and rated overall sound quality for fNIRS speech stimuli using the Judgement of Sound Quality (JOSQ). Results: fNIRS revealed significant differences in cortical activation in auditory association areas between listening conditions for both NH and CI listeners. Activation responses were variable across both conditions and subjects. Discussion: fNIRS holds promise for identifying differences in activation corresponding to improved performance. Data collection with CI users is ongoing. Supported by an NIH NIDCD T35DC008763 Short Term Research Traineeship.

Poster # 14 - (CI05)

Stimulus Expectancy and Response Entropy in Older Cochlear Implant Recipients **Mentored Student Research Poster Award**

Nicole Amichetti, MS; Eriko Atagi, PhD; Arthur Wingfield, PhD, Brandeis University, Waltham, MA
Ying-yee Kong, AuD, NorthEastern University, Boston, MA

Post-lingually deafened older adults are now receiving cochlear implants (CIs). In addition to perceptual challenges, older listeners are faced with declines in working memory and in inhibition efficiency that typically accompany adult aging. I report the results of an experiment in which younger and older adult

CI users identified sentence-final words using word-onset gating, in which words were heard with increasing amounts of word-onset information until correctly identified. Older CI users required a larger onset duration to identify sentence-final words than younger users and this difference was reduced in the presence of a constraining linguistic context. We also asked if response entropy, calculated as the number of potential competitors and the uniformity of their probability distributions, might also affect the amount of word onset information needed for correct identification. Results showed that the older adults' word recognition thresholds were more negatively affected by response entropy than the younger adults. This age dissociation in effects of response competition supports the notion of an age-related inhibition deficit independent of sensory function in spoken word recognition in context.

Poster # 15 - (CI06)

Neural Correlates of Age-Related Perceptual Deficits in Cochlear-Implant Users
Alessandro Presacco, MS; Matthew J. Goupell, PhD; Casey Gaskins; Maureen Shader, AuD; Samira Anderson, PhD, University Of Maryland, College Park, MD

The benefits of a cochlear implants (CIs) vary considerably. One potentially important factor is age; older CI users may have poorer speech perception than younger CI users. Behavioral and physiological studies have demonstrated temporal processing deficits in older adults; therefore, performance in older CI users should be similarly affected. Here, we compared cortical responses to speech stimuli in younger (YCI), middle-aged (MCI), and older (OCI) adults who use CIs. We recorded responses to the following speech stimuli: a 400-ms synthesized /a/ vowel and naturally produced words 'ditch' (530 ms) and 'dish' (470 ms). A bivariate polynomial approach was used to remove artifact generated by the CI and the responses were circularly cross-correlated with a template derived from normal-hearing individuals. Preliminary results showed more accurate speech encoding in the MCI group (higher cross-correlations) than in the other age groups for the simpler /a/ vowel, but not for the more complex words. The YCI listeners' responses may be affected by factors arising from sensory deprivation during critical periods in auditory development. These findings may have clinical implications for management of OCI users, both in terms of the development of CI processing algorithms and for mapping of individual devices.

Poster # 16 - (CI07)

A Signal Coding Strategy Comparison across the Age Spectrum
Meredith Anderson, AuD; Margaret Dillon, AuD, University Of North Carolina At Chapel Hill, Chapel Hill, NC
English King, AuD; Ellen Deres, AuD, UNC Healthcare, Chapel Hill, NC

Initial activation of a cochlear implant prompts the need to decide between various feature options. One decision is the selection of a signal coding strategy among the multiple possibilities. Most studies report similarities in speech perception between signal coding strategies available currently. These investigations typically include subjects with a wide range of age at implantation. Map features, such as stimulation rate, are often manipulated when mapping an older adult. There are limited investigations as to whether the selection of a specific signal coding strategy at initial activation may influence speech perception outcomes in the older adult population. The present report reviewed speech perception outcomes of younger and older adults listening exclusively to one of two signal coding strategies. All subjects experienced an improvement in speech perception outcomes as compared to preoperative

performance. There was no difference between the two signal coding strategies during the first year post-initial activation of the external speech processor. There was also no effect of age at implantation for speech perception performance over time.

Poster # 17 - (CI08)

Older Listeners' Processing of Envelope Modulations in Cochlear-Implant Simulated Speech
Maureen J. Shader, AuD; Sandra Gordon-Salant, PhD; Matthew J. Goupell, PhD, University Of Maryland, College Park, Maryland, MD

Cochlear implants (CIs) provide spectrally degraded representations of speech signals, while temporal envelope cues remain intact. The number of CI users over 65 years of age is steadily increasing, but the extent to which older adults with age-related temporal processing deficits make use of temporal envelope cues when spectral cues are degraded is unknown. Current CI speech processing algorithms encode temporal modulations up to ~400 Hz, despite evidence that cues above ~180 Hz do not improve recognition (Stone et al., 2008). In the current study, we evaluated systematically degraded CI-simulated speech understanding in younger and older normal-hearing listeners. Sentence recognition was measured as a function of number of spectral channels (4-16 channels) and envelope modulation frequency (5-1000 Hz) for noise-vocoded sentences. Results show that on average, younger listeners achieve significantly higher scores than older listeners. Moreover, younger listeners are able to process envelope modulations above 20 Hz significantly better than older listeners, especially for the 6- and 8-channel conditions. These results have implications for the effectiveness of CI speech processing algorithms for older listeners; for example, speech recognition could be improved for older CI users by increasing the saliency of higher-rate envelope modulations.

ANATOMY AND PHYSIOLOGY

Poster # 18 - (ANAT01)

Effects of Noise on Glucose Transport in the Cochlear-Lateral Wall **T35 Research Trainee Poster**
Alyssa Everett, BA, University Of Arizona, Bel Air, MD
Kevin Ohlemiller, PhD, Washington University, Saint Louis, MO

This study analyzed the effects of noise exposure on glucose transport in the inner ear, evaluated by the presence or absence of glucose in the organ of Corti and lateral wall. A non-metabolizable glucose analog bound to fluorescein tracer was used to monitor the movement through the cochlea. C57BL/6J and CBA/J mice were divided into: 1) No noise, no tracer control; 2) No noise, with tracer; and 3) 107 dB noise exposure for 2 hours, with tracer. The organ of Corti and lateral wall were analyzed under the confocal microscope. The objective of this study was to determine if the presence of glucose in organ of Corti and lateral wall was disrupted with exposure to noise in a strain-specific manner. Results showed no glucose in the control group and presence of glucose in the no noise, with tracer group. Noise exposed mice show a reduction of glucose in most samples. Future work is needed to obtain more significant interpretations of noise exposed, with tracer samples. Future studies should determine more efficient ways to extract the organ of Corti attached to the lateral wall from the mouse cochlea.

Poster # 19 - (ANAT02)

Signaling Mechanisms that Regulate Resistance to Noise Induced Hearing Loss
O'neil Guthrie, PhD, Flagstaff, AZ

The cochlea of the 129S6/SvEvTac (abbreviated 129S) mice is resistant to the metabolic stress that underlies noise induced hearing loss (NIHL). The cell signaling mechanism that drives this resistance in not known. Uncovering this mechanism would be a significant break-through in the development of therapies that limit the severity of NIHL. The current experiments revealed that ataxia telangiectasia mutated (ATM), a master cell signaling kinase that regulates global DNA repair can also regulate the resistant phenotype of the 129S mice. A high affinity inhibitor to ATM was perfused into the cochlea which abolished the noise resistant phenotype (NRP) relative to control conditions. In Silico computations were then conducted to identify other kinases that were similar to ATM. Three mouse kinases with significant homology to ATM were identified. Two of these kinases also function to regulate global DNA repair. High affinity inhibitors were then used to inhibit each kinase which resulted in the abolition of the NRP. The third kinase had little or no role in regulating global DNA repair and high affinity inhibition of this kinase failed to abolish the NRP. These experiments demonstrated that cell signaling mechanisms that drive global DNA repair activity may regulate susceptibility to NIHL.

Poster # 20 - (ANAT03)

Silver Decreases P. aeruginosa Adherence in an In Vitro Model **T35 Research Trainee Poster**
Rachel King, BA, University Of Maryland, College Park, Department Of Hearing And Speech Sciences, Baltimore, MD
Wee-tin Kao, MD; Patricia Gagnon, MD; Richard Chole, MD, Washington University In St. Louis School Of Medicine, Department Of Otolaryngology, St. Louis, MO
Joseph Vogel, PhD, Washington University in St. Louis School of Medicine, Department of Molecular Microbiology, St. Louis, MO

Objective: Bacterial biofilm formation poses serious risks of infection to patients with biomedical implants, including those with tympanostamy tubes. Silver has long been known to exhibit anti-microbial effects, and is used frequently in the treatment of burn wounds. It has also been used in indwelling catheters and devices to decrease bacterial adherence and infection. In this study, we have applied a thin silver coating to the surface of glass slides to evaluate the effect of silver on bacterial adhesion. Study Design: To study the effect of silver coating on adhesion, glass slides were covered with silver using a physical vapor deposition method. PAO1, PA14 and 3 otopathogenic strains of P. aeruginosa were adhered to the surface of these silver coated slides. The number of adherent bacteria was counted and analyzed. Results: Silver coating resulted in decreased adherence in vitro for all tested strains of P. aeruginosa. Conclusion: We confirm the reports in literature that silver coating decreases adherance of P. aeruginosa, most likely due to the antimicrobial effects of silver.

Poster # 21 - (ANAT04)

Neuronal Correlates of the Detection of Modulated Tone in Modulated Noise **T35 Research Trainee Poster**

Samantha Hauser, BA; Ramnarayan Ramachandran, Vanderbilt University, Nashville, TN

Similarities and differences in stimulus characteristics influence perception of auditory objects embedded in streams of competing information. How these are implemented by neurons in the auditory pathway and how these responses relate to behavior remain unknown. We trained macaque monkeys to detect tones in noise, and manipulated the similarity of the tone and masker by varying amplitude modulation parameters. Modulations are present in everyday signals and are influential in object formation. Responses were measured from single units in the inferior colliculus (IC) of three monkeys while they detected the modulated tones in modulated noise. Modulation frequency of the noise was varied. Behavioral thresholds are highest when the target and distractor are at the same modulation frequency in phase and lower in all other conditions. Neuronal thresholds (based on response magnitude and on temporal patterns) were similar to behavioral thresholds for many units, but some units showed significantly different thresholds and trends as the modulation frequency changed. Preliminary data suggests that similar trends held for variation of modulation phase differences. These results suggest that rate and temporal information is available in the IC to segregate a target stimulus from the background.
Supported by an NIH NIDCD T35DC008763 Short Term Research Traineeship

OTOACOUSTIC EMISSIONS

Poster # 22 - (OAE01)

Comparison of DPOAE and SFOAE Suppression in Humans **Mentored Student Research Poster Award**

Emily Bosen, BS; Daniel Rasetshwane, PhD; Judy Kopun, MA; Stephen Neely, PhD, Boys Town National Research Hospital, Omaha, NE

The purpose of this study was to compare distortion product (DP) and stimulus frequency (SF) otoacoustic emission (OAE) suppression in the same ears. Emissions were measured in normal-hearing subjects. The probe frequency (fp for SFOAEs and f2 for DPOAEs) was selected for each subject to be the frequency with the largest emission within 100 Hz of 1000 kHz when the probe level was 30 dB SPL. Suppressor frequencies (fs) for both types of emissions ranged from 350 to 1410 Hz and levels ranged from 0 to 80 dB SPL in 5 dB steps. Growth of suppression for each fs and tuning-curve properties (i.e., high-frequency slope, tip-to-tail difference, and QERB) were compared between emission types. Although analyses are ongoing, preliminary results suggest that DPOAE have larger tip-to-tail difference and SFOAE STCs have steeper high frequency slopes.

Poster # 23 - (OAE02)

Multi-tone Suppression of Distortion-product Otoacoustic Emissions in Humans **T35 Research Trainee Poster**

Nicole Sieck, BS, The University Of Texas At Austin, Austin, TX
Daniel Rasetshwane, PhD; Judy Kopun, MA; Walt Jesteadt, PhD; Michael Gorga, PhD; Stephen Neely, PhD, Boys Town National Research Hospital, Omaha, NE

The purpose of this study was to investigate the combined effect of multiple suppressors. Distortion-product otoacoustic emission (DPOAE) measurements were made in 22 normal-hearing participants. Primary tones had fixed frequencies (f2 = 4000 Hz; f1 / f2 = 1.22) and a range of levels. Individual suppressor tones were at three frequencies (fs = 2828, 4100, 4300 Hz) and range of levels (-20 to 80 dB SPL). Decrement was defined as the attenuation in DPOAE level due to the presence of a suppressor. A measure of suppression called suppressive intensity was calculated by an equation previously shown to fit DPOAE suppression data. Suppressors were combined into pairs of two different frequencies. Suppressor pairs were presented at levels selected to have equal single-suppressor decrements. The suppressor pair with the smallest frequency ratio produced decrements that were consistent at all primary-tone levels with an additive-intensity model. The suppressor pair with the largest frequency ratio produced decrements at the highest level that were consistent with an additive-attenuation model. Other suppressor-pair conditions produced decrements that were intermediate between these two extremes. A hybrid model is proposed that describes the observed range of interaction when two suppressors are combined.

Poster # 24 - (OAE03)

Cochlear Mechanisms and Otoacoustic Emission Test Performance **Mentored Student Research Poster Award**

Nikki Go, AuD; Tiffany Johnson, PhD, University Of Kansas Medical Center, Kansas City, KS
Greta Stamper, PhD, Mayo Hearing Aid Clinic, Jacksonville, FL

It has been suggested that the interaction of two cochlear sources (i.e. nonlinear-distortion and coherent-reflection) may contribute to errors in clinical OAE measures (e.g., Shera, 2004). Here, we evaluate the influence of controlling source contribution on OAE test performance. Data were collected from 212 normal-hearing and mild-moderately hearing-impaired subjects who fell into two categories based on a DPOAE screening protocol: the uncertain-identification group (where errors were likely), and the certain-identification group (where errors were unlikely). DPOAE fine-structure patterns were recorded at intervals surrounding f2= 1, 2 and 4 kHz, with L2= 35, 45 and 55 dB SPL. Discrete Cosine Transform (DCT) was used to smooth fine structure, limiting source contribution to nonlinear-distortion. Reflection-source OAEs were also recorded using amplitude-modulated stimulus frequency OAEs (AM-SFOAE; Neely et al., 2005). Present data suggest that reducing the reflection-source contribution resulted in improved detection of hearing loss when f2=1 and 2 kHz, but not at 4 kHz, for a clinically feasible false-positive rate of 5%. These improvements were typically small, between 5 and 20%. The reflection-source AM-SFOAE test performance was never better than the best DPOAE conditions. [Work supported by the NIH-NIDCD R03 DC011367.]

Poster # 25 - (OAE04)

Otoacoustic Emissions in Infants: Normal, Sensorineural, and Conductive Hearing Loss **Mentored Student Research Poster Award**

Chelsea Blankenship, AuD; Lisa Hunter, PhD, Cincinnati Childrens Hospital Medical Center, Cincinnati, OH
Douglas Keefe, PhD; Denis Fitzpatrick, PhD, Boys Town National Research Hospital, Omaha, NE

Patrick Feeney, PhD, VA Portland Health Care System, National Center for Rehabilitative Auditory Research, Portland, OR

The primary purpose of this study was to characterize distortion product otoacoustic emission (DPOAE) level and signal to noise (SNR) values in a group of infants diagnosed with conductive (CHL) or sensorineural hearing loss (SNHL) by diagnostic Auditory Brainstem Response (ABR; Elsayed et al., 2015). DPOAE results from the CHL and SNHL groups will be compared to longitudinal normative data from newborns and infants under age 1 year (McCune et al., 2014). A total of 764 ears were included in the study. The normal hearing (NH) group included 705 ears of infants that passed the newborn hearing screening and had normal ABR thresholds. The hearing loss group included 49 ears diagnosed with a CHL and 10 ears diagnosed with a SNHL via ABR. Receiver operating characteristic (ROC) curves were constructed to determine the diagnostic utility of DPOAE levels to predict the presence of hearing loss at each test frequency. ROC curves demonstrate that test performance is frequency dependent, with the best performance seen in the high frequencies. Test frequencies below 2 kHz fail to differentiate infants with hearing loss. Additional analysis will be completed to determine appropriate cut-off points to distinguish between NH, CHL, and SNHL in newborns and infants.

Poster # 26 - (OAE05)

Improvements in Identifying Hearing Loss Using Transient Evoked Otoacoustic Emissions

Hammam AlMakadma, AuD; Beth Prieve, PhD, Syracuse University, Syracuse, NY

Transient-evoked otoacoustic emissions (TEOAEs) have been used for two decades as screening and diagnostic tests to identify hearing loss, yet there has been little development to optimize their effectiveness. Clinically, it is common to determine whether the TEOAE in a particular frequency band is present or absent based on a 6 dB signal-to-noise ratio (SNR) or a 70% reproducibility. The purpose of this project was to use univariate and multivariate models to determine optimal TEOAE characteristics for identifying and diagnosing hearing loss. The retrospective analysis included TEOAEs measured using the Biologic Scout system and audiometric data from 162 individuals (373 ears) ranging in age from 20 to 95 years. Receiver operator curves (ROC) were constructed for univariate and multivariate predictors of hearing status (i.e., normal vs. hearing-impaired) that included TEOAE reproducibility, TEOAE level and SNR at three audiometric frequencies. Results suggest that ROC using multivariate factors are superior at some frequencies to those for univariate factors. Hearing threshold criteria for determining whether an ear had normal hearing or hearing loss resulted in different ROC areas. Discussion will focus on whether TEOAEs that are present but low level can improve clinical protocols. [Supported by Gerber Auditory Research Fund, Syracuse University]

Poster # 27 - (OAE06)

Distortion-Product Otoacoustic Emissions for Monitoring Ototoxicity in Cystic Fibrosis Patients

Daniel Putterman, AuD; Patrick Feeney, PhD; Garnett McMillan, PhD, VA Portland Health Care System, Portland, OR
Angela Garinis, PhD, Oregon Health & Science University, Portland, OR
Douglas Keefe, PhD; Denis Fitzpatrick, PhD, Boys Town National Research Hospital, Omaha, NE
Lisa Hunter, PhD, Cincinnati Children's Hospital Medical Center, Cincinnati, OH

Distortion product otoacoustic emissions (DPOAEs; 0.841 to 8.0 kHz) and pure-tone thresholds (PTT; 0.25 to 16.0 kHz) were used for serial monitoring of auditory function in 96 patients (mean age= 26 yr.) with cystic fibrosis (CF) who received obligate aminoglycosides. DPOAEs were obtained using a commercial system with L1= 65 dB SPL and L2= 55 dB SPL, with a F1/F2 ratio of 1.22. The criterion for the presence of a DPOAE was signal-to-noise ratio (SNR). Receiver operating characteristic (ROC) analyses within the CF group demonstrated that DPOAEs possessed excellent ability to distinguish sensorineural hearing loss from normal hearing with an area under the ROC curve of 0.85 to 0.96 at each DPOAE frequency band. 90% reference limits for test-retest differences in DPOAE SNR were also obtained from 40 normal hearing control subjects (mean age = 30 yr.) to identify CF ears with abnormal changes in DPOAEs. Seven CF ears demonstrated persistent PTT shifts based on data from at least three valid test sessions. DPOAE SNR generally decreased in the same frequency region as the PTT shift for these ears. Individual DPOAE data for cases of persistent PTT shifts will be presented. Supported by NIH R01 DC010202.

ELECTROPHYSIOLOGY

Poster # 28 - (EP01)

Stimulus Parameter and Age Effects on the ABR in Adults **T35 Research Trainee Poster**
Jordan Racca, BA, The University Of Texas At Dallas, Ft Worth, TX
Linda Hood, PhD, Vanderbilt University, Nashville, TN

This study examined the combined effects of stimulus rate, frequency, and intensity on ABR latency and amplitude measures in both younger and older adults with normal hearing. Earlier studies in the Human Auditory Physiology Lab at Vanderbilt University found an increased Wave V latency shift from slow to fast stimulus rates only for low frequency, low intensity stimuli that was replicated using high-pass masking and increased stimulus rates. The present study was designed to further define effects of stimulus interactions in young adults with normal hearing and to compare younger and older age groups. In the first part of the study, intensity functions were completed for toneburst stimuli centered at 1, 2, and 3 kHz across three rates ranging from 29-156/s to better define frequency and intensity characteristics giving rise to the observed Wave V latency shift. Greater latency shifts from 29-78/s were seen for stimuli at and lower than 2 kHz and 45 dB nHL for the younger group. Greater latency shifts between 29-156/s occurred at all frequencies tested at various intensity levels in both age groups, with greater shifts in older listeners suggesting a potential sensitivity to auditory aging. [Supported by an NIH-NIDCD-T35DC008763 Short Term Research Traineeship.]

Poster # 29 - (EP02)

Age and Hearing Impairment Effects on FFR to Dynamic Stimuli **T35 Research Trainee Poster**
Jane Grabowski, MA, Towson University, Baltimore, MD
Curtis Billings, PhD; Michelle Molis, PhD; Sam Gordon; Melissa Frederick, AuD; Sean Kampel, AuD, National Center For Rehabilitative Auditory Research, Portland, OR

Synchronous neural firing and accurate phase-locking support the encoding of time-varying acoustic features of speech critical for speech discrimination. Evidence suggests that phase-locking is disrupted in older and hearing-impaired adults, which may help account for the frequently-reported perceptual deficits in those populations not otherwise accounted for by peripheral hearing sensitivity. The frequency-following response (FFR) has previously been utilized to index subcortical encoding in various populations. The current study examined differences in FFR quality between three listener groups: younger normally-hearing (YNH) (N=10, M=27.7, range=24-33), older normally-hearing (ONH) (N=10, M=59.7, range=51-66), and older hearing-impaired (OHI) (N=10, M=66.5, range=54-77) adults, as a function of sweep count in response to dynamic tonal stimuli. Three-thousand sweeps were collected in alternating polarity to a rising tonal stimulus 120 ms in length spanning two-thirds of an octave. FFR waveforms were averaged in increasing increments of 50 consecutive sweeps and were analyzed via cross-correlation analysis. Results reveal that FFR quality predictably increases as a function of sweep count in all three populations, but ONH and OHI adults require significantly more sweeps than YNH adults to achieve FFRs of similar quality, suggesting that there is some desynchronization in temporal information encoding in older individuals and individuals with hearing loss.

Poster # 30 - (EP03)

Onset-Offset N1-P2 Responses in Individuals with High-Frequency Sensorineural Hearing Loss
Mentored Student Research Poster Award
Jennifer Gonzalez, PhD, University Of Connecticut, Scottsdale, AZ
Frank Musiek, PhD, University Of Arizona, Tucson, AZ

Central auditory processing disorder (CAPD) is commonly described as difficulty hearing in background noise despite a normal audiogram. However, CAPD and sensorineural hearing loss (SNHL) are not mutually exclusive; rather, the two can occur together and can have different underlying mechanisms. Due to a lack of understanding of the effects of SNHL on central auditory function, the diagnosis of CAPD in individuals with SNHL remains difficult. This study examined the onset-offset N1-P2 auditory evoked response in two groups of individuals, one with normal hearing and one with high-frequency sensorineural hearing loss (HFSNHL), as a first step in evaluating whether SNHL could be distinguished from CAPD using this objective paradigm. Stimuli were presented in dB SL and consisted of broadband noise, 500 Hz-centered narrowband noise (region of normal hearing), and 4000 Hz-centered narrowband noise (region of hearing loss). Results are promising for the use of the onset-offset N1-P2 response evoked by broadband noise in distinguishing SNHL from central auditory dysfunction, as HFSNHL appeared to have little effect on the response at higher sensation levels. Several enhanced waveform components obtained using the narrowband noise stimuli suggest that homeostatic plasticity, or 'brain gain,' resulting from SNHL may have contributed to the results.

Poster # 31 - (EP04)

Perceptual and Neurophysiological Effects of Age-Related Hearing Loss and Amplification
Mentored Student Research Poster Award
Kate McClannahan, BA; Kristina Backer, PhD; Kelly Tremblay, PhD, University Of Washington, Seattle, WA

The purpose of this study was to examine the neural representation and use of sound in three groups of age-matched older adults (aged 55-75; n = 15 per group) with different hearing experiences: 1) Normal Hearing (NH), 2) Untreated age-related sensory-neural hearing loss (u-SNHL) without a history of hearing aid use, and 3) Treated sensory-neural hearing loss (t-SNHL) via regular hearing aid use. Participants completed two sessions: 1) Behavior: Audiometry, cognitive screening, quality of life questionnaires, nonverbal IQ test, speech recognition in quiet and noise, and tests of working memory capacity (both auditory and visual); 2) Electrophysiology: Evoked potentials (P1-N1-P2) were recorded in response to a speech syllable presented at different sound levels (equal sound pressure level (SPL) and equal sensation level (SL)). All three groups performed similarly on tests of working memory and nonverbal IQ, but differed on self-report measures. Both hearing loss groups indicated greater difficulty in daily listening situations (SSQ12), and the t-SNHL reported greater hearing handicap (HHIE) than the NH and u-SNHL groups. Neural measures showed significant morphology differences (latency and amplitude) between groups when the stimuli were presented at equal SPL; however, once audibility was accounted for (equal SL levels) these differences were not present, suggesting group differences were due to audibility, and not central changes secondary to auditory deprivation. Funded by NIH NIDCD F30 DC010297, T32-DC005361 and AAA Student Investigator Research Grant.

Poster # 32 - (EP05)

Auditory Event-Related Potentials to Speech in Informational and Energetic Masking **Mentored Student Research Poster Award**

Katharine Fitzharris; Ross Roeser, PhD, University Of Texas At Dallas, Dallas, TX

The most common complaint of individuals with hearing loss is their inability to understand speech in noisy environments; thus, speech-in-noise (SIN) has been an area of tremendous research. It has been established that a complex interaction of peripheral and central auditory systems underlies the ability to comprehend speech in degraded environments. Methodologically, however, behavioral and electrophysiological studies have been disparate: where behavioral and clinical testing establishes a variable signal-to-noise ratio (SNR) threshold based on an individual's performance, studies utilizing auditory event-related potentials (AERPs) tend to use fixed SNR values, resulting in variable performance. Both behavioral and AERP studies have illustrated the impact of stimulus effects on SIN performance, e.g., SNR and masker type. The purpose of this study was to use AERPs in order to evaluate the interactions between peripheral and central systems in the processing of syllable stimuli. Using behaviorally-established SNR levels (60%-correct, 100%-correct) and two types of background noise (speech-shaped noise, multitalker babble) in an oddball task, AERPs were recorded and analyzed relative to the peak amplitudes and latencies of the N1, P2, and P3. Results from 20 young adults indicate that when behavioral accuracy is controlled for, peripheral contributions (SNR) have the greatest impact on speech processing.

Poster # 33 - (EP06)

Effects of Amplification on Phase Locking to a Speech Syllable **Mentored Student Research Poster Award**

Calli Fodor, BS; Samira Anderson, PhD, University Of Maryland, College Park, MD

Older adults often have trouble adjusting to hearing aids when they start wearing them for the first time. There is little research about the effects of amplification on auditory evoked responses to speech stimuli during initial hearing aid use. The present study assesses the effects of first-time hearing aid amplification on subcortical and cortical phase locking to a speech signal in older adults. Unaided and aided frequency following responses and cortical responses to the stimulus [ga] were recorded in the sound field for three conditions: 65 dB SPL and 80 dB SPL in quiet, and 80 dB SPL in 4 talker babble (+10 signal-to-noise ratio). When comparing unaided and aided responses, increased phase locking at most harmonics, as well as an increase in the response amplitude were noted in the 65 dB SPL aided condition during the transition time region, which corresponds to the high frequency consonant. Similar improvements in phase locking were noted for the aided 65 dB SPL cortical response. No significant changes were noted in the other conditions. These results suggest that initial amplification improves neural encoding of the region of the speech signal that is most difficult to hear, the high frequency consonant vowel transition.

Poster # 34 - (EP07)

Informational Masking Effects on Neural Encoding of an Acoustic Change **Mentored Student Research Poster Award**

Christopher Niemczak, BS; Kathy Vander Werff, PhD, Syracuse University, Syracsue, NY

Recent investigations using cortical auditory evoked potentials have shown masker-dependent effects on sensory cortical processing of speech information (e.g. Bennett et al., 2012). Behaviorally, we know that informational masking, composed of speech, provides greater challenges to speech understanding than simple energetic masking (Helfer and Freyman, 2008). We used the acoustic change complex to a vowel change from /u-i/ recorded in normal-hearing young-adults under four conditions: quiet, continuous speech-shaped noise, 8-talker babble and 2-talker babble. These conditions represent increasing informational masking from continuous noise to babble, and as talker number decreases. Amplitude and latency results to stimulus onset generally showed decreasing amplitude and increasing latency of the N1-P2 from quiet to continuous noise to the babble conditions. However, mean amplitude of the two babble conditions were not significantly different ($p>0.05$). The P1-N1-P2 evoked by the acoustic change was smaller than the onset response. This response was reduced by all noise conditions and could not be reliably identified in babble conditions for most subjects. These results of continuous noise versus babble support the idea that the presence of informational masking, but not the amount of talkers, has a larger effect on the speech encoding at the level of the auditory cortex.

Poster # 35 - (EP08)

Neural Synchrony for Novelty Detection Predicts Speech Perception in Noise **Mentored Student Research Poster Award**

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

Auditory event-related potentials (ERPs) can help understand the neurophysiological processes underlying speech perception in noise, a listening situation that is difficult for many individuals. In the present study, ERPs were obtained from normal-hearing listeners during an active change-detection task. The experimental protocol employed a double-oddball paradigm involving the detection of a consonant

change and a vowel change. Two stimulus conditions were used to compare speech perception in quiet and in noise. Averaged ERP responses were analyzed to obtain P3 latency and amplitude measures, and time-frequency analysis was performed to examine the effect of noise on inter-trial phase coherence (ITPC) in selected oscillatory frequency bands. Additionally, behavioral phoneme-change detection and sentence recognition were evaluated to find potential neurophysiological correlates. Significant noise-induced changes were observed in the P3 response and its associated ITPC. Moreover, there were several significant brain-behavior correlations, suggesting that the novelty detection response and trial-by-trial neural synchrony measures are good predictors of behavioral performance across the quiet and noise listening conditions.

Poster # 36 - (EP09)

Auditory-Evoked Potentials and Speech-in-Noise Perception in Presbycusis **Mentored Student Research Poster Award**

So Eun Park, MS; Cynthia Fowler, PhD, University Wisconsin-Madison, Department Of Communication Sciences And Disorders, Madison, WI

The study examined the effects of aging and hearing loss on auditory neural coding and neural correlates of behavioral speech-in-noise (SIN) perceptual ability. Auditory evoked potentials (AEP) to speech /ba/ and tonebursts (500Hz, 2kHz) were recorded in three conditions (quiet, speech noise, babble) at the levels of 80-100 dB SPL, accompanied by noise (65 dB SPL). SIN perception was measured using Speech Perception in Noise (R-SPIN) test and low-predictability items were only scored and correlated with amplitudes and latencies of AEP components (Pa, N1, P2, N2). Three groups are formed: (1) five young normal-hearing adults (YNH), (2) six older normal hearing adults (ONH), and (3) six older adults with presbycusis (OHL). Different spectrotemporal cues of speech and nonspeech affects the morphological changes in AEPs for all groups. The greater amplitudes of Pa and N1 in ONH reflect the effects of aging (YNH vs. ONH), while more enhanced amplitudes of N1 and P2 in OHL reflect the effects of hearing loss (ONH vs. OHL). N2 latencies were remarkably delayed for both aged groups. Strong negative correlations were found between /ba/-evoked AEPs in babble and SPIN-LP scores for both aged groups. The findings contribute to determining the neural bases of central presbycusis.

AUDITORY PROCESSING

Poster # 37 - (AP01)

Testing Variables that Affect APD Test Outcomes

Maria Pomponio, AuD, Temple University School Of Medicine, Philadelphia, PA
Stephanie Nagle, PhD; Jennifer Smart, PhD, Towson University, Towson, MD
Shannon Palmer, PhD, Central Michigan University

The auditory processing abilities of 33 adults were evaluated using three tests of auditory processing disorder (APD). All participants were given each test in accordance with published guidelines, and with variances from standardized methodology. Results revealed significant effects of varying standardized procedures on test outcome. Based on these findings, it is imperative that audiologists administer tests of

APD in accordance with published guidelines in order to improve test reliability and reduce the controversy surrounding the assessment and diagnosis of APD.

Poster # 38 - (AP02)

The Audiologic Evaluation of the Multiple Sclerosis Patient **Mentored Student Research Poster Award**

Diane Cheek, BA; Renata Filippini, PhD; Frank Musiek, PhD, University Of Arizona - Speech, Language, And Hearing Sciences, Tucson, AZ

Affecting over two million people worldwide, multiple sclerosis (MS) leaves the central nervous system vulnerable to demyelinating lesions within its white matter. The central auditory nervous system (CANS) is not immune to these pathologic effects and functional listening deficits may occur well before the more overt neurologic symptoms appear. For example, over fifty-percent of MS patients report listening difficulties despite having normal audiometric thresholds. These listening difficulties could be associated with the presence of lesions to auditory areas of the brainstem or corpus callosum, two highly myelinated CANS structures important in auditory function. This literature review analyzed results of refereed studies involving ABR and Dichotic Listening (DL) in MS. A two-test ABR-DL protocol yielded greater sensitivity to MS lesions than either ABR-alone or DL-alone. The current results support the combined use of ABR and DL tests in the audiologic evaluation of the MS patient. This will place clinicians in a key position to determine whether perceived changes in functional listening in the already-diagnosed patient are a result of disease progression in the central nervous system.

Poster # 39 - (AP03)

Effects of Parkinson's Disease on Auditory Processing **T35 Research Trainee Poster**

Amy Riggins, BA, University Of Wisconsin - Madison, Madison, WI
Jay Vachhani, AuD; Sarah Theodoroff, PhD; Rachel Ellinger; Frederick Gallun, PhD; Robert Folmer, PhD, National Center For Rehabilitative Auditory Research, Portland, OR

This study assessed auditory processing abilities of 36 patients with Parkinson's Disease (PD) and 35 healthy age-matched control subjects. Participants were separated into four groups: younger healthy controls (average age 60.4 years), younger PD patients (average age 60.5 years), older healthy controls (average age 71.4 years), and older PD patients (average age 71.7 years). Assessments included conventional audiometry, central auditory processing (CAP) tests, electrophysiologic measurements, and questionnaires such as the Hearing Handicap Inventory for Adults (HHIA). Both study groups exhibited moderate high-frequency sensorineural hearing loss and did not differ significantly on most CAP assessments. One exception was superior performance by the young control group on Spatial Release from Masking (SRM) tests. While there were no significant differences in auditory brainstem response (ABR) latencies or amplitudes between the study groups, there were significant differences between groups in long latency evoked potentials for the P300 and N200 components in response to tonal and speech stimuli ($p<0.05$). These differences in higher-level processing of auditory stimuli might be early indicators of cognitive decline for the PD group. Study supported by the U.S. Department of Veterans Affairs RR&D Service and the National Center for Rehabilitative Auditory Research at Portland VA Health Care System.

Poster # 40 - (AP04)

MLD with Digits (MLDD): Development and Normative Data
Kathryn Schwartz, PhD, Old Dominion University, Norfolk, VA
Dania Rishiq, PhD; Greta Stamper, PhD; David Zapala, PhD, Mayo Clinic Florida, Jacksonville, FL
Samantha Kleindienst, PhD, Mayo Clinic Arizona, Scottsdale, AZ

The capacity to understand speech in background noise is influenced by hearing and linguistic ability. Important variables that differ across existing tests which assess speech understanding in noise include the linguistic complexity of the target stimuli, the type of background noise, and the presentation mode. The Masking Level Difference with Digits (MLDD) is a new test created by Mayo Clinic Florida to address the need for a speech in noise test that is linguistically primitive (does not require high-level linguistic processing) and measures the release from masking effect. This effect is the ability to hear a signal in noise better when the noise is presented to both ears (diotic) compared to only one ear (monotic) and occurs at the level of the auditory nerve and lower brainstem. The MLDD test is designed to offer two advantages: (1) sensitivity to end organ, CN VIII, and brainstem-level diseases; and (2) measure precursor abilities necessary to complete higher-order speech in noise tasks. We will present normative data from 18 normal-hearing young individuals (mean age 23 yr), and 60 normal-hearing older individuals (mean age 59 yr). This poster will review the development and standardization of the MLDD for potential use in diagnostic clinical settings.

Poster # 41 - (AP05)

Dichotic Digit Test Performance Across the Ages
Mary E. Fischer, PhD; Karen J. Cruickshanks, PhD; David M. Nondahl, MS; Barbara Ek Klein, MD; Ronald Klein, MD; Ted S. Tweed, MS, University Of Wisconsin-Madison, Madison, WI

A Dichotic Digit Test (DDT) under free- and directed-recall conditions was performed in the Epidemiology of Hearing Loss Study (2008-2010) and Beaver Dam Offspring Study (2010-2013). Twenty-five sets of triple-digit pairs were presented at 70 dB HL. Audiometric hearing thresholds were measured. There were 3655 participants (mean age=61.1 years; range=21-100 years). The average free-recall score was 76.7% and older age, male sex, and less education were significantly ($p < 0.0001$) associated with poorer performance. Participants with hearing loss had significantly ($p < 0.0001$) lower age-sex adjusted scores than participants without hearing loss [mild loss: -3.6 digits (2.4%); moderate or marked loss: -12.0 digits (8.0%)]. For directed-recall, 69% of the participants had a perfect score and 15.5% missed only 1 digit. Poorer directed-recall scores were related to older age, less education, and moderate or marked hearing loss ($p < 0.0001$). Adjusting for age, sex, education, and hearing loss, participants with cognitive impairment had lower mean scores [free-recall 12.5 digits (8.3%) lower and directed-recall 5.8 digits (7.8%) lower, (both $p < 0.0001$)] than participants without cognitive impairment. Substantial variation remained in free-recall DDT scores that was not explained by age, sex, education, hearing loss, and cognitive impairment.

AUDIOLOGY / OTOLOGY

Poster # 42 - (AO01)

Diabetic Retinopathy and Auditory Dysfunction in a Veteran Cohort **T35 Research Trainee Poster**

Megan Eitel, BS, Montclair State University, Wayne, NJ
Don Austin, MD; Dawn Konrad-Martin, PhD; Kelly Reavis, MS; Jane Gordon, MS; Daniel McDermott, MS; Marilyn Dille, PhD, National Center For Rehabilitative And Auditory Research (NCRAR), Portland, OR
Weon Jun, Portland VA Medical Center, Portland, OR

Objective: Developing diabetic retinopathy is dependent on metabolic control and/or disease severity. Research suggests that diabetes can cause peripheral and central abnormalities in the auditory system. This study aims to determine the relationship between auditory deficit and retinopathy. Study Design: A prospective cross sectional study comparing auditory dysfunction and presence of retinopathy in Veterans diagnosed with diabetes mellitus type 2 (DM2). Methods: Participants were 62 Veterans with DM2. Pure tone audiometry and retinal scans completed between 01/01/2011 and 12/31/2014. Retinopathy scans taken from closest corresponding time point to the hearing test. The worse ear, based on clinical PTA, was chosen for analysis. Threshold measures of 250 Hz, the clinical pure tone average (PTA), a high frequency PTA, and ABR wave I latency and amplitude values were compared with retinopathy scores. Results: Preliminary analysis revealed a significant association between presence of retinopathy and hearing loss at 250 Hz. Hearing impairment observed in higher percentage of participants with retinopathy, as opposed to participants without retinopathy. Conclusions: Retinopathy, a marker of microvascular disease, is analyzed for its relationship with hearing loss and ABR wave I changes. Hearing loss in diabetes may be more prevalent among individuals with retinopathy possibly attributed to microvascular changes.

Poster # 43 - (AO02)

Automated Forced-Choice Word-Recognition Tests

Robert Margolis, PhD; George Saly, Audiology Incorporated, Arden Hills, MN
Heather Gilbert, University Of Minnesota Dept Of Otolaryngology, Minneapolis, MN
Brandon Madsen, AuD, National Center for Rehabilitative Auditory Research, Portland, OR
Richard Wilson, PhD, Arizona State University, Tempe, AZ

Using a forced choice response task, automated speech-recognition tests were constructed and evaluated with ten normal-hearing listeners and twenty listeners with sensorineural hearing loss. Speech-recognition thresholds were measured with CID W-1 recordings of spondaic words in a four-interval forced-choice paradigm. Word presentation levels converged on the 50% point of the recognition-performance function (SRT). SRTs were compared to pure-tone averages obtained by automated audiometry. Word-recognition tests were conducted with recorded NU-6 monosyllabic words (VA recordings) at five presentation levels using closed-set and open-set responses. Because chance performance and use of context make the closed-set task easier than the open-set task, closed-set scores were significantly higher than open-set scores for normal and hearing-impaired listeners. The results permit a determination of the presentation levels for open- and closed-set tests that produce equivalent scores for listeners with normal hearing. These levels were used to determine if the performance by individual impaired listeners was poorer than for normal-hearing listeners.

Poster # 44 - (AO03)

Prognostic Value of the Threshold Equalizing Noise Test in Patients with Sudden Sensorineural Hearing Loss

Jungmin Ahn, MD; Ji Eun Choi; Il Joon Moon, PhD; Won-ho Chung, PhD; Yang-Sun Cho, PhD; Sung Hwa Hong, PhD, Samsung Medical Center, Department of Otorhinolaryngology - Head and Neck Surgery, Samsung Medical Center, Sungkyunkwan University School of Medicine, 50 Irwon-dong, Gangnam-gu

The aim of this study was to investigate the prognostic value of the threshold-equalizing noise (TEN)test in predicting hearing recovery in patients with SSNHL. One hundred and one patients who had experienced SSNHL on the both side were enrolled. We performed the TEN test and pure tone audiometry(PTA) for each participant. The PTA was calculated to compare the hearing change between patient with and without dead regions(DRs) which detected by TEN test. When we divided two groups according to the presence of DRs, 82 ears belonged to the DR (-) group, 30 ears belonged to the DR (+) group. Initial average pure-tone thresholds were 68.4-1.4 dB and 67.3-3.4 dB in patients without DRs and with DRs. However, initial word recognition score(WRS) were significantly poorer in patients with DRs than those without DRs.(p=0.037). When compared the change of pure tone thresholds between the two groups, there was difference between the two groups. DRs are associated with poor hearing recovery and poor speech intelligibility in patients with SSNHL. Therefore, the TEN test appears to be a reliable tool for the prediction of recovery in patients with SSNHL.

Poster # 45 - (AO04)

Use of Sentence Cues Based on Confidence During Word-Recognition Tests

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During clinical word-recognition tests, writedown-talkback errors dramatically decrease when sentences that contain the target word are used in a meaningful context, but this method is time consuming (Han et. al., 2014). The purpose of this study is to assess the effectiveness of sentences with contextual cues based on a tester's confidence. Participants with simulated hearing loss (Low pass filtered at 1000 Hz) judged whether persons in videos repeated words correctly and assigned a number regarding the confidence with which they made decisions (1: not very sure - 5: very sure) either in an auditory only (AO) or auditory visual (AV) condition. About 40% of the test words (250 words) were scored again using sentence cues created by persons in the videos, and confidence about each decision was also collected. All of the video-taped oral responses were obtained at -4 dB SNR for approximately 50% performance. The use of sentence cues based on confidence reduced test time approximately 80% with a scoring accuracy of 99 % in an AV condition. This result was also observed in two participants with cochlear implants. In the AO condition, however, performance was too poor for the sentence strategy to help.

Poster # 46 - (AO05)

Auditory Phenotype of NGLY1-CDDG

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Carlos Ferreira, MD; Donna Krasnewich, MD; William Gahl, MD; Lam Christina, MD; Lynne Wolfe, NHGRI/NIH, Bethesda, MD

NGLY1-CDDG is the first congenital disorder of de-glycosylation, a rare inborn error of metabolism first described to cause human disease in 2012. Here, we set out to determine if and how the auditory system is involved, and develop an understanding of the role of this enzyme in the auditory system. Methods: We evaluated eleven patients (2-21 years) with NGLY1-CDDG and confirmed biallelic NGLY1 mutations who were enrolled in a prospective natural history protocol at the NIH. Audiologic tests included pure-tone thresholds, tympanometry, DPOAE and ABR. Results: Pure-tone thresholds could be established in only three patients and all had normal hearing sensitivity. Tympanometry provided no evidence of middle ear dysfunction. Cochlear integrity (i.e., present DPOAE and/or cochlear microphonic) was intact bilaterally for 10 patients and unilaterally for one patient. Wave I of the ABR was present bilaterally for six patients and unilaterally for one. Nine subjects had delayed, dysynchronous and/or immeasurable transmission through the auditory brainstem. Severity of abnormalities in both eighth nerve and brainstem ABR components worsened with increasing age. Discussion: The auditory pathway through the cochlea was largely intact, however, patients with NGLY1-CDDG can have poor auditory neural synchrony and degradation of the auditory signal through the brainstem.

SPEECH PERCEPTION

Poster # 47 - (SPAD01)

Band-Importance Functions of Clear Speech and Conversational Speech **Mentored Student Research Poster Award**

Pitchulee Uayporn, BS; Catherine Palmer, PhD, University Of Pittsburgh, Pittsburgh, PA

The literature demonstrates acoustic differences between clear speech (i.e., speech that is deliberately clearly spoken) and conversational speech (i.e., speech that individuals speak in their daily life). Most speech materials used in audiology research and clinical practice are read-speech material which is often referred to as clear speech. Materials may consist of single words and in these cases the significance of clearly spoken material versus a conversational presentation will not be particularly relevant. In sentence length or longer materials, the difference between clear speech and conversational speech will be relevant and may impact research findings and clinical recommendations. The vast majority of studies examining speech intelligibility have used clear speech as the material of interest. Our goal is to gain further understanding of how information in clear and conversational speech signals are spread among the various frequency bands of the distinct spectra. In this study, the influence of speech materials (clear or conversational speech) on band-importance functions (BIFs) was investigated using a compound approach for establishing BIFs. As a result, BIFs for conversational speech is different from that of clear speech in terms of shapes and weights suggesting that frequency bands of the particular materials contribute differently in speech understanding.

Poster # 48 - (SPAD02)

Spatial Release from Masking: Effects of Simulated Unilateral Hearing Loss **Mentored Student Research Poster Award**

Nicole Corbin, AuD; Emily Buss, PhD, The University Of North Carolina At Chapel Hill, Chapel Hill, NC
Lori Leibold, PhD, 3Center for Hearing Research, Boys Town National Research Hospital, Omaha, NE

This study assessed the impact of simulated unilateral hearing loss (simUHL) on children's ability to benefit from spatial separation of the target and masker, an effect referred to as spatial release from masking (SRM). Children and adults with normal hearing completed a sentence recognition task in the presence of a masker that was either two-talker speech or speech-shaped noise. The target was always presented from 0 degrees azimuth, and the masker was presented from either 0, +90, or -90 degrees azimuth. Testing was completed both with and without a moderate simUHL, created through the use of a foam earplug and supra-aural earmuff. When the masker was presented contralateral to the simUHL, thresholds were elevated relative to the co-located condition for both maskers. When the masker was presented ipsilateral to the simUHL, SRM was reduced relative to the baseline (normal bilateral hearing) condition for the two-talker masker. This pattern of results was observed for both children and adults, although children performed more poorly overall. These findings suggest that competing two-talker speech reveals listening difficulties in the simUHL conditions that the speech-shaped noise does not.

Poster # 49 - (SPAD03)

Recognition of Interrupted Words by Listeners with Sensorineural Hearing Loss **Mentored Student Research Poster Award**

Kadie Sharrett, BS, East Tennessee State University, Bristol, TN

Two recent studies have shown that the temporal locations of interruption patterns within words have a substantial influence on word-recognition performance. An interruption paradigm (10 ips, 50% duty cycle) using 10 sequential interruption patterns synchronized to word onset was applied to 70 monosyllabic words and studied on young adults with normal hearing (Hamm & Wilson, AAS, 2015). Two recognition patterns emerged for the words across the 10 onset conditions, flat and U-shaped. The current study replicated that study on 24 older adults with sensorineural hearing loss; an uninterrupted-word condition was added. Two sessions were required. Recognition performance on the 70 words uninterrupted was 91.0% with overall performance on the 10 interruption conditions 63.2% (range, 57.9%-69.3%) compared to 80.4% (range, 73.0%-87.7%) obtained earlier on the young adults. The best performances were at the extremes of the onset conditions and no dominant recognition patterns emerged. Comparing the two studies, most subjects and words had poorer performances with the older subjects. The diversity of recognition performances by the older listeners on the 10 interruption conditions with each of the 70 words supports the notion that the term hearing loss is inclusive of processes well beyond the filtering produced by end-organ sensitivity deficits.

Poster # 50 - (SPAD04)

Effects of Audio-Visual Distractions in Older and Younger Listeners **Mentored Student Research Poster Award**

Mary Barrett, BA, Beltsville, MD

Real-world listening situations are characterized by rapid and unpredictable changes in the target talker, background noise, and visual distractions. Multiple competing audio-visual (AV) talkers, in addition to variations in the identity and position of the target talker, may cause significant declines in speech recognition. Aside from talker variability and visual distraction from multiple talkers, every day listening situations are also saturated with non-speech related high visual distractions, which can cause the listener to miss the utterance spoken in the group conversation. The present study assesses speech recognition performance in younger and older normal hearing listeners, as well as older hearing-impaired listeners, using the AV modality in three types of situations: increase in talker variability, decrease in talker predictability, and the presence of high visual distractions. Results tentatively indicate that age and hearing-impairment may influence speech recognition when AV distractions are present, with younger normal hearing listeners outperforming older normal hearing listeners, and older normal hearing listeners outperforming older hearing-impaired listeners. The results suggest that older listeners, especially older hearing-impaired listeners, are at a disadvantage for understanding speech in the presence of high-distraction competing AV stimuli.

Poster # 51 - (SPAD05)

Adaptation to Foreign-Accented Speech: Influence of Aging and Hearing Loss **Mentored Student Research Poster Award**

Rebecca Bieber, BS; Sandra Gordon-Salant, PhD, University Of Maryland College Park, College Park, MD

For native English listeners, some non-native speakers can prove challenging to understand due to their accented speech. Prior work has shown that exposure to numerous foreign accents may lead to generalization of adaptation to accented speech. Benefits of exposure training have been shown for young, normal hearing listeners, but the benefits of this type of training have not been evaluated for older listeners. This proposal outlines an experiment which furthers the investigation of adaptation to accented speech through a training paradigm. Participants include young listeners with normal hearing, older listeners with normal hearing, and older listeners with hearing loss. Training consists of exposure to multiple accented speakers with various foreign accents. Concurrently, participants complete a secondary visual probe task. The results of this task, as well as of cognitive measures, allow for estimation of cognitive effort and of the relationship between speech recognition performance and cognitive resources. Results indicate a mild improvement in speech perception performance following training, and absence of long-term retention of benefit. Older listeners do not appear to benefit as much as younger listeners from exposure to systematic variation in foreign accented speech.

Poster # 52 - (SPAD06)

The Effects of Priming on False Hearing **T35 Research Trainee Poster**

Angela Yung, BS; Mitchell Sommers, PhD, Washington University In St. Louis, St. Louis, MO

This study investigated the effects of priming on performance and confidence levels in cases of false hearing. False hearing occurs when an individual reports 'sink' as the last word in the sentence "The plumber fixed a drink". Results were compared among older and younger adults. Each of the subjects were presented with three types of SPIN sentences: low predictability (LP) sentences, high predictability (HP) congruent sentences, and incongruent sentences. The task was to repeat the last word of each

sentence that was presented in background noise. SNR for the noise was sent to produce approximately 50% correct for each individual in the baseline condition. Some of the incongruent words were primed while others were not. Results showed no improvement of the amount of hits with priming for both older and younger adults. However, there was an effect of priming on the false alarm rates for the incongruent sentences. For both older and younger adults, there was a lower false alarm rate for the primed words than for the non-primed words in the incongruent trials. Confidence rating was also higher for primed words than non-primed words for the incongruent trials Results are discussed within a dual basis of responding framework.

Poster # 53 - (SPAD07)

Comparing Behavioral Measures of Listening Effort Across the Lifespan **Mentored Student Research Poster Award**

Kristi Ward, BS; Jing Shen, PhD; Pamela Souza, PhD; Tina Grieco-Calub, PhD, Northwestern University, Evanston, IL

Listening effort (LE) refers to the allocation of cognitive resources for speech perception. Behavioral methods commonly used to quantify LE include verbal response time (VRT) and dual-task paradigms (DTP). The present study aimed to address two questions regarding these measures: (1) whether VRT and DTP similarly capture changes in cognitive resource allocation during effortful listening and (2) how changes in cognitive function across the lifespan influence VRT and performance on DTP. Children (8-12 years), young adults (18-25 years), and older adults (55-82 years) performed a DTP consisting of a primary degraded speech recognition task and a secondary visual monitoring task in four noise-band vocoded conditions (i.e., unprocessed, 8-ch, 6-ch, 4-ch). LE was quantified by (1) VRT during the speech recognition task when performed in isolation and (2) changes in accuracy and reaction time on the secondary task when performed in isolation versus when performed simultaneously with the primary task. LE, as quantified with VRT and secondary-task accuracy but not with secondary-task reaction time, increased with spectral degradation: children and older adults expended more LE than young adults as the task became more difficult. Implications of quantifying LE across the lifespan using VRT and DTP will be discussed. [Supported by NIH]

Poster # 54 - (SPAD08)

Sound Quality Impacts the Speed and Effort of Sentence Perception

Matthew Winn, PhD, University Of Washington, Seattle, WA

Speech communication involves not only the recognition of words, but also processing and prediction resulting from those words. This study explored the question of whether prediction guided by semantic context reduces physiological listening effort, and whether this process is as quick and effective in people who use cochlear implants (CIs). To test this research question, pupil dilation was used as a time-varying index of effort during sentence perception by CI users and listeners with normal hearing. NH listeners also heard spectrally degraded vocoded versions of the stimuli, which consisted of high-and low-context sentences. For NH listeners, context resulted in effort reduction for normal speech; effort was reduced immediately during stimulus perception. For degraded stimuli, this effect was not observed until after the stimulus was over, suggesting that listeners normally process and take benefit from context in real time,

but poor signal quality delays that process. For CI listeners, effort reduction from context was generally not as early or as large as that for NH listeners. These effects all persisted even when intelligibility was perfect, suggesting that word and sentence recognition scores could mask difficulties in functional language use, like timing and prediction in speech comprehension.

Poster # 55 - (SPAD09)

Vocabulary Facilitates Speech Perception in Children with Hearing Aids **T35 Research Trainee Poster**

Kelsey Klein, BA; Elizabeth Walker, PhD, University Of Iowa, Iowa City, IA
Benjamin Kirby, PhD; Meredith Spratford, AuD; Ryan McCreery, PhD, Boys Town National Research Hospital, Omaha, NE

We examined the potential facilitative effect of vocabulary on speech perception in children who are hard of hearing (CHH) and children with normal hearing (CNH). Participants included two groups of five- to 12-year-olds: one group of 25 CNH and one group of 24 CHH. Groups were matched according to age, vocabulary, articulation, and visuospatial working memory. The experimental speech perception task included six conditions: four word recognition conditions varying on age of acquisition and lexical frequency, and two nonword repetition conditions varying on phonotactic probability. Participants repeated each monosyllabic stimulus in the presence of varying noise levels. Performance in each condition was measured by the signal to noise ratio at which the child could accurately repeat 50% of the stimuli (SNR-50). A mixed model showed an interaction effect between expressive vocabulary and age of acquisition on word recognition SNR-50, indicating that vocabulary was more facilitative of recognition of late-acquired words than early-acquired words. Aided audibility and amount of hearing aid use did not have an effect on SNR-50 in CHH. Findings suggest that vocabulary facilitates speech perception similarly in both CHH and CNH. Even after controlling for language and working memory abilities, CHH showed overall poorer speech perception than CNH.

Poster # 56 - (SPAD10)

Prosodic Contrast for Target Words in Child-Directed Speech in Noise **T35 Research Trainee Poster**

Julia Garrick, BS, University Of Cincinnati Department Of Communication Sciences And Disorders, Cincinnati, OH
Christine Hammans; Timothy Vallier, MA; Nicholas Smith, PhD, Boys Town National Research Hospital Perceptual Development Laboratory, Omaha, NE
Bob Mcmurray, PhD, University of Iowa Department of Psychological & Brain Sciences, Iowa City, IA

Mothers adapt their speech in several ways when talking to young children, and it is thought that these adaptations may serve to enhance speech clarity and contribute to speech and language development. This study examined mothers' speech to 3- to 5-year-old children in an interactive speech perception task. Mothers instructed children or adults to find pictures of target words on a touch screen (e.g., "Find pig.") Our analysis examines differences in the suprasegmental properties (i.e., pitch and intensity) between informative target words (matching the picture) and redundant carrier phrases (i.e., "Find"). Our results show that mothers do not uniformly enhance the intensity and pitch properties of their child-

directed speech, but rather they selectively increase the level and variability of these properties in target words relative to carrier phrases. This increased prosodic contrast may reflect mothers' sensitivity to the perceptual and cognitive needs of their children, as it may highlight important elements in their speech to children.

Poster # 57 - (SPAD11)

Voice Emotion Recognition by Children With Mild to Moderate Hearing Loss **T35 Research Trainee Poster**

Shauntelle Cannon, BA, University Of North Carolina At Chapel Hill, Carrboro, NC
Monita Chatterjee, PhD, Boys Town National Research Hospital, Omaha, NE

Emotion communication is important in children's social development. Here, we studied voice emotion recognition by school-aged children (6-18 years of age) with mild to moderate hearing loss (MMHL) and with normal hearing (NH). A group of NH adults was also tested. Stimuli comprised sentences spoken in one of five emotions (angry, happy, sad, neutral and scared), either in a child-directed or in an adult-directed manner. We hypothesized that the children with MMHL would be comparable to their NH peers when tested with child-directed materials but would show significant deficits when tested with adult-directed materials. The task was a single-interval, five-alternative forced-choice paradigm, in which the participants heard each sentence in turn and indicated which of the five emotions was associated with that sentence. Results showed significant effects of age and test materials (better performance with child-directed materials). Contrary to our hypothesis, no significant differences were observed between the two groups of children in either emotion recognition (percent correct) or in reaction time, with either child- or adult-directed materials. Alongside age, vocabulary was found to be a significant predictor of performance. We conclude that children with MMHL do not have significant deficits in voice emotion recognition compared to their NH peers.

Poster # 58 - (SPAD12)

Does Sentence Predictability Influence Word Identification in School-Age Children?

David Kessler; Elizabeth Walker, PhD, University Of Iowa, Iowa City, IA
Meredith Spratford, AuD, Boys Town National Research Hospital Center for Childhood Deafness, Omaha, NE
Jacob Oleson, PhD, University of Iowa, Biostatistics, College of Public Health, Iowa City, IA
Ryan McCreery, PhD, Boys Town National Research Hospital, Omaha, NE

We compared performance between children who are hard of hearing (CHH) and children with normal hearing (CNH) on a gated speech perception task. 41 CHH and 24 CNH, in first or third grades, participated. Stimuli were sentences with high and low semantic predictability with the gated target word presented at the end of each sentence. Each target word was gated in 50 ms increments starting 0 ms from the onset of the word. Percentage of gates heard at the isolation point (first correct response) and acceptance point (two sequentially-correct responses) were calculated. Analysis of variance was used to analyze main effects of age, sentence predictability, and hearing status, as well as interactions between these factors. Regression analysis was used to determine how specific factors (i.e., aided audibility, vocabulary, grammar, and complex working memory) influenced ability to use sentence

predictability to facilitate word identification. It is predicted that 1) CNH will require less gates than CHH to identify target words, 2) CNH and CHH will benefit from semantic predictability to identify target words, and 3) aided audibility will moderate the relationship between cognitive skills and ability to use sentence predictability when identifying target words for CHH. Work supported by NIDCD.

PSYCHOACOUSTICS

Poster # 59 - (PSY01)

Behavioral and Electrophysiological Measures of Partially Filled Gap Detection Performance **Mentored Student Research Poster Award**

Julianne M. Ceruti, PhD, University Of Connecticut, Storrs, CT
Leslie R. Bernstein, PhD, University Of Connecticut Health Center, Farmington, CT
Frank E. Musiek, PhD, University of Arizona, Tucson, AZ

Objective: The purpose of this study was to evaluate a new clinical assessment of temporal resolution, the Decrement in Noise Test (DeNT). This clinically-oriented partially-filled gap detection procedure was compared to a 'gold-standard' method as well as an electrophysiological procedure. Design: The DeNT consisted of decrements of varying durations and depths (5 depths X 10 durations X 6 repetitions) randomly placed within 150 noise trials. Results & Discussion: The DeNT was administered to 35 normal-hearing female college students. It took approximately 20 minutes per ear to administer. Using a hit-rate based threshold criterion, decrement duration thresholds were 5.8 ms, 6.6 ms and 10.6 ms for 100%, 75% and 50% decrements, respectively. Thresholds derived using d- were reduced by half relative to those derived from hit-rate alone. This suggests that measures based on hit-rate (without consideration of false alarm rate) cannot discriminate differences in sensitivity from bias. Electrophysiological gap detection demonstrated a trend of increased N1-P2 amplitude and a significantly larger signal-to-noise ratio as the decrement magnitude is increased. Conclusions: The DeNT procedure can be used to evaluate temporal resolution. Future studies will evaluate the validity and the sensitivity of the DeNT to lesions of the central auditory nervous system.

Poster # 60 - (PSY02)

Effect of Amplification on the Contribution of Specific Frequency Bands to Loudness **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 aimed to quantify the effects of hearing aid amplification on the contribution of different frequency bands to loudness perception. Eight subjects with sensorineural hearing loss completed a two-interval loudness judgement task in aided and unaided conditions. During a trial, two stimuli composed of seven noise bands were randomly picked from a list containing 500 unique files and presented in succession. Subjects were asked to pick the louder of the two noises. The stimuli were created by randomly roving the level of each of the seven bands plus or minus 6 dB from a base level of 51 dB SPL. The aided stimuli were created on an individual subject basis by processing the original stimuli through a computer program designed to amplify signals according to DSL 5.0 adult prescription targets. Multiple

regression analysis was used to obtain perceptual weights, a measure indicating the relative contribution of individual frequency bands to overall loudness. Results indicated a substantial difference in perceptual weights between the aided and unaided conditions. Specifically, amplification caused a relative increase in the contribution of high frequency bands to loudness, but a significant decrease in the contribution of low frequency bands to loudness. [Work supported by NIH]

Poster # 61 - (PSY03)

The Chase: Perception of Animacy in the Hearing Realm **T35 Research Trainee Poster**
Miriam Glicksberg, BA; Daniel Ashmead, PhD, Vanderbilt University, Nashville, TN

The perception of animacy based on the motion paths of multiple objects has been studied in vision, with links to the social psychology of attributions. The present study investigated auditory perception of chasing. Motion paths of two distinct sounds, falcon and cicada, were simulated in an anechoic chamber. Trials contained two intervals, one with a falcon-cicada chase and the other with uncorrelated motion of falcon and cicada, and the listener indicated which contained chasing. Experiment 1 explored the effect of lag time at which the chaser tracked the target (0 or 1 s). Experiment 2 controlled for a confound by eliminating relative proximity of sound sources at the endpoints as a cue. In Experiment 1, threshold for chase events corresponded to "loose" chasing, suggesting that auditory perception of chasing is robust. Performance was significantly better with a chase time lag of 0 s, indicating that motion paths are best compared within a short time. Experiment 2 showed that performance was significantly better when endpoint proximity was an available cue, but that the task could be performed well even when "pure motion" was the only cue. This study was supported by an NIH NIDCD T35DC008763 Short Term Research Traineeship.

Poster # 62 - (PSY04)

Evaluation of the Hypersound® Audio System in an Anechoic Environment
Shaum Bhagat, PhD, School Of Communication Sciences And Disorders, Memphis, TN
Brian Taylor, AuD, Senior Director, Clinical Affairs, Turtle Beach Corporation, San Diego, CA

The Hypersound® audio system uses ultrasonic technology to create sound in the air. Unlike conventional audio speakers, which create audio at the surface of a loudspeaker, Hypersound® transmits a narrow beam of sound, which focuses the incident sound waves in a direct path to the listener. Recently, Hypersound® became commercially available as a home audio device for individuals with hearing loss. In this study, the Hypersound® emitters were evaluated in an anechoic chamber. Subjects were placed in positions in the path of the Hypersound® narrow beam and just outside the path of the narrow beam. A speech sample was projected from the Hypersound® emitters to the location of the subjects. Comparisons of ear-level probe microphone measurements in subjects placed at the various positions were made. The results of this study provided for the quantification of sound levels at the ear for subjects positioned inside and outside of the beam. The findings of this study, including the implications for speech intelligibility, will be discussed.

Poster # 63 - (PSY05)

Amplitude-Modulated Forward Masking in Listeners with Normal and Impaired Hearing
Adam Svec, PhD, Starkey Hearing Technologies, Eden Prairie, MN
Magdalena Wojtczak, PhD; Peggy Nelson, PhD, University Of Minnesota, Minneapolis, MN

In a previous study (Svec et al., 2015b), excess forward masking due to inherent masker envelope fluctuations was larger for listeners with hearing loss (HI) than for those with normal hearing (NH) at long masker-probe delays, suggesting the masking effects from inherent envelope fluctuations persist to a greater degree and duration in regions of hearing loss. Amplitude-modulated (AM) forward masking may be contributing to the observed differences between forward maskers with maximal or minimal envelope fluctuations. For this reason, the current study measured AM forward masking for NH and HI listeners at 4000 and 1000 Hz, using continuous and non-continuous (gated) masker and signal carriers. A low-fluctuation noise (LFN; Hartmann and Pumplin, 1988) carrier was used for the 'continuous carrier' conditions, and an unmodulated LFN masker, Gaussian noise (GN) masker, and an AM LFN masker were included for the gated-carrier conditions. In line with predictions, an unmodulated GN masker yielded more masking than an unmodulated LFN, suggesting that inherent masker envelope fluctuations contributed to AM forward masking for both listener groups. Contrary to predictions, there were no differences for AM forward masked thresholds between NH and HI listeners, suggesting little effect of hearing loss on recovery from AM forward masking.

Poster # 64 - (PSY06)

Sources of Discrepancy Between Loudness Perception and Model Predictions
Tzu-Ling J Yu, MS; Robert S Schlauch, PhD; Heekyung J Han, MS; Edward Carney, PhD, Department Of Speech-language-hearing Sciences, University Of Minnesota, Minneapolis, MN

Schlauch et al. (2014) found that a static model of loudness overestimates pure-tone-average/spondee-threshold differences in functional hearing loss. To explore this discrepancy, loudness was measured under earphones and in a free field for stimuli chosen to reveal possible mechanisms contributing to the static model's over-prediction. Compared to a static model of loudness (ANSI S3.4, 2007), a time-varying model (Glasberg and Moore, 2002) for earphone stimuli produced more accurate estimation for spondees but still over-predicted loudness differences between tones and the other stimuli-speech-shaped noise, sustained vowels, and spondees. To eliminate possible confounds from headphone frequency response corrections and dynamic variations in a model's predictions, magnitude estimations of sustained speech-shaped noise and 1.0 kHz tones were measured in a free field. The two models evaluated in this study still overestimated loudness differences. These findings suggest that current models (Glasberg & Moore, 2002; ISO532-1, 2011) overestimate loudness summation of wideband sounds.

Poster # 65 - (PSY07)

Contributions of Frequency Bands to the Loudness of Broadband Tonal and Noise Stimuli
Walt Jesteadt, PhD; Katyarina Brunette, PhD; Oluwaseye Ogun, MD; Marcin Wroblewski, AuD, Boys Town National Research Hospital, Omaha, NE

Contributions of individual frequency bands to judgments of total loudness can be assessed by varying the level of each band independently from one presentation to the next and determining the relation between the change in level of each band and the loudness judgment. In a previous study, measures of perceptual weight obtained in this way for noise stimuli consisting of 15 bands, each two critical bands wide, showed greater weight associated with the highest and lowest bands than loudness models would predict. This was true even for noise with the long-term average speech spectrum, where the highest band contained little energy. One explanation is that listeners were basing decisions on some attribute other than loudness. The current study replicated earlier results for noise stimuli and included conditions using tones located at the center frequencies of the noise bands. Although the two types of stimuli sound very different, the patterns of perceptual weight are nearly identical, suggesting that both sets of results are based on loudness judgments and that the edge bands play an important role in those judgments. [Work supported by NIH].

TINNITUS

Poster # 66 - (TIN01)

Developing an Audiologist-Delivered Psychological Intervention for People with Tinnitus
Mentored Student Research Poster Award
Dean M Thompson; Deborah A Hall, PhD; Derek J Hoare, PhD, National Institute For Health Research Nottingham Hearing Biomedical Research Unit, Nottingham
Dawn-Marie Walker, PhD, University of Southampton, Southampton

Tinnitus is associated with depression and anxiety disorders and psychological therapies have been tested resulting in a convincing level of evidence, enough to warrant its recommendation for use in practice in the UK and the US. However this evidence relates to psychological therapies delivered by psychologists and psychiatrists. In the UK, audiologists play a majority role in supporting tinnitus patients, but the therapeutic approach differs between audiologists. Ideally the most important components of audiologist-delivered psychological therapy should be manualised to standardise care. To do that we must first map what those elements might be, asking "what is known from the literature about the identity of components of psychological therapies for tinnitus"? A scoping review was conducted to map these components. Sixty-four records were retained for data extraction. Twenty-five themes of therapy components were derived from 1085 individual components. Components were predominantly extracted from Cognitive Behavioural Therapy, Acceptance and Commitment Therapy, Mindfulness and educational counselling, though a smaller group was taken from Gestalt Therapy and Existential Therapy. Further research will involve patients and clinicians using the Delphi methodology to determine a consensus on what should be included as essential elements of audiologist-delivered psychological therapy for tinnitus.

Poster # 67 - (TIN02)

Assessing the Impact of Sound Sensitivity in Tinnitus **Mentored Student Research Poster Award**
Benjamin Greenberg, MA, American School Of Professional Psychology At Argosy University, San Francisco Bay Area, Orinda, CA

Bong Walsh, PhD; Megan Carlos, PhD, American School Of Professional Psychology At Argosy University, San Francisco Bay Area, Alameda, CA

Despite many recent advances in understanding mechanisms of tinnitus and hyperacusis as individual disorders, greater clarification concerning how tinnitus and heightened sound sensitivity may interact is still needed. Although the literature acknowledges frequent comorbidity of subjective tinnitus and increased sound sensitivity as potentially more devastating than either condition alone, little acknowledgement is given to negative effects of environmental sound stimuli on subjective tinnitus, thus representing a gap in understanding how tinnitus and hyperacusis interact. Therefore, the objective of this study was to develop a psychometrically reliable scale that measures the subjective negative impact of exposure to loud sounds in tinnitus patients. A secondary objective of this study was to further clarify psychological factors such as depression and anxiety that pertain to cases of heightened sound-sensitivity in tinnitus. Accordingly, the Sound Sensitive Tinnitus Index (SSTI) was created to assess for challenges associated with exposure to noise including psychosocial impact, and may potentially indicate a subtype of sound sensitive tinnitus that has not yet been operationally defined. Preliminary data suggests that exposure to sound considered even moderately loud can have negative exacerbating effects on tinnitus, thus inferring the SSTI to be a potentially important assessment tool to researchers and clinicians alike.

Poster # 68 - (TIN03)

Economic Analyses of a Tinnitus Management Clinic

Craig Newman, PhD; Sharon Sandridge, PhD, Cleveland Clinic Head & Neck Institute, Cleveland, OH

Rationale and Aims: The Tinnitus Management Clinic (TMC) at the Cleveland Clinic offers an efficient method for providing patients informational counseling and coping strategies in a group format. Given the practical benefits of a 'shared medical appointment,' the cost-effectiveness of the TMC remains unclear. This study evaluated the economic value of the TMC by: (1) applying a cost-utility analysis (CUA); and (2) determining willingness-to-pay (WTP) for attendees. Methods: Fifty-two patients completing the Tinnitus Handicap Inventory (THI) before and after TMC (without intervening treatment) participated. CUA provides a common unit (cost per Quality Adjusted Life Years, QALY) for comparisons among interventions. For each patient, QALY gained was calculated based on: cost of treatment, life expectancy, and THI benefit score. WTP was based on the patient's knowledge that the cost of attending the TMC was $300. Results: The mean TMC cost was $3.16 per QALY gained. These data will be compared against other audiologic/otologic interventions (e.g., sound therapy; cochlear implantation; hearing aid rehabilitation programs). On average, WTP for those patients attending the TMC was $287.00. Conclusions: Based on the outcome of the CUA and WTP analyses, the TMC provides a cost-effective approach as an initial step in the overall management of tinnitus.

Poster # 69 - (TIN04)

Systematic Review of Outcomes in Tinnitus Trials: COST Action BM1306

Dean M Thompson; Deborah A Hall, PhD, National Institute For Health Research Nottingham Hearing Biomedical Research Unit, Nottingham, NA

Because tinnitus is a subjective condition, the definition of outcomes is challenging and it remains unclear which distinct aspects of tinnitus ('domains') are most relevant for assessment. This systematic review will contribute to the development of a core domain set for future controlled trials on tinnitus treatment effectiveness using quantitative data collected from ongoing registered or published trials since 2006. Electronic and manual search of research databases and registered clinical trials identified 2129 records. Only 228 records met eligibility for inclusion. Data synthesis is ongoing, but interesting observations are: (1) mostly trials evaluated pharmacotherapy, electrophysiology, sound therapy and psychological therapy in approximately equal measure; (2) at least half of all studies stated only one primary outcome but >10% of trials had five or more primary outcomes; (3) about 1/4 of studies did not report what they were interested in assessing (e.g., tinnitus loudness); (4) about 1/3 of studies used an overarching description (e.g., handicap, distress, severity), which are not informative about the construct of interest. The findings from this review will be the first step towards achieving a minimum outcome reporting standard for tinnitus that has been reached via a methodologically rigorous and transparent process.

Poster # 70 - (TIN05)

Why is Tinnitus a Problem? A Qualitative Analysis of Problems Reported by Tinnitus Patients

Derek Hoare, PhD; Emily Watts; Kathryn Fackrell; Sandra Smith, University Of Nottingham, Nottingham
Jacqueline Sheldrake, Tinnitus and Hyperacusis Centre, London

Tinnitus is prevalent and individuals often experience a wide range of associated problems. However, to date only two studies have evaluated why tinnitus is a problem, in different populations, and with relatively modest sample sizes. In order to replicate this work in a larger sample, we performed a retrospective analysis of anonymised clinical data from 988 patients who attended a single tinnitus treatment centre in the UK. The primary aim was to identify the domains of tinnitus problem according to this large patient population, and secondly to examine the relevance of the TFI as a clinical measure against those domains. We identified 21 distinct domains of tinnitus problem. Tinnitus-related fear was notably common. Many individual TFI items could be mapped as relevant to the problem domains identified. This work will inform a core outcome set for tinnitus research currently under development in Europe, and the development of any future tinnitus questionnaires.

Poster # 71 - (TIN06)

Psychometric Properties of the Tinnitus Functional Index (TFI): Assessment in a UK Research Volunteer Population

Derek Hoare, PhD; Kathryn Fackrell; Deborah Hall, University Of Nottingham, Nottingham
Johanna Barry, MRC Institute of Hearing Research, Nottingham

Questionnaires are essential for measuring tinnitus severity and intervention-related change but there is no standard instrument used routinely in research settings. Guided by quality criteria for the measurement properties of health-related questionnaires, this study involved a retrospective analysis of Tinnitus Functional Index (TFI) and other questionnaire data collected for 294 members of the general public being screened for a clinical trial. Analyses showed the 8-factor structure was acceptable for this general (non-clinical) population; however the 'auditory' factor showed poor loading with the higher order factor 'functional impact of tinnitus'. The TFI had high internal consistency (? = 0.80), extremely

high reliability (ICC: 0.86), whilst agreement was borderline acceptable (93%). Construct validity was demonstrated by high correlations between scores on the TFI and other tinnitus questionnaires (r = 0.82), and moderate correlations with single item loudness (r =0.46), annoyance (r =0.58), or quality of life scales (r = -0.48), and depression and anxiety questionnaire scores (r = 0.57 and 0.38 respectively). Floor effects were observed for more than 50% of the TFI items. A smallest detectable change score of 22.4 was estimated for this population. Further investigation is needed to determine whether these estimates are relevant in other populations.

VESTIBULAR

Poster # 72 - (VEST01)

Effects of Initial Head Position and Eye Movement Direction on vHIT Gain in Patients with Unilateral Vestibular Dysfunction **T35 Research Trainee Poster**

Joel Goebel, MD; Charlotte Dutcher; Belinda Sinks, AuD; Allison Sargent, Washington University School of Medicine, Saint Louis, MO

This study examined the eye velocity vs head velocity gain and position gain during the center-to-side head-turn procedure as well as the side-to-center procedure during horizontal vestibular head impulse testing (vHIT). The side-to-center procedure may be more comfortable for the patient because there is a known stopping position. Subjects with normal vestibular functioning and vestibular dysfunction were tested. Infrared cameras were used to measure eye velocity vs head velocity and position gain during high velocity head thrusts. No significant differences in gain were found using the side-to-center procedure in comparison to the center-to-side procedure in either the normal population or the vestibular dysfunction population. An interesting difference was discovered between the abducting and adducting eyes. The adducting eye had a higher gain than the abducting eye in both normal subjects and those with vestibular dysfunction. The difference in gain values obtained in abducting and adducting eyes may make it more clinically accurate to use a two camera system as opposed to a one camera system.

Poster # 73 - (VEST02)

Perception of Vertigo: Quantitative Measurement with/without Galvanic Vestibular Stimulation

Gaurav Pradhan, PhD; Samantha Kleindienst, PhD; Jamie Bogle, PhD; Michael Cevette, PhD; Jan Stepanek, MD, Mayo Clinic Arizona, Scottsdale, AZ

Galvanic vestibular stimulation (GVS) is a simple method for eliciting vestibular reflexes through non-invasive transcutaneous electrical stimulation. Studies have demonstrated the capability of GVS to influence balance stability and provide favorable suppression of acute vestibular symptoms. While the diagnostic and rehabilitative applications of GVS are broad, methods for quantifying an individual's perception of GVS and vertigo are limited. The purpose of this study was: (1) to evaluate the effect of GVS on nystagmus suppression during caloric stimulation, and (2) to quantify subjective perception of motion using a novel avatar software application. Twenty healthy adult participants completed water caloric irrigations with and without GVS suppression. Analysis demonstrated no significant difference in caloric peak slow phase velocity between conditions. However, there was a significant reduction in the duration of perceived motion with GVS compared to without GVS ($F(1,19)= 7.5$, $p=0.01$). Yaw was the dominant

dimension of motion and while not significant, there was an overall 32% reduction in the average yaw velocity perception. Preliminary results suggest promise for the use of GVS in the mitigation of vestibular symptoms. Further, the ability to objectively quantify the perception of vestibular motion may play an important clinical role by quantifying symptoms of patients with vertigo.

Poster # 74 - (VEST03)

Hearing Loss and Fear of Falling in Older Adults

Adele Goman, PhD; Jennifer Deal, PhD; Judith Kasper, PhD; Frank Lin, MD, Johns Hopkins University, Baltimore, MD

Falls and fear of falling are major public health issues. This project investigated the association between self-reported hearing difficulty and falls, fear of falling, and activity restriction due to fear of falling, among older adults. Data from round one of the National Health and Aging Trends Study were analyzed. 6840 adults over 65 years of age were categorized as having 'hearing difficulty' or 'no hearing difficulty' based on self-report to functional hearing questions. Outcome variables consisted of whether the participant had fallen in the past year (yes/no), whether they had worried about falling in the past month (yes/no) and whether their worry about falling had limited their activities (yes/no). Logistic regression models were adjusted for demographic characteristics, cardiovascular risk factors, and balance function. In fully adjusted models, self-reported hearing difficulty was not significantly associated with reported falls. However, self-reported hearing difficulty was significantly associated with a 44% increased odds of fear of falling and a 63% increased odds of activity restriction due to being worried about falling. Further research is needed to assess whether hearing rehabilitative treatment can ameliorate fear of falling and resulting activity restriction among older adults with hearing difficulty.

Poster # 75 - (VEST04)

Clinical Effectiveness of the Epley Omniax for Treatment of BPPV

Dave Harris, PhD; Kathryn Phillippe; Melissa Lowe, AuD; Sarah Keenan-Meyer; Anthony Mikulec, MD, Saint Louis University School Of Medicine, St. Louis, MO

Benign paroxysmal positional vertigo (BPPV) is the most common cause of otologic dizziness. Manual repositioning maneuvers have been found to be highly effective for treatment of BPPV. Repositioning chairs have also been found to be just as, or even more effective in treatment of BPPV. 243 patients were referred for assessment and treatment of BPPV with the Epley Omniax. Of 243 patients, 235 were diagnosed with BPPV with a positive Dix-Hallpike and/or roll test. 180 (76.6%) patients with BPPV required only one treatment session for resolution of positional nystagmus and vertigo symptoms. 42 (17.8%) patients required 2 sessions in the repositioning chair, and 13 (0.06%) patients required 3 or more sessions. Our clinical data corroborates previous findings suggesting the Epley Omniax is an effective treatment option for BPPV. While the manual repositioning maneuvers are also highly effective, the Epley Omniax system provides advantages over manual maneuvers such as unlimited 360 degree patient movement, safe maneuverability with patients with limited range of motion, along with accurate constant electronic nystagmic recording.

Poster # 76 - (VEST05)

Vestibular Consequences of Mild Traumatic Brain Injury and Blast Exposure
Faith Akin, PhD; Owen Murnane, PhD; Courtney Hall, PhD; Jennifer Sears, AuD; Kristal Riska, PhD; Richard Atlee, Mountain Home VA Medical C, Mountain Home, TN

Symptoms of dizziness and imbalance are common sequelae following concussion and blast exposures that result in mild traumatic brain injury (mTBI), and these symptoms often last six months or longer. Most studies examining the effect of vestibular dysfunction on postural stability have used symptom scales or tests of vestibulo-ocular reflex (VOR) that measure horizontal semicircular canal (hSCC) function only. Vestibular loss, however, can occur in one or both labyrinths, in one or both branches of the vestibular nerve, and in one or more vestibular sensory end-organs. A prospective case-controlled design was used to determine the effect of mTBI and blast exposure on peripheral vestibular system function, postural stability, and gait. MANOVAs revealed significant differences between the control and mTBI and blast groups for cervical vestibular evoked myogenic potentials, sensory organization test, and dynamic gait index. These findings suggest that mTBI and blast affect the otolith organs, postural stability, and gait. The frequency of test abnormalities ranged from 22 to 71% with the most frequent abnormalities occurring on tests of balance and gait function. Vestibular test abnormalities occurred in 48% of individuals with mTBI and/or blast exposure. Specifically, abnormalities occurred more often in tests of otolith organ function than hSCC function.

Poster # 77 - (VEST06)

Gait Variations in Relation to Hearing
Ashley M. Deeb, AuD; Kenneth R. Bouchard, PhD, Henry Ford Medical Group, Detroit, MI
Jacklyn Theis, AuD, Advanced Audiology, Dewitt, MI

Falls are the leading cause of injuries in older adults and typically occur during ambulation. The purpose of this study was to understand the impact of hearing loss, as simulated by masking noise, on gait performance. Cadence, velocity, stride length, and double support as they relate to the presence, type, and intensity of masking noise to simulate loss of auditory cues were evaluated. Gait measures of fifteen normal gait and hearing participants were assessed under presentation of multi-talker babble and white noise stimuli of varying intensities versus no acoustic stimuli. The GAITRite system was used to obtain targeted spatial and temporal gait measures. Participants served as their own control. Results showed that individuals tended to have a faster gait with presence of louder noise. Velocity and stride length were increased when masker increased to 80 dB for both multi-talker babble and white noise. Cadence was increased for 80 dB for multi-talker babble. Our data are of the first documented to encompass multiple gait parameters versus just looking at gait speed (velocity) and offer a window to answering a number of questions that haven't yet been addressed in the literature that could potentially lead to improved outcomes in hearing loss patients.

HEARING HEALTH

Poster # 78 - (HH01)

Barriers and Facilitators for Seeking Hearing Healthcare: A Four-Country Perspective **Mentored Student Research Poster Award**

Cornetta Mosley, BA; C Baylor, PhD; Kathryn Yorkston, PhD; Kelly Tremblay, PhD, University Of Washington, Seattle, WA
Kathleen Pichora-Fuller, PhD, University of Toronto, Mississauga, Ontario
Catherine Mcmahon, PhD, Macquarie University, North Ryde, New South Wales
Adrian Davis, PhD, Public Health England, London

It is a well-known fact that a large proportion of older adults who have hearing impairment do not seek hearing healthcare services. The present study explored the barriers to and facilitators for seeking hearing healthcare in older adults in four English-speaking, developed countries. Focus groups of older adults recruited from the community were conducted in Australia, Canada, the United Kingdom (UK), and the United States (US) to gain insights into participants' experiences with hearing loss and the hearing healthcare system. Despite differences in healthcare systems across countries, key barriers (e.g., cost and stigma) and facilitators (e.g., family support and trust in providers) were consistent. Subtle differences emerged in the discussion of trusting hearing healthcare professionals in the context of the different healthcare systems. These findings suggest that many aspects of hearing healthcare-seeking behaviors for older adults with hearing loss are universal across healthcare systems despite differences in funding models for hearing healthcare.

Poster # 79 - (HH02)

Hearing Loss, Physical Health and Cognition in Rural Alabama

Marcia Hay-McCutcheon, PhD; Adriana Hyams, MA; Brianna Panasiuk, MS; Sarah Ondocsin, MS, The University Of Alabama, Tuscaloosa, AL

According to US Census data, the aging population in Alabama is increasing. Additionally, across the nation the state ranks 42nd in poverty levels. There could be, therefore, a large percentage of individuals living in Alabama who have hearing losses and have no or few resources to address them. The main goal of this study was to examine the extent to which physical health, emotional issues and cognition were associated with hearing loss for people living in rural Alabama. Two hundred and ninety-seven adults aged 19 years of age or older living in West Central Alabama completed testing. Pure-tone thresholds were obtained at 250 Hz, 500 Hz, 1000 Hz, 2000 Hz, and 4000 Hz. Additionally, the Continuous Visual Memory Test (CVMT), the SF-36 Health Survey and the Charlson Comorbidity Index were administered. Outcomes revealed that hearing loss was associated with physical health and one measure of cognition, the ability to recognize familiar designs from the CVMT test after a 30-minute delay. This preliminary study is the first in a series of studies that will be conducted to help us understand how cognitive, physical and emotional issues are associated with hearing health in adults living in rural Alabama.

Poster # 80 - (HH03)

Demographics of Audiologic Care Provided by Arizona Sonora Borders Project

Page Beukelman, BS; Kylie Jordan; Nicole Denny, BA, University Of Arizona, Tucson, AZ
Pablo Valenzuela, ARSOBO
James Dean, AuD, University of Arizona and Tucson Medical Center, Tucson, AZ

To reduce hearing health-care disparities experienced by underserved populations in Nogales, Mexico, the Arizona Sonora Borders (ARSOBO) project provides low-cost hearing assistive devices to individuals with hearing impairment. Since inception, this innovative integrated service program has provided audiologic care for over 150 children and adults. This poster's purpose is to describe the service delivery model, challenges faced and decision matrices utilized in providing hearing-health services. A demographic summary describing the underserved populations identified and treated is included.

Poster # 81 - (HH04)

Hearing Loss Management in a Rural Community: Barriers and Facilitators
Adriana Sanchez, BS; Nicole Marrone, PhD; Maia Ingram; Jill De Zapien; Daisey Sanchez; Frances Harris, PhD; Sonia Colina, PhD, Speech, Language, And Hearing Sciences, University Of Arizona, Tucson, AZ
Rosie Piper, Mariposa Health Clinic, Nogales, AZ

This study was conducted to identify patient-centered factors underlying barriers in access to care and self-management of hearing loss within the low-resource, rural U.S.-Mexico border community. The research team provided free hearing screenings to identify community members with hearing loss that were not currently served by the health system. The study included community hearing screenings, community focus groups, interviews with people with hearing loss, focus groups with their family members, and interviews with health care providers serving the community. The data were transcribed, coded, and analyzed using the Health Belief Model. Overall interest across the community in response to the community health workers' invitation to the community screening and group interviews was the first indication of the importance of hearing loss to the community. Participants identified severity and barriers to action as the most salient Health Belief Model constructs related to the experience of hearing loss. The devastating emotional impact of living with unmanaged hearing loss reflected the perceived severity and barriers to help-seeking and created clear opportunities to emphasize in the development of a community-based intervention. We also identified specific cultural influences, resources, and cues to action that could support an intervention. [Research supported by NIH/NIDCD.]

Poster # 82 - (HH05)

A New Online Questionnaire for Assessing Spatial-hearing Ability
Adriana Goyette, AuD; Christophe Micheyl, PhD; Sridhar Kalluri, PhD, Starkey, Eden Prairie, MN

This study describes the design and validation of a new online inventory designed to assess spatial-hearing ability. The Inventory of Spatial Hearing Abilities (ISHA) facilitates experiential recall by including images related to the situations depicted in the questions and through the use of ecologically valid situations. To design, analyze, and validate the ISHA we used the probabilistic (Bayesian) Item Response Theory (IRT) model. Our approach to establishing the construct validity of the ISHA was testing for correlations in scores across this inventory and the spatial subscale of the SSQ (Gatehouse and Noble, 2004). 76 subjects participated in this study, including individuals with normal hearing, unilateral, asymmetric, or symmetric hearing loss, hearing-aid wearers and non-wearers. Data analyses using the IRT model showed: (a) statistically significant correlations between spatial-hearing abilities inferred across the two questionnaires, even after taking into account the limited precision of inferences at the

individual level; (b) statistically significant differences in inferred spatial-hearing abilities between the normal-hearing group and other participant groups with impaired hearing.

Poster # 83 - (HH06)

Outcomes on Two Versions of the Hearing Handicap Inventory
Jay Vachhani, AuD; Gabrielle Saunders, PhD,; Robert Folmer, PhD; Patrick Feeney, PhD, National Center For Rehabilitative Auditory Research-VA Portland Health Care System, Portland, OR
Robert Margolis, PhD, Audiology Incorporated, Arden Hills, MN
Lawrence Feth, PhD; Christina Roup, PhD, Ohio State University-Department of Speech and Hearing Science, Columbus, Ohio

Currently two versions of the Hearing Handicap Inventory (HHI) are used clinically to assess self-reported hearing difficulty. The HHIA is used for individuals <65 years of age and the HHIE is used for people 65+. Two versions exist because the developers assumed older and younger individuals encountered different listening situations. These versions differ in the wording of three questions. The purpose of this study is to determine whether two versions are necessary. The data were collected as part of a larger study examining the effectiveness of community-based hearing screenings as motivation for individuals to enter the hearing healthcare system. Data were collected from 555 individuals (100 were 65+ years) who reported hearing difficulties at four test sites throughout the country. Participants completed a version of the HHI that included questions from both the HHIA and HHIE permitting separate scores to be calculated and compared for all individuals. The HHIE and HHIA scores did not differ for individuals age <65 years (HHIE: mean: 25.4; SD: 23.7 & HHIA: mean 24.7; SD: 24.7) or for individuals age 65+ (HHIE: mean 25.6; SD: 22.0 & HHIA: mean: 26.4; SD: 22.7) suggesting that two versions may be unnecessary. Supported by NIDCD R33DC011769.

Poster # 84 - (HH07)

Correlation Between Dietary Quality and Audiological Results in Young Adults **Mentored Student Research Poster Award**
Janelle Kelley, BS, University Of Florida / Mayo Clinic Jacksonville, Ormond Beach, FL
Christopher Spankovich, PhD, University Of Mississippsi Medical Center
Meghan Jolley, University of Florida

Background: Dietary intake of various nutrients has been reliably associated with hearing sensitivity in older adult populations. The current study assessed the relationship between dietary quality and audiological outcomes in young adults. Methods: 58 healthy individuals aged 18-25 years participated. Subjects entered two days of dietary intake into the Automated Self Administered 24-Hour Dietary Recall database. In addition, they underwent otoscopy, tympanometry, otoacoustic emissions (OAE's), standard pure tone audiometry, and extended high-frequency audiometry to obtain hearing thresholds. Results: Dietary intake was converted into Healthy Eating Index-2010 (HEI-2010) scores ranging from 1 to 100, with lower scores indicating lower dietary quality. Linear regressions revealed no significant relationship between diet and hearing thresholds. However, a positive and significant relationship between diet quality and OAE's was detected at higher test frequencies. Conclusions: Individual's with higher quality diets were associated with more robust OAE's than those with lower quality diets. Smaller OAE

amplitudes in those with poorer dietary intakes could suggest inner-ear damage that has not yet affected hearing thresholds or compromised metabolic integrity of the cochlea. Conclusions may become part of future clinical recommendations and counseling sessions concerning hearing conservation.

Poster # 85 - (HH08)

Screening for Otologic Functional Impairments in the Elderly (SOFIE)
Sharon Sandridge, PhD; Craig Newman, PhD, Cleveland Clinic Head & Neck Institute, Cleveland, OH
Barbara Weinstein, PhD, CUNY - GC, New York, NY

Rationale and Aims: The underdetection and undertreatment of hearing loss, balance disorders, and tinnitus in older adults have negative consequences on health-related quality of life (HRQoL) and patient care. The Screening for Otologic Functional Impairments in the Elderly (SOFIE) was developed to quantify quickly and efficiently the presence of these highly prevalent and potentially devastating symptoms. This study assessed the validity and reliability of the SOFIE. Methods: Forty-four patients from the Head & Neck Institute at the Cleveland Clinic participated. The 10-item SOFIE is comprised of high-value items drawn from screening versions of the Hearing Handicap Inventory (HHI), Dizziness Handicap Inventory (DHI) and Tinnitus Handicap Inventory (THI). The mean test-retest interval was 245 days. Results: SOFIE subscales (n = 44) were highly correlated with scores on the HHI (r =0.83), DHI (r = 0.91) and THI (r = 0.85), attesting to its validity. The SOFIE total score (n = 20) demonstrated high test-retest reliability (r = 0.72) and repeatability (based on Bland Altman coefficient) between baseline and re-administration. Conclusion: The SOFIE is a psychometrically adequate instrument for identifying older adults with otologic impairments who might benefit from medical and/or rehabilitative services aimed at improving HRQoL (e.g., hearing aids and falls prevention).

Poster # 86 - (HH09)

Development for the Self-assessment of Hearing Screening of the Elderly
Gibbeum Kim, BS; Woojae Han, PhD; Jinsook Kim, PhD; Wondo Na; Gungu Kim, Hallym University, Chuncheon, Gangwondo

The purpose of the study was to develop and standardize a screening tool for the elderly who wish to check themselves for hearing loss. The Self-assessment for Hearing Screening of the Elderly (SHSE) consists of 20 questions based on characteristics of presbycusis using a 5-point scale: seven questions covered general issues due to hearing loss, seven covered hearing difficulty under distracting conditions, two covered hearing difficulty in fast-rate speech, and four covered working memory in the communication situation. To standardize the SHSE, a total of 83 elderly participated: 25 with normal hearing, and 22, 23, and 13 for mild, moderate, and moderate-to-severe sensorineural hearing loss, respectively. All were re-tested again three weeks later using the same questionnaire. The results showed that SHSE scores for normal hearing and mild, moderate, and moderate-to-severe hearing loss were 42.24%, 59.9%, 64.15%, and 75.86%, respectively, while reflecting the degree of hearing loss appropriately. In particular, items 1, 3, 17, and 20 showed systematically increased scores as the hearing loss increased. Although we need to statistically analyze the data in terms of internal consistency and test-retest reliability, the SHSE will help the elderly self-diagnose their hearing loss and understand their

hearing loss more easily and objectively.

HEARING LOSS / REHABILITATION

Poster # 87 - (HLRE01)

Cognitive Screening and Hearing Loss **T35 Research Trainee Poster**
Anna Cosgrove, BS, Montclair State University, Bloomfield, NJ
Ian Odgear; Melissa Frederick, AuD; Gabrielle Saunders, PhD, National Center For Rehabilitative Auditory Research, Portland, OR

Cognitive screening exams are used by a variety of healthcare professionals to assist in the diagnosis of cognitive disorders. Many recent research studies have suggested there is a link between decreased cognition and hearing loss. Cognitive screening tasks are generally administered verbally, requiring processing of the incoming auditory signal and auditory working memory. The goal of this study was to determine what role audibility may play in cognitive screening performance. The test selected for use was the Montreal Cognitive Assessment (MoCA, Nasreddine et al, 2005). Cognitive screening of individuals with hearing loss was conducted with and without amplification (either with the participant's own hearing aids or using a PockeTalker if the participant did not own hearing aids). Scores for aided and unaided testing were compared, and the relationships between MoCA scores and degree of hearing loss were examined. The study's findings raise questions about how cognitive screenings should be conducted with hearing impaired individuals.

Poster # 88 - (HLRE02)

Use of QuickSIN Stimuli to Obtain Acceptable Noise Levels
Hua Ou, PhD, Illinois State University, Normal, IL

It is clinically useful to find a method to predict success with hearing aids, prior to a fitting. The Quick Speech-In-Noise test (QuickSIN), and the Acceptable Noise Level (ANL) test have been recognized as able to predict hearing-aid use success. But the two measures use different stimuli and require administration of two tests. One common speech stimulus across these measures to obtain as much information as possible within a timely manner, it might be able to achieve a more complete picture of factors affecting hearing aid use success. The purpose of the study was to evaluate the reliability of using the speech material from QuickSIN to measure ANL. Twenty adults with normal hearing participated in the study. The average QuickSIN ANL was 5.3 dB (SD = 3.0) in the study. It was comparable to the results using the traditional ANL stimuli (mean = 4.1 dB, SD = 3.2) for the same group of participants. No significant differences were found between these two ANLs using two different materials ($p = .2$). Test-retest reliability was high for QuickSIN ANL ($r = .8$, $p < .0001$). It was concluded that QuickSIN speech material can be used to measure acceptable noise level in clinic.

Poster # 89 - (HLRE03)

Is the Device-Oriented Subjective Outcome (DOSO) Independent of Personality?

Kelsey Dumanch, BS; Yu-hsiang Wu, PhD; Elizabeth Stangl, AuD; Ruth Bentler, PhD, University Of Iowa, Iowa City, IA
Christi Miller, PhD; Christopher Bishop, PhD; Kelly Tremblay, PhD, University of Washington, Seattle, WA

Standardized outcome measures, or self-report questionnaires, are expected to be sensitive to influences from patient variables; however, studies have shown that personality can account for 10-30% of the variance in response to self-report measures. As a result, these influences can impact results and limit their generalizability. To circumvent personality influences on outcome data, the DOSO was developed. The DOSO is meant to demonstrate outcomes of the amplification device independent of the individual who is wearing it. Still, it is unknown if the DOSO achieves its original goal. Our study examines the relationship between personality and the DOSO. Sixty-five adults who have worn hearing aids for at least six months were recruited (University of Iowa and University of Washington). The NEO-FFI was used to measure personality. The DOSO, together with several other questionnaires, was administered to measure hearing aid outcomes. The results show significant correlations between personality and the DOSO and (consistent with the literature) other questionnaires such as the HHIE. This is in direct contradiction to the purpose for its use. Using the DOSO as an outcome measure, specifically in regards to evaluating the merit of a hearing aid technology, will be discussed

Poster # 90 - (HLRE04)

Statistical Analysis of Outcomes from the Device-Oriented Subjective Outcome Scale
Ryan Irey, MA; Elizabeth Galster, AuD; Alyson Gruhlke, AuD; Amanda Wolfe, AuD; Jason Galster, PhD, Starkey Hearing Technologies, Eden Prairie, MN

The Device-Oriented Subjective Outcome Scale (DOSO; Cox, Alexander, & Xu, 2014) is a subjective assessment of hearing aid outcomes that focuses on aspects of device performance. One potential application of the DOSO is in the comparison of different hearing aids or hearing aid features: the DOSO may be administered both prior to and after an evaluation period with a new hearing aid. Here, we describe a method of analyzing such data using ordinal logistic regression. Participants in two hearing aid clinical trials (n = 101) completed the DOSO short-form version A prior to study commencement. After at least six weeks of using a new hearing aid device, they completed the DOSO short-form version B. We demonstrate the use of a proportional odds model in analyzing the DOSO outcomes within each of its six subscales: First, the relevant model assumptions are evaluated. Next, the cumulative probabilities for each of the seven categories of responses (five categories, in the 'Use' subscale) are estimated within each subscale. Finally, the statistical significance of any observed changes in response probability between versions is derived using point-polyserial correlations. Finally, conclusions are drawn based on the statistical significance and direction of the point-polyserial correlations.

ANATOMY AND PHYSIOLOGY

Poster # 91 - (ANAT05)

Investigating the Role of Temporal Bone Anatomy on Caloric Stimulation
David Carpenter, BA; Erin Piker, PhD; David Kaylie, MD; Dennis Frank-ito, Duke University Medical Center, Durham, NC

Hypothesis: Patients with increased variation in bilateral temporal bone anatomy have greater caloric asymmetry. Background: Despite its role as the etiologic gold standard for vertigo, caloric stimulation has limited clinical utility due to poor mechanistic understanding. The present study addresses the effect of temporal anatomy on the magnitude of the caloric response. Methods: Eligible patients included those who were referred to an otology clinic complaining of dizziness with a head computed tomography (CT) scan and caloric stimulation results indicative of non-vestibular findings. Observed differences between left and right temporal bone anatomy, as derived from three-dimensional reconstructions of CT scans, were compared to caloric stimulation findings in 11 patients. Statistical analysis was done using the nonparametric Wilcoxon Rank-Sum test. Results: Lateral semicircular canal (LSCC) volume and LSCC SA to V were the only two anatomic parameters significantly corresponding to caloric asymmetry ($p = 0.036$ for LSCC V; $p=0.023$ for LSCC SA:V). In contrast to our hypothesis, greater asymmetry in LSCC V and SA:V were observed in patients with a lower caloric asymmetry. Conclusions: The caloric asymmetry in subjects without vestibular impairment may be influenced more by patient state and end organ function than by left-right differences in temporal bone anatomy.

Poster # 92 - (ANAT06)

Voice Analysis Following Vagus-nerve Stimulation with Tones for Treating Tinnitus

Helen Kochilas, BA; Amy Arnold, AuD; Anthony Cacace, PhD, Department Of Communication Sciences & Disorders, Wayne State University, Detroit, MI
Michael Seidman, MD, Henry Ford Health System, West Bloomfield, Michigan
Brent Tarver, MicroTransponder, Inc., Austin, Texas

Quantitative longitudinal voice analysis was performed on 7 individuals following surgical implantation of a vagus nerve (VN) electrode and an electrical-stimulator currently being evaluated as an experimental treatment modality for tinnitus. After implantation, individuals were required to enter a treatment regime consisting of computer controlled electrical stimulation of the VN paired with suprathreshold tones, presented randomly above and below the tinnitus frequency; 2.5 hours per day, 7 days/week, as part of a targeted plasticity approach for tinnitus abatement. However, stimulating the VN electrically could also impact vocal function, but to date, assessment of voice data is lacking for chronic daily stimulation using the approach described above and with the device utilized (Serenity System). In this investigation, we performed a repetitive quantitative vocal analysis based on: pitch, jitter, shimmer, and harmonic-to-noise ratio measures on samples of sustained vowels /e/, /o/ and /ah/ over the course of 7 sequential pre and post surgical sessions encompassing a time course of over 4 months. Preliminary data analyses indicated that these vocal functions were safe and stable over the time course measured. Results will be discussed in the context of data using VN stimulation to treat tinnitus and other medical conditions (depression, epilepsy).

Poster # 93 - (ANAT07)

Cochlear Nerve Deficiency and Brain Abnormalities in Pediatric Patients

Thierry Morlet, PhD; Markian Pazuniak, MD; Robert O'reilly, MD; Kandula Vinay, MD; Arabinda Choudhari, MD, AI Dupont Hospital For Children, Wilmington, DE

With the use of magnetic resonance imaging studies following the diagnosis of sensorineural hearing loss, the prevalence of cochlear nerve deficiency (CND) is increasingly recognized and may represent the most anatomic abnormality in children with unilateral hearing loss. In many of these cases, otoacoustic emissions are present and auditory brainstem responses are absent or highly abnormal. Previous studies have suggested that CND may also be associated with intracranial abnormalities. To expand on previous reports, the MRIs of 46 pediatric patients diagnosed with CND from 2007 to 2014 were examined with attention to gross intracranial abnormalities, absence or hypoplasia of each cranial nerve, myelination, and specific abnormalities in the cochlear nucleus, lateral lemniscus, lateral geniculate nucleus, medial geniculate nucleus, trapezoid body, inferior colliculus, superior olivary nucleus, and middle temporal gyrus. The most common abnormality was observed at the level of the vestibular system with absent vestibular nerves in 6 children, no or abnormal separation of the superior and inferior vestibular nerves in 4 children, while 12 others had vestibular anomalies. Twelve children had a cochlear malformation, most of them with atretic cochlear nucleus. Other brain abnormalities were observed in only 5 children, all of them with defective vestibular systems.

WIDEBAND IMMITANCE

Poster # 94 - (WI01)

Medial Olivocochlear Reflex and Changes in Middle Ear Reflectance
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The medial olivocochlear reflex (MOCR) modifies the action of outer hair cells and is often assessed by comparing transient-evoked otoacoustic emissions (TEOAEs) obtained with and without the presence of contralateral acoustic stimulation (CAS). Low CAS levels (~30-35 dB SL) are typically used in order to avoid confounding effects of the middle-ear muscle reflex (MEMR), which is also activated by CAS. Measured this way, MOCR effects are usually small, somewhat variable, and absent in approximately 20% of normal-hearing individuals. It may be possible to use higher CAS levels by taking advantage of the variability in MEMR-induced changes in middle-ear reflectance across frequency. By constraining analysis of MOCR to frequencies where reflectance changes are minimal, confounding effects of MEMR may be avoided at higher CAS levels. This strategy could potentially allow measurement of larger, more stable MOCR shifts. TEOAEs were recorded with CAS levels ranging from 36-84 dB SL. Analysis bands for each subject were chosen corresponding to minimal changes in reflectance, and correlations between MOC shifts and changes in middle-ear pressure reflectance were examined. Results suggest that using this method, larger MOC shifts can be measured and that a greater percentage of normal-hearing subjects show significant MOC shifts.

Poster # 95 - (WI02)

Middle Ear Muscle Contraction Assessment for Impulsive Sounds
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Middle ear muscle contractions (MEMC) have been invoked in damage-risk criteria for impulsive noises for over 40 years and one damage-risk criteria proposes that MEMC precede the impulse for a warned listener via response conditioning. However, scant empirical data describing the prevalence, magnitude, and time-course of reflexive MEMC elicited by impulsive stimuli as well as non-acoustic stimuli and behaviors are available. Likewise, empirical support for anticipatory MEMC is limited. The current study is a large-scale, multi-experiment project designed to address these limitations in a laboratory and field environment. MEMC are detected using click train stimuli as probes. Reflexive MEMC are elicited using tones, recorded gunshots, and non-acoustic stimuli (e.g., controlled release of compressed nitrogen gas to the face). Anticipatory MEMC are assessed across varying levels of distraction, beginning with participant instructions to pay attention to the conditioning stimulus and culminating in the assessment of anticipatory MEMC during live-fire exercises with rifles.

Poster # 96 - (WI03)

Contralateral Stimulus Comparison of the Acoustic Reflex via Reflectance Measures
Jinna Borgstrom, MA; Souraya Lorenz; David Velenovsky, PhD, University Of Arizona, Tucson, AZ

The acoustic reflex (AR) occurs as the result of a contraction of the stapedius muscle in response to the presentation of a loud sound. When the stapedius muscle contracts, the ossicular chain and the tympanic membrane are stiffened. Increased stiffness of the middle ear system causes low frequency sounds to be more readily reflected off the tympanic membrane, while high frequency sounds are more easily admitted into the middle ear. Wideband power reflectance (WPR) measures energy across a broad frequency range (200-6000Hz) as it is reflected off of the tympanic membrane.. Use of WPR allows for measurement of stiffness effects across frequencies, in comparison to conventional immittance instruments, which measure admittance changes only at a single probe tone (226Hz). The purpose of this study was to identify whether reflectance measures could be used to examine reflectance patterns as a function of contralateral stimulus type (broadband noise, 500, 1000, 2000 and 4000Hz). This study hypothesized that innervation distribution patterns of the basilar membrane would result in the AR producing different stiffness changes based on contralateral stimulus type. This study additionally demonstrates the potential of WPR to enhance understanding of the AR effects on the auditory system.

Poster # 97 - (WI04)

The Effect of the Acoustic Reflex on Middle Ear Transmittance
Haley Lanoue; Sarah Mackenzie; Brenden Bagnoli; Clemente Morales; Liza Clark; David Velenovsky, PhD, University Of Arizona, Tucson, AZ

The acoustic reflex (AR) is a contraction of the stapedius muscle that stiffens the ossicular chain. This stiffening causes an increase in reflectance of low and high frequency sounds and an increase in admittance of mid frequency sounds. Research has shown that the activation of the reflex results in selective filtering across frequency. We used wideband power reflectance (WPR: % energy reflected) and power transmittance (change in dB SPL) during ipsilateral reflex activation, to visualize this effect. The Mimosa Acoustics HearID® 5.1 system chirp was used as the probe and reflex elicitor stimulus. Preliminary results reveal the greatest decrease in transmittance occurs between 500 and 900 Hz with an average AR threshold of 74 dB SPL. These activation levels are on par with those commonly encountered

in typical noisy listening situations. Reduction in energy below 1000 Hz could be advantageous when listening in noisy environments, i.e., that the AR can effectively improve the signal to noise ratio in difficult listening situations.

Poster # 98 - (WI05)

Ipsilateral Measurements of the Acoustic Reflex Using Wideband Power Reflectance
Sarah MacKenzie; Haley Lanoue; Clemente Morales; Brenden Bagnoli; David Velenovsky, PhD, University Of Arizona, Tucson, AZ

The contraction of the stapedius muscle is known as the acoustic reflex (AR) which stiffens the ossicular chain/tympanic membrane. Conventional immittance systems only evaluate changes in admittance for the 226 Hz probe tone with AR activation. Conversely, wideband power reflectance (WPR) provides information regarding energy reflected from the tympanic membrane across a broad frequency range, typically 200 to 6000 Hz. The purpose of this study was to determine if acoustic reflexes can be measured ipsilaterally (IPSI) using a novel protocol. Pure tone or broadband noise stimuli typically used for IPSI reflex recording could not be employed when measuring the reflex via WPR. This is because the levels needed to activate the AR for pure tone stimuli are much higher (85-100 dB SPL) than the chirp stimulus (62 dB SPL) and would thus contaminate the reflectance measure. Therefore, we used the WPR chirp stimulus as both the probe stimulus and reflex elicitor for our IPSI reflex measures Ipsilateral AR thresholds measured using the wideband chirp stimulus were comparable to conventionally measured IPSI ARs. Our study demonstrates the potential of wideband power reflectance as a measure of the ipsilateral acoustic reflex using the chirp stimulus as both the probe and the elicitor.

Poster # 99 - (WI06)

Age Effects in the Adult Middle Ear: Wideband Acoustic Immittance
Chris Sanford, PhD; Gabriel Bargen, PhD; Jacob Diller; Heather Smith; Alyssa Hartman; Jeff Brockett, Idaho State University, Pocatello, ID

With the recent commercialization of wideband acoustic immittance (WAI) technology, the need to translate research work to clinical practice, including the creation of normative data, has been accelerated. Data presented here are from a larger study with aims of identifying ages at which differences in WAI are present and developing a WAI normative database for individuals across the age spectrum. For the present study, adult WAI absorbance data from individuals in three age groups were examined (20 - 30, 45 - 55, and 65 - 75 years). Absorbance was similar for the two older age groups across the entire frequency range (250 - 8000 Hz). However, significant age effects were found for absorbance with the younger group. In particular, absorbance for the 20 to 30 year old group was up to 20% lower than the two older groups for 600 through 3000 Hz and higher by up to 10% for 4000 to 7000 Hz. These results suggest a trend toward decreasing middle-ear stiffness with age. They also hold relevance for the establishment of normative data for WAI measurements and for understanding the aging process in the peripheral auditory system.

ELECTROPHYSIOLOGY

Poster # 100 - (EP10)

Characterizing ABRs in Preterm Infants: The BabyEars Project

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Beth Prieve, PhD, Syracuse University, Syracuse, NY

Auditory brainstem responses (ABR) show changes in morphology, latency and amplitude of various peak components well after birth. While ABRs have been characterized in healthy term infants, less information is available in preterm infants, particularly those with neurodevelopmental delays. As part of a larger longitudinal study of auditory responses and infant development (The BabyEars Project), ABR data were collected for 63 preterm infants tested at 33 and 35 weeks gestational age and 2 months corrected age. ABRs were recorded for click stimuli presented to each ear individually at two intensities using ipsilateral and contralateral recording montages. Middle-ear and cochlear status were assessed via wideband acoustic absorbance (A) and transient otoacoustic emissions (OAEs). Infants with peaks in A within the 2-4kHz range, present OAEs, and present ABRs for low-intensity stimuli show long ipsilateral ABR wave latencies that decrease with increasing age. Simultaneous contralaterally recorded ABRs contain minimally identifiable waves in many infants and, where present, component latencies differ from responses on later tests. Patterns of ipsilateral and contralateral ABR latency and morphology changes with age will be discussed. The long-term goal of The BabyEars Project is to relate early auditory characteristics to neurodevelopment and speech/language development outcomes. [Supported by NIH-NIDCD R01DC011777]

Poster # 101 - (EP11)

Auditory Steady-State Long-Latency Response (ASSLLR): Back to Fundamental Stimulus Parameters

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The purpose of this study was to further examine effects of the two most fundamental stimulus parameters--intensity and frequency--particularly auditory evoked potentials using a steady-state approach to response evocation and analysis. The primary aim was to measure magnitude changes of auditory steady-state responses (ASSRs) at 40 and 0.75 Hz repetition rates and of respective derived transient middle- and long-latency responses as a function of parameters within the mid-auditory response area. Repeated tone-bursts were presented at three carrier frequencies and five SPLs. A cohort of 48 normally hearing adults was examined. Magnitudes of both ASSRs (frequency domain analyses) and derived transient responses (time-domain analyses) showed small, yet statistically nonsignificant, changes to carrier frequency (0.5-2 kHz) for both repetition rates, concurring overall with the literature. Although the relationship is strongly debated in the literature, as expected, magnitudes systematically increased with SPL (40-80 dB), but with substantially different input-output (I-O) functions. The I-O functions for 40 Hz exhibited signs of saturating growth, whereas that at 0.75 Hz (ASSLLR) approximated a log-log linear function. However, with an eye toward potential perceptual relevance, the slope fell well below that of doubling of loudness per 10 dB SPL. Implications discussed.

Poster # 102 - (EP12)

Electrocochleography Obtained at High Stimulus Rates in Patients with Meniere Disease
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Rafael Delgado, PhD, Intelligent Hearing Systems, Miami, FL

Objectives: To investigate a new strategy of auditory evoked responses recorded at high stimulation rates in Meniere disease ears (MDEs). Methods and Measures: Control ears (CEs) and 32 MDEs were tested using an evaluation strategy of the auditory system involving a 'Continuous Loop Averaging Deconvolution' technique (CLAD) (Delgado & Ozdamar, JASA 2004; Ozdamar & Bohorquez, JASA 2006). Hearing was tested by transtympanal electrocochleography (TT-ECochG). Ears were stimulated using clicks (85 dB nHL) presented at rates of 7/s-780/s with the CLAD option. Results: In the CEs, the SP/AP ratio reached -1 at a stimulation rate of 600/s while in MDEs at 50-100/s. AP latencies in the CEs were found to be increasing at stimulation rates equal to 300/s, then were stable, and for rates of >=500/s, were found to be decreasing. For MDEs, latency changes were relatively similar to stimulation rate 250/s, and then, the latency remained stable. AP amplitude reduction pattern in MDEs was also different comparing to CEs. Conclusions: These very high stimulation rates provide a valuable tool for the assessment of the adaptation processes of the peripheral auditory system in CEs and MDEs. The CLAD strategy supports traditional audiological test battery in diagnosis of typical cochlear auditory pathologies.

Poster # 103 - (EP13)

Frequency Following Response: Normative Data
Saradha Ananthakrishnan, PhD, Towson University, Towson, MD

The Frequency Following Response (FFR), a scalp-recorded auditory evoked potential reflecting brainstem pitch representation, has been successfully recorded to a variety of speech and non-speech stimuli in various populations such as autism, learning disorders, specific language impairment, normal hearing and sensorineural hearing loss. Further, it is a sensitive index of experience-dependent neural plasticity, as reflected by stronger brainstem response amplitudes for pitch encoding in musicians and speakers of tonal languages such as Mandarin. However, there is very little information on normative FFR data in evoked potential literature due to a variety of reasons. Firstly, the FFR can be recorded to a variety of stimuli, each of which evokes a unique response, with potentially different norms. Secondly, there are many different methods of analyzing this neural response, including but not limited to autocorrelation analysis, Fast Fourier Transforms, and stimulus-response correlations. Lastly, the vulnerability of the FFR to experience-dependent learning effects can potentially introduce considerable variability even among apparently homogeneous control groups. The specific focus of the current experiment is on developing age- and gender- specific normative data for pitch extraction metrics for FFRs evoked by pure tone stimuli.

Poster # 104 - (EP14)

Assessment of Consistency of Brainstem Binaural Hearing Component: Preliminary Results
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Susan Stanton, PhD; Ewan Macpherson, PhD, Health And Rehabilitation Sciences Graduate Program, 2National Centre For Audiology, Western University, London, ON

A physiological measure of processing of binaural stimuli is the binaural interaction component (BIC) of the auditory brainstem response (ABR), defined as the difference between the ABR evoked by binaural stimuli and the sum of the left and right monaurally evoked ABRs. To identify neural plasticity in brainstem BIC generators, normative data for the stability of the BIC across recording sessions are required. Five channels (earlobes, parieto-occipital, and neck) of chirp-evoked ABR were recorded in normally hearing listeners in two consecutive sessions in unilateral, diotic and dichotic stimulus conditions. The dichotic stimuli varied in interaural time difference (ITD). BICs were computed for each binaural stimulus, and normative data were obtained by comparing the latency and amplitude of the BIC, and their dependency on ITD, across sessions. The amplitude and latency of the BIC remained stable across channels in the diotic condition. Dichotic (non-zero ITD) stimuli delayed the peaks and reduced the amplitude of the BIC in all channels. Repeated measures analyses revealed no significant differences in these effects across the recording sessions. We will apply the normative data for our future study to investigate changes in the asymmetrically stimulated brainstem by recording the BIC before and after a corrective treatment.

Poster # 105 - (EP15)

Neural Correlates of Age-related Changes in Auditory Temporal Processing **New Investigator Poster Award**
Samira Anderson, PhD; Sandra Gordon-Salant, PhD; Casey Gaskins; Matthew Goupell, PhD, University Of Maryland, College Park, MD

Older adults often report that they experience difficulty hearing, especially in challenging listening environments. This hearing decline may be attributed in part to decreased processing of rapidly changing auditory information. Perceptual experiments have demonstrated that older adults have greater difficulty discriminating between words that differ on brief temporal cues than younger adults. To investigate the neural mechanisms underlying these deficits, psychophysical functions were obtained for pairs of contrasting words that differ on a 7-step continuum based on silent interval duration ('dish' vs. 'dish'), and frequency following responses (FFRs) were recorded to the endpoints of this continuum in groups of young normal hearing (YNH), older normal hearing (ONH), and older hearing impaired (OHI) listeners. Psychophysical testing demonstrated that both ONH and OHI listeners require longer silence durations to discriminate between 'dish' and 'ditch' than YNH listeners. In the FFR recordings, the salience of the silent interval was reduced by delayed offsets in the ONH and OHI compared to the YNH listeners. Finally, FFR offset latency correlated with the 'ditch-dish' cross-over point on the identification functions across listeners, suggesting that decreased temporal precision contributes to poorer perception of certain speech contrasts in older adults.

Poster # 106 - (EP16)

P300 in Participants with Sensorineural Hearing Loss: Relation to Working Memory and Speech Perception in Noise

Naveen Nagaraj, PhD; Samuel Atcherson, PhD; Jennifer Franklin, AuD, UAMS/UALR, Little Rock, AR

The present study examined the relationship between P300, working memory (WM) and speech perception in noise. 17 participants with SNHL (age: 25 to 75; M=51 years) were recruited and their speech perception ability in noise (SNR loss) were measured using QuickSIN sentences mixed with multitalker babble, restaurant, aircraft and storm noise. WM capacity (WMC) and speed of information processing was measured using automated Listening and Reading span tasks. P300 was recorded using an oddball paradigm consisting of 1000 and 2000 Hz (oddball) stimuli. Correlational analysis revealed that P300 latency and SNR loss correlated significantly with WMC and WM processing speed. However, there was no significant correlation between speech perception scores and P300 latency. P300 amplitude was not associated with WMC, processing speed or SNR loss. Interestingly, linear regression analysis with interaction between WMC, speed of processing and P300 latency explained 56 % variance in SNR loss. These results may suggest that the relation between P300 latency and speech perception in noise may be moderated by individuals WM capacity. P300 latency may be used as an objective clinical tool to gain insight into individual's speed of information processing and WM capacity, which in turn may reflect speech perception ability.

Poster # 107 - (EP17)

Attentional Modulation of Neural Responses in Normal-hearing and Hearing-impaired Listeners

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Auditory selective attention differentially modulates neural processing of simultaneous auditory streams. This study investigates the effect of hearing loss on the neural responses to attended and unattended speech in diotic listening. Eight normal-hearing and eight hearing-impaired young adults participated. Both listener groups were tested on a sentence recognition task with IEEE sentences, and a story comprehension task during which EEG responses were recorded. For both tasks, two simultaneous speech signals were presented at different target-to-masker ratios (TMRs). In one condition, the two speech stimuli were spoken by talkers of the same gender. In another condition, they were of different genders. Speech signals were amplified using the NAL-RP method for the hearing-impaired listeners. Results showed that hearing-impaired listeners demonstrated poorer speech intelligibility and diminished neural modulation responses to both speech streams at more challenging TMRs compared to normal-hearing listeners. Neural modulations of the attended speech were similar between the two groups of listeners when compared at equivalent IEEE recognition performance levels. Finally, differential neural modulations were significantly correlated with speech intelligibility in hearing-impaired listeners. These results suggest that hearing loss negatively impacts sound segregation, making it difficult to employ top-down attention to differentially process different simultaneously presented speech streams.

Poster # 108 - (EP18)

Reduction of Listening Effort with Binaural Algorithms in Hearing Aids: A EEG Study

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Measuring listening effort is an interesting method if hearings aids are evaluated in supra threshold listening situations, where speech intelligibility may not differentiate performance or acceptance. The subjective assessment of listening effort with questionnaires often leads to imprecise and inconsistent results; Therefore it was investigated whether the analysis of the electroencephalogram (EEG) is able to measure the influence of the listening effort on the cognitive load of a hearing aid user. In the study seven subjects were fitted with hearing aids using a binaural algorithm to support listening on the phone. The algorithm was tested both activated and deactivated. While the subjects executed a working memory task, the event-related potentials (ERP) and changes in alpha frequency in the EEG signal were recorded. For variation of the listening effort the background noise was presented at a low and a high SNR. The analysis of the ERP show a more pronounced N1 wave when the binaural algorithm was active and an increased alpha when the binaural algorithm was inactive, both in the low SNR condition. The results support the conclusion that the binaural algorithm reduces listening effort and the EEG measurement is a promising methodology to determine listening effort.

Poster # 109 - (EP19)

Relations Among ABR/MLR Response Measures and Categorical Loudness Judgments
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Monica Hawley, PhD, University of Maryland, Baltimore, MD

The goal of several prescriptive fitting protocols for nonlinear hearing aids is to normalize loudness. It would be beneficial for audiologists to have an objective tool, such as AEPs, to assess loudness perception in difficult-to-test populations, who cannot provide reliable and accurate loudness judgments. Aims of study: to characterize changes in response measures of tone-evoked (500 and 2000 Hz) ABR/MLRs as function of perceived loudness and intensity of these stimuli in 10 normal-hearing adults; to delineate range of levels corresponding to subjects' categorical loudness judgments for these stimuli. ABR/MLRs were recorded at presentation levels corresponding to each listener's loudness judgments for four categories on Contour test of loudness. Results: Group-mean ABR wave V and MLR wave Pa latencies at 500 Hz and 2000 Hz increased significantly as categorical loudness judgments decreased from loud-but-OK to comfortable-but-slightly-soft. Group-mean waves V-V' and Na-Pa amplitudes increased as listeners' loudness judgments increased from comfortable-but-slightly-soft to loud-but-OK for 500 and 2000 Hz. Listeners assigned a 30-40 dB range of intensities when judging the loudness of tone bursts within a specific category, which was true for all loudness categories at both stimulus frequencies. Conclusion: It appears that response measures, especially response latencies, for tone-evoked ABR/MLRs reflect, at least in part, listener's behavioral perception of loudness.

Poster # 110 - (EP20)

Electrophysiological Masking Level Differences with Speech Tokens
Cynthia Fowler, PhD; Emily Wilson, MS, University Of Wisconsin, Madison, Madison, WI

Binaural temporal coding compares the low-frequency signals that arrive at each ear to aid in the detection of a signal in background noise. This effect can be quantified with the Masking Level Difference (MLD). Since verbal speech is a fundamental part of our communication, using speech stimuli in place of tonal stimuli may provide more insight into the ability to hear speech in noise. However, until now the Electrophysiological Masking Level Difference (eMLD) has not been evaluated with speech stimuli. This study evaluates the MLD both behaviorally (bMLD) and electrophysiologically using five speech tokens (nonsense syllables) that vary in consonant and vowel characteristics. The tokens include /AH/, /DA/, /DI/, /TA/, and /WA/ and were chosen to represent a variety of speech characteristics. The bMLDs and eMLDs were measured by threshold differences between SoNo and S-No conditions, with a speech masking noise set to 65 dB SPL, on 20 young, normal-hearing adults. The bMLDs were largest with /AH/ and /WA/ and smallest with /DA/ and /TA/. For the eMLDs, /AH/, /DA/, /DI/, and /WA/ were equally large whereas /TA/ was the smallest. The eMLDs were slightly larger than the bMLDS. Implications of MLD size will be discussed.

Poster # 111 - (EP21)

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

When compared to their non-musician peers, adult musicians demonstrate enhanced speech-in-noise perception (Parberry-Clark et al, 2013), verbal memory (Chan et al, 1998), phonological skills (Deg & Schwarzer, 2011), and reading (Tierney & Kraus, 2013). Recent evidence from auditory brainstem responses suggests that early musical training primes neural plasticity that facilitates listening in degraded environments (Strait et al., 2012). Our study examined the hypothesis that neural enhancements, subsequent to preadolescent musical training, improves binaural speech processing and temporal processing that are known to contribute significantly to speech understanding in complex listening environments (Hirsh, 1950; Snell & Frisina, 2000). We tested middle-school aged (10 - 14 years) children with and without musical training based on years of experience (< 6 months = non-musician; > 1 year = musician) and musical aptitude (Intermediate Measures of Music Audiation; rhythm subtest) on tests of spatial listening (Listening in Spatialized Noise-Sentences Test, Dillon, 2007) and auditory temporal processing (Adaptive Test of Temporal Resolution, Lister et al., 2011). We also measured working memory and visual processing efficiency (picture pattern memory and processing speed; NIH Tool Box) to understand the potential influence of multimodality higher-order cognitive skills over modality-specific enhancements in auditory perceptual processing secondary to musical training.

Poster # 112 - (EP22)

Auditory Function in Patients with Charcot-Marie-Tooth Disease
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Charcot-Marie-Tooth disease (CMT), also known as hereditary motor and sensory neuropathy, is an inherited disorder of the peripheral nervous system. Hearing loss is a relatively common symptom in patients with CMT, and auditory deficit may be associated with neural conduction abnormalities in the afferent auditory pathway. By measuring auditory brainstem responses to three speech stimuli ([ba], [da] and [ga]), this study aimed to identify abnormalities in the brainstem processing of speech in CMT patients. Twenty-four patients confirmed by genetic testing to have CMT participated, and twenty-four age-/sex-matched normal-hearing controls were recruited. Speech-evoked auditory brainstem responses (complex ABR, cABR) and click ABRs were recorded in both groups. Structured questionnaires were administered to evaluate hearing handicap. Interestingly, all CMT patients of this study had normal sound detection, but they showed electrophysiological evidence of auditory neuropathy with delayed or low amplitude auditory brainstem responses. In addition, cross-response phase differences of cABR to three speech syllables were significantly different between the two groups. Subjective hearing difficulties assessed by using questionnaires were slightly prominent in CMT group. Although sound detection evaluated by standard auidiometry is normal, abnormal cABR findings in this study have revealed disturbance in subcortical auditory processing of complex stimuli in CMT patients.

PSYCHOACOUSTICS

Poster # 113 - (PSY08)

Statistical Confidence in the Comparison between Estimated Decision Weights
Samuel Hess, MS; Huanping Dai, PhD, University Of Arizona Dept Of Speech, Language, And Hearing Sciences; Dept. Of Electrical Engineering, Tucson, AZ

In recognizing auditory objects, listeners must compare or integrate information derived from different segments (or pixels) of the sound along time and/or frequency. Within the framework of a linear-observer model of the signal-detection theory, in which the decision variable for discriminating between two objects is expressed as a linear weighted sum of stimulus variables (e.g., sound level of pixels), the pattern of decision weights describes how information is integrated. To accurately determine the pattern of weights the experimenter must establish the statistical confidence in the difference between estimated weights. The purpose of this presentation is to describe how to establish the statistical confidence of the relative magnitude of the estimated weights, and specifically, the confidence interval of an estimated ratio between weights. We examined the effect of various factors on this confidence interval, including internal noise, response bias, number of pixels in the auditory object, and the techniques for estimating decision weights. The results and their implications will be discussed in this presentation.

Poster # 114 - (PSY09)

How Does Musical Training Impact Auditory Streaming?
Aurora Weaver, PhD; Jessica Burford, Auburn University, Auburn, AL

Jeffrey Digiovanni, PhD, Ohio University, Athens, OH

The purpose of this study was to determine if musical training leads to improved auditory streaming. Making sense of the auditory world around us is facilitated through one's ability to organize and group auditory information. Hearing a stimulus in a particular way may be easier to control for a musician or trained ears than for untrained ears (Bregman, 1990); therefore, the impact of musical training on auditory streaming was investigated. The present study measured the temporal delay between the onset of a 21 s sequence of repeating tone triplets (ABA) and the time the listener indicated that two separate sequences (A-A-A-A and -B---B-) were perceived. This was quantified across three conditions which placed different attention demands during the triptone sequence presentation, replicating those utilized in similar streaming investigations (Carlyon et al., 2001). Additionally, a pitch pattern span measure was obtained to evaluate the relationship between pitch pattern capacity and auditory streaming. Preliminary results indicate that attention modulated streaming performance and that the amount of musical training enhanced pitch pattern capacity measures consistent with previous outcomes (Weaver et al., 2015). The further impact of musical experience on auditory streaming will be discussed.

Poster # 115 - (PSY10)

On Estimating Internal Noise: Comparison of Three Methods

Huanping Dai, PhD, Auditory Perception And Amplification Lab Dept Of Speech, Language, And Hearing Sciences, Tucson, AZ
Samuel Hess, MS, Dept Of Speech, Language, And Hearing Sciences; Dept Of Electrical Engineering, Tucson, AZ

Human observers are noisy, in that their responses to identical stimulus input played repeatedly are not always identical. As a result, human perception is, to some degree, inherently inconsistent and unpredictable. Within the framework of the signal-detection theory (SDT), the limited consistency and predictability of human responses in psychophysical tasks is modeled by including a parameter called the internal noise. The internal noise will pose a limitation to the task performance. Since understanding task performance is a primary goal of human psychophysics, it is important that we have ways to estimate internal noise accurately. The purpose of this presentation is to compare three methods for estimating internal noise from a simulated observer: 1). Algebraic method; 2). Binomial logistic-regression method; 3). Double-pass method. The results indicate that each method has its particular strength and weakness, and that practical applications may require a combination of two or all three methods.

Poster # 116 - (PSY11)

Evaluation of Cochlear Implant Candidates using Spectrotemporal Modulations Test

Ji Eun Choi, MD; Il Joon Moon, PhD; Jung-min Ahn, MD; Jinryoul Kim, PhD; Heesung Park, PhD; Sung Hwa Hong, PhD, Samsung Medical Center, Seoul

This study explores a possibility that spectrotemporal modulation (STM) detection test can be a viable option for CI candidacy evaluation. Twenty four patients with moderately severe to profound hearing loss participated in this study. Unaided spectral modulation detection (SMD) and STM detection tests were applied during CI candidacy evaluation. The STM detection test consisted two different temporal

modulation rates and three different spectral modulation densities, producing a total 6 different STM stimulus conditions. Correlation analysis between performance of psychoacoustic tasks and sentence recognition scores in quiet were performed. Correlation analysis showed that unaided SMD and STM detection thresholds except for 1.0 c/o and 10 Hz were significantly correlated with aided sentence recognition scores in quiet. When created new equation using combination of weighted STM stimulus conditions, the prediction was stronger with new equation (r_s=-0.834, $p<0.001$) than that from SMD threshold (r_s=0.790, $p<0.001$). The new equation showed good diagnostic value, with a derived area under the ROC curve of 0.9545, sensitivity of 100%, and specificity of 90% by finding the cutoff value for predicting sentence recognition scores less than 50%. Unaided STM detection thresholds were predictive of speech recognition performance and it could enable an efficient process for evaluating CI candidacy.

Poster # 117 - (PSY12)

Build-up Effect of Auditory Stream Segregation using Amplitude-modulated Narrowband Noise
Harley Wheeler; Yingjiu Nie, PhD; Alexandria Matz, James Madison University, Harrisonburg, VA

Recent psychoacoustic experiments (Deike et al., 2012, B-ckmann-Barthel et al., 2014) have re-examined research regarding stream segregation and the build-up effect. Stream segregation is the ability to discern auditory objects within a stream of information; such as distinguishing one voice amongst background noise. Initial works examining this topic proposed that auditory information is not immediately distinguished as various streams, but rather that differences accumulate cognitively over time, allowing listeners to segregate information following a period of build-up (i.e., the build-up effect); whereas more current findings indicate a build-up period is unnecessary for segregation. This experiment has modified those prior to define response functions at earlier windows of stimuli presentation, attempting to minimize data extrapolation. Listeners in this experiment indicated whether they experienced one or two auditory streams during a 24.7 second window of stimuli presentation consisting of alternating A and B noise bursts. This experiment examined possible correlations of spectral difference, amplitude modulation rate, and initial response of stream number. Results thus far indicate a strong correlation between initial response and spectral difference, but that AM-rate does not appear to influence initial response. Our findings are consistent with recent reports. Findings on cochlear implant users will also be discussed.

Poster # 118 - (PSY13)

Relationships of Cognitive Abilities to Spectro-Temporal Ripple Detection
Benjamin Kirby, PhD; Meredith Spratford, AuD; Judy Kopun, MA; Ryan McCreery, PhD, Boys Town National Research Hospital, Omaha, NE
Kelsey Klein, University Of Iowa, Iowa City, IA

The ability to understand speech is thought to be related to ability to detect spectral detail in complex and changing acoustic signals. Spectro-temporal ripple detection is positively related to listener age and aided audibility in children (Kirby et al. 2015). The purpose of this work was to establish the contribution of general cognitive abilities such as working memory and executive function to spectro-temporal ripple detection threshold in addition to known predictors of listener age and audibility. Children with mild-to-severe bilateral sensorineural hearing loss who were full-time hearing aid users completed the spectral-

temporally modulated ripple test (SMRT, Aronoff and Landsberger, 2013), and measures of aided audibility (SII), sustained auditory attention, executive function, non-verbal intelligence, and both auditory and visual working memory. A generalized linear model (GLM) fit of the data was completed. Auditory working memory was found to be a significant positive predictor of spectro-temporal modulation ripple detection threshold in the overall model, independent of listener age and aided SII.

Poster # 119 - (PSY14)

Effects of Self-generated Noise on Children's Pure-tone Detection Thresholds
Emily Buss, PhD; John Grose, PhD; Joseph Hall, PhD, UNC School Of Medicine, Chapel Hill, NC
Heather Porter, PhD, University Of Southern California, CA
Lori Leibold, PhD, Boys Town National Research Hospital, Omaha, NE

Detection in quiet develops earlier in childhood for high than low frequencies. The present study tested the hypothesis that self-generated noise plays a role in this finding. When adults listen for sounds near threshold, they tend to engage in behaviors that reduce physiologic noise (e.g., quiet breathing), which is predominantly low frequency. Children may not suppress self-generated noise to the same extent. This possibility was evaluated by measuring sound levels in the ear canal simultaneous with adaptive threshold estimation for 250-, 1000- and 4000-Hz pure tones. Stimuli were delivered and recordings were made using a receiver/microphone assembly coupled to a foam insert. Listeners were children (4.3-16.0 yrs) or adults. Consistent with previous data, the effect of child age was robust at 250 Hz, whereas thresholds of even the youngest listeners were nearly adult-like at 4000 Hz. The spectral shape of self-generated noise was generally similar across listener age groups, although the magnitude was higher in younger listeners. Trial-by-trial data were evaluated to assess the relationship between noise levels and response accuracy: there was an association for younger listeners. These results are consistent with the hypothesis that self-generated noise plays a role in the prolonged development of low-frequency detection in quiet.

Poster # 120 - (PSY15)

Binaural Pitch Fusion in Normal-Hearing and Hearing Impaired Children
Curtis Hartling, AuD; Jennifer Fowler, AuD; Gemaine Stark; Anna-Marie Wood; Ashley Sobchuk; Yonghee Oh, PhD; Daniel Talian; Lina Reiss, PhD, Oregon Health & Science University, Portland, OR

Recent evidence indicates that many hearing-impaired adults have broad binaural pitch fusion, such that sounds with large pitch differences are fused across the two ears and lead to detrimental binaural averaging of spectral information. In this study, binaural pitch fusion was measured in children between 6-8 years old with normal-hearing, bilateral hearing aids, bimodal cochlear implant and hearing aid, and bilateral cochlear implants. Stimuli used were tones or electrodes, depending on listening modality. Fusion ranges were measured by simultaneous, dichotic presentation of reference and comparison stimuli in opposite ears, and varying the comparison stimulus to find the range that fused with the reference stimulus. Compared to adults, children in all groups except the bimodal group had broader fusion. Across groups, normal-hearing and bimodal children had sharper fusion than hearing aid children. The bilateral cochlear implant group was highly variable, with some children fusing all electrodes, and others exhibiting no fusion. The findings suggest that fusion is still developing at this age,

and that hearing device type may influence the development of fusion. A long-term objective is to follow children over time and determine how fusion changes during development, and the clinical implications of these group differences for rehabilitation.

OTOACOUSTIC EMMISSIONS

Poster # 121 - (OAE07)

A Critical Study of Perception of the Double Vowel
Anusha Yellamsetty, PhD; Shaum Bhagat, PhD, The University Of Memphis, Memphis, TN

Normal hearing listeners take advantage of the fundamental frequency (F0) and level differences of vowels to segregate one talker from competing talkers. When two vowels are presented simultaneously it is believed that the amount of masking provided by one vowel on the other contributes to the percept of the listener (either vowels, or only one). Individual differences in vowel perception in the double vowel paradigm may be explained by inter-subject differences in cochlear compression. Individuals with a strong compressive nonlinearity near the cochlear place where the target vowel is processed may exhibit differences in which vowels are perceived compared with individuals with a weaker compressive nonlinearity. The present study is designed to investigate the relationship between cochlear compressive non-linearity inferred through measurement of otoacoustic emission input-output functions (I/O) functions and the perceptual benefit of f0 and level difference in double vowel conditions. Six concurrent vowel pairs were presented to the normal-hearing listeners in different combinations with F0 differences of 2 semitones and 4 level differences (10 dB step) of the masker vowel. Stimulus frequency otoacoustic emissions (SFOAE) and distortion product otoacoustic emissions (DPOAE) I/O functions were measured with evoking tones configured to match the formant frequencies of the double vowel combinations. Statistical analysis were carried out to examine correlations of percentage correct identification scores to the amount of cochlear compressive nonlinearity. The implications of the findings of the study for identification of concurrent vowels will be discussed.

Poster # 122 - (OAE08)

Perceptual Correlates of Weakened Cochlear Compression during Aging
Amanda Ortmann, PhD; Carolina Abdala, PhD; Yeini Guardia, University Of Southern California, Los Angeles, CA

Distortion product otoacoustic emissions (DPOAEs) recorded as a function of stimulus level form input/output (I/O) functions, providing an indirect measure of cochlear compression. Compressive nonlinearity in the cochlea is necessary to maintain a wide dynamic range of hearing. During early aging, it appears to weaken. In some middle-aged ears, the DPOAE I/O shows an extended range of monotonic growth (compared to young-adult ears), even after accounting for age-related variations in hearing threshold. It is likely that compromised DPOAE compression has perceptual correlates. Here we examine preliminary associations between compressive features of the DPOAE I/O function and categorical loudness scaling in young-adult and aging ears. 2f1-f2 DPOAEs were recorded using swept primary tones at levels varying from 25-80 dB SPL. The distortion component of the total DPOAE was isolated and I/O functions were constructed at six half-octave intervals from 1.3-7.4 kHz. Also, categorical loudness

scaling was conducted at each of these six test frequencies. The slope of the loudness rating x stimulus level function was calculated and correlations between DPOAE compression and loudness rating were analyzed. We hypothesize that those with atypical measures of cochlear compression (indicated by the DPOAE I/O function) will show more rapid growth of loudness.

Poster # 123 - (OAE09)

Click-evoked Otoacoustic Emissions Measured using Three Non-linear Extraction Strategies
James Lewis, PhD; Kristen Waggoner; Mary Easterday, AuD, University Of Tennessee Health Science Center, Knoxville, TN

Measurement of short-latency click-evoked otoacoustic emission (CEOAE) components requires a non-linear extraction strategy to minimize stimulus artifact that otherwise contaminates the early-time portion of the ear-canal response. This study compared the effectiveness of different strategies in reducing artifact and examined the effect of strategy on the measured CEOAE. Click responses (44-86 dB pSPL) were measured in an IEC711 coupler and normal-hearing ears using (1) double-source, double-evoked, (2) single-source non-linear differential and (3) stimulus scaling strategies. Artifact-free time-frequency windows were defined from the coupler responses and used to extract the CEOAE from the ear-canal responses. The double-source, double-evoked strategy yielded greatest attenuation of artifact and permitted measurement of the shortest-latency components. High-level artifact contaminated the initial milliseconds of the click responses for the single-source non-linear differential strategy and, to a lesser extent, the stimulus-scaling strategy. Consequently, the contributions from short-latency components to the emission were sometimes reduced. The growth rates and relative magnitudes of the different-latency components were sensitive to extraction strategy and influenced the latency-intensity function. Of the different strategies, stimulus-scaling had the advantage of reduced test time and lower noise levels. OAE extraction strategy may be important to consider when comparing OAE-based metrics to behavioral and/or electro-physiologic responses.

Poster # 124 - (OAE10)

Contralateral Suppression of Otoacoustic Emissions in Ears with Spontaneous Components
Wiktor Jedrzejczak, PhD; Krzysztof Kochanek, PhD; Henryk Skarzynski, PhD, World Hearing Center, Institute Of Physiology And Pathology Of Hearing, Kajetany

The effect of suppression of otoacoustic emissions (OAE) by contralateral stimulation has quite high variability across the subjects. One of the features that differentiates subjects is presence or absence of spontaneous OAEs (SOAEs). The purpose of the present study was to compare the levels of contralateral suppression of transiently evoked OAEs (TEOAEs) in ears with and without SOAEs. OAEs were recorded in a group of adults with normal hearing thresholds and normal tympanograms. TEOAEs were recorded using linear protocol (all stimuli at same level and polarity), stimulus levels were kept at 60 dB peSPL, and 65 dB SPL broadband noise was delivered to contralateral ear as a suppressor. Each subject was tested for the presence of SOAEs using the synchronized SOAE technique.

Poster # 125 - (OAE11)

Contralateral Suppression of TEOAEs and ASSRs Measured Concurrently
Ian Mertes, PhD; Barden Stagner; Erin Wilbanks, AuD; Marjorie Leek, PhD, VA Loma Linda Healthcare System, Loma Linda, CA

In normal-hearing individuals, medial olivocochlear (MOC) function is typically quantified as the change in otoacoustic emission (OAE) amplitude with versus without contralateral stimulation that activates the MOC (contralateral suppression). OAEs are weak or absent in hearing-impaired ears, so alternative methods to assess the effects of hearing loss on the MOC warrant exploration. Suprathreshold auditory steady-state responses (ASSRs) can be measured in people with mild-moderate hearing loss, so contralateral suppression of ASSRs may allow for the study of MOC function in some hearing-impaired individuals. This study compared contralateral suppression of ASSRs and transient-evoked OAEs (TEOAEs) in adults with normal hearing or mild sensorineural hearing loss. Measurements were made concurrently using the same stimuli to reduce methodologic differences and changes in subject state between tests. Responses were elicited using clicks presented at a rate of 39.06/s at 55 and 65 dB pSPL. Measurements were made with and without broadband noise presented contralaterally at 60 dB SPL. Preliminary results showed that contralateral suppression was typically larger using ASSRs relative to TEOAEs. Results will be discussed in terms of the feasibility of using contralateral suppression of ASSRs to measure MOC and the relationship between speech-in-noise performance and contralateral suppression of ASSRs and TEOAEs.

Poster # 126 - (OAE12)

2f2-f1 DPOAE Sources in Contradiction to the Two-Source/Two-Mechanism Model?
Jennifer Horn, PhD; Sheila Pratt, PhD; John Durrant, PhD; Catherine Palmer, PhD, University Of Pittsburgh, Agoura Hills, CA
Peter Torre, PhD, San Diego State University, San Diego, CA

Distortion product otoacoustic emissions (DPOAEs) can be separated into distortion (active/hair-cell-generator-based mechanism) and reflection sources (passive/hydro-mechanically-based mechanism) linked to specific physiological-acoustic events along the cochlear partition. Researchers have shown that 2f1-f2 (using parameters f2/f1=1.22, 65/55 dB SPL) is dominated by the distortion source. However, 2f2-f1 is far less well understood and rarely tested. Measured with optimal parameters, f2/f1=1.08, 65/65 dB, 2f2-f1 likely is dominated by the reflection source. The purpose of this study was to determine how sources differ between 2f1-f2 and 2f2-f1 using fine-structure analyses elicited by parameter sets promoting robust responses: (1) f2/f1=1.22, 65/55 dB and (2) f2/f1=1.08, 65/65 dB. Fine-structure spectra, representing four parameter combinations, were elicited from each participant for comparison. The results affirmed that the distortion source is dominant for 2f1-f2 DPOAEs when measured using f2/f1=1.22, 65/55 dB - a finding demonstrated in all participants. Second, the reflection source was dominant for the other three conditions, with 100% occurrence for 2f2-f1 DPOAEs measured using the f2/f1=1.08, 65/65 dB. Lastly, although not contradicting the two-source/two-mechanism model overall, other observations will be presented that argue for some revision of the prevalent model to include upper sideband DPOAEs.

HEARING LOSS / HEARING DISABILITY

Poster # 127 - (HLD01)

Comparison of Limitation Volume Levels to Music using Mobile Phones
Gibbeum Kim, BS; Woojae Han, PhD; Jihyeon Lee, Hallym University, Chuncheon, Gangwondo

Today, people listen to music loudly on their personal listening devices including a mobile phone. This study estimated the output levels of different music genres at and above the recommended limitation volume levels for mobile phones. Six mobile phones (e.g., Galaxy Note 3 and S6 from Samsung Co., G2 and G3 from LG Co., Iphone 5S and 6 from Apple Co.) and four music genres (i.e., ballad, dance, pop, hip-hop) were measured at their limitation levels and higher volume steps, using a sound level meter and a 2cc coupler with artificial mastoid. The results showed that Galaxy S6 had the lowest output level at the limitation volume level, while dance was slightly higher than other genres. Higher volume levels were needed for the middle frequency, compared to the lower and higher frequencies. We conclude that the recommended limitation volume levels provided by mobile companies are not low enough to prevent noise-induced hearing loss if users continue to listen to music at those levels. Moreover, as environmental noise increases, total output levels will increase, which suggests that public education and more concrete functions to restrict these output levels are needed to prevent potential hearing loss and tinnitus.

Poster # 128 - (HLD02)

Sound Exposure of University Music Students and Potential Hearing Risk
Jason Smith, BA; David Velenovsky, PhD; James Dean, AuD, University Of Arizona, Tucson, AZ

It is known that musicians are exposed to high levels of sound throughout regular individual practice, ensemble rehearsal and performance. There is evidence to suggest that musicians can exceed daily allotments of noise exposure in 2 hours of practice threefold. As a result, these individuals may have an increased risk of noise induced hearing loss (NIHL). To explore this, measurements of sound level exposure were taken of music students during practice using noise dosimetry. We will also address the occurrence of any hearing threshold shift observed for each session. This poster's goal is to present maximum sound pressure levels as well as equivalent sound levels according to The National Institute for Occupational Safety and Health (NIOSH) and Occupational Safety and Health Administration (OSHA) guidelines during a single individual practice session for a variety of musical instruments.

Poster # 129 - (HLD03)

Mild-to-Moderate Hearing Loss and Psychomotor Performance of Professional Drivers
Mariola Sliwinska-Kowalska, MD; Piotr Kotylo, MD; Jadwiga Siedlecka, PhD; Marcin Kossobudzki, MA; Alicja Bortkiewicz, PhD, Nofer Institute Of Occupational Medicine, Lodz

Sufficient functional hearing abilities are necessary for safe and effective performance of several hearing-critical jobs. The aim of this study was to assess the relationship between bilateral mild to moderate hearing loss of professional drivers and their performance in a bus cabin simulator. In total 63 men were included into this study. Hearing was assessed by pure-tone audiometry (PTA) and Hearing in Noise Test (HINT). Psychomotor performance was assessed during the simulation of driving a city bus, through

registration of driving technique indicators and instances of causing a collision. The results show that with greater hearing threshold shift the braking was less frequent and deceleration time was shorter. A statistically significant difference was found between normal hearing subjects and the drivers with hearing loss higher than 40 dB on average in high and middle audiometric frequencies. The risk of causing a collision was several times lower in drivers with hearing loss comparing with normal hearing subjects. Good correlation was found between PTA and HINT results in relation to psychomotor performance. Hearing loss seems to affect the driving technique. Contrary to the initial hypothesis, the drivers with mild to moderate hearing loss drive more cautiously than their normal hearing colleagues.

Poster # 130 - (HLD04)

Speech, Spatial, and Qualities of Hearing Scale: SSQ5 or SSQ12?
Elaine Kim, BA; Hua Ou, MD, Illinois State University, Normal, IL

The Speech, Spatial, and Qualities of Hearing Scale (SSQ) was developed to measure a range of hearing disabilities. A reduced 12-item version (SSQ12)was handcrafted based on experts' opinions, whereas the 5-item version of SSQ (SSQ5) was developed primarily from a cluster analysis. Both were claimed for hearing disability screenings. The purpose of the study was to compare SSQ-full version scores to the reduced version scores, and to investigate the degree of agreement between the SSQ12 and SSQ5 when collected from the same full version and as separate entities. Twenty-four hearing aid users completed the full-version SSQ; the appropriate items for each reduced versions were selected for both SSQ12 and SSQ5. Preliminary data (n=14) from the other group of hearing aid users was collected for SSQ5 and SSQ12 separately. The results from both analyses indicated that the individual total scores of the SSQ12 were consistently lower than those of the SSQ-full and SSQ5. The intraclass correlation coefficient (ICC) of total scores was 0.86 and 0.67 between the SSQ5 and SSQ12 extracted from the full form and as separate entities, respectively. The SSQ5 may serve as a better screening tool over the SSQ12.

TRAINING / REHABILITATION

Poster # 131 - (TR01)

Effects of Intensive Piano Training on Auditory and Cognitive Processing
Celia Riffel, BA; Jennifer Lister, PhD; Nathaniel Maxfield, PhD, University Of South Florida Department Of Communication Sciences And Disorders, Tampa, FL

Computerized, adaptive, process-based auditory training programs have been shown to improve working memory, speed of processing, and everyday function among older adults but compliance is often a problem. It is thought that a more engaging and social program of auditory training may encourage compliance and provide more benefit. Learning to play a musical instrument is a form of auditory training that is adaptive and engaging, and adult musicians are known to have superior auditory processing compared to non-musicians. The purpose of this study was to investigate the effects of an intensive, two-week piano training program on working memory, speed of processing, and executive function for seven older adults (mean age = 70). Participants had fewer than three years of formal music training, minimal hearing loss, and no neurological or cognitive disorders. We hypothesized that the participants would demonstrate training-related improvement on all outcome measures. Paired-sample

t-tests indicated no significant difference between pre- and post-training scores on any of the outcome measures. Results suggest that an intensive piano training program is not a viable alternative for a computerized, adaptive, process-based auditory training program. Results will be compared to recent studies where other types of auditory training have been employed.

Poster # 132 - (TR02)

Can a Computer-Based Auditory Training Program Improve Audiovisual Speech Performance?
Dania Rishiq, PhD, Mayo Clinic, Florida, Jacksonville, FL
Aparna Rao, PhD, Department Of Speech And Hearing Science, Arizona State University, Tempe, AZ
Tess Koerner, AuD, Department of Speech-Language-Hearing Sciences, University of Minnesota, MN
Harvey Abrams, PhD, Starkey Hearing Technologies, Eden Prairie, MN

Audiovisual (AV) speech perception is the process by which auditory and visual stimuli are integrated to understand speech. The multisensory integration of AV speech cues improves recognition accuracy, particularly for speech in noise. The purpose of this study was to measure the training effects of ReadMyQuips™ (RMQ™) on the AV perception of speech. ReadMyQuips™ is a computer-based AV training program designed to improve speech perception in noise. Twenty-four first-time hearing aid users with bilateral mild to moderately-severe sensorineural hearing loss were randomly assigned to either the experimental or control group. The experimental group received RMQ™ training after a trial period with hearing aids; the control group received hearing aids but not the RMQ™ training. The Multimodal Lexical Sentence Test for Adults' (MLST-A) (Kirk et al. 2012) was used to measure AV and auditory-only (AO) speech perception outcomes at three different signal-to-noise ratios (SNRs). Participants were tested at the time of hearing aid fitting, after four weeks of hearing aid use, and following four weeks of RMQ™ training. Results did not reveal an effect of training as measured by the MLST-A. As expected, interactions were found between: (1) mode (AO vs. AV) and SNR and (2) test session and SNR.

Poster # 133 - (TR03)

A Manualized Audiology Intervention: Can Intervention Slow Cognitive Decline?
Courtney Matthews, BA; Victoria Williams-Sanchez, PhD; Michelle Arnold, AuD; Theresa Chisolm, PhD, The University Of South Florida Department Of Communication Sciences And Disorders, Tampa, FL
Frank Lin, MD; Nicholas Reed, AuD, Johns Hopkins University Department Of Otolaryngology- Head And Neck Surgery, Baltimore, MD

Given our aging population and the personal, socioeconomic, and public health implications of cognitive impairment in older adults, new intervention approaches are needed. Epidemiologic studies strongly suggests that age-related hearing loss in older adults is independently associated with accelerated cognitive decline and incident dementia, suggesting the need to examine the effects of comprehensive hearing rehabilitative treatment on the rate of cognitive decline. In planning a randomized controlled trial (RCT) to address this issue, a feasibility study was conducted to manualize best practices audiological intervention. The steps involved included: (a) systematic review of the literature; (b) convening of an expert panel to provide review and input into the clinical protocols; and, (c) implementation of the manualized intervention with 20 older adults and their significant others. Individualized goals were developed with all participants receiving hearing aids, a home-based aural

rehabilitation program and at least one assistive listening device. The steps involved in the development of the manualized intervention, feedback from audiologists and patients, as well as disease-specific (e.g., HHIE, IOI) and generic (e.g., Cohen Social Network Scale, UCLA Loneliness Scale) short-term outcomes, their relationships, and implications for the planned RCT, will be presented. Work supported by NIA R34AG046548 and funding from the Eleanor Schwartz Charitable Foundation.

SPEECH PERCEPTION

Poster # 134 - (SPAD13)

Do Working Memory Abilities Predict the Multimodal Lexical Sentence Test?
Christi Miller, PhD; Erin Stewart; Christopher Bishop, PhD; Kelly Tremblay, PhD, University Of Washington, Seattle, WA
Yu-hsiang Wu, MD; Ruth Bentler, PhD, University of Iowa, Iowa City, IA

A robust relationship between working memory (WM) and speech perception in noise has been previously established in hearing impaired listeners. The goal of this study was to evaluate if this relationship is maintained with more ecologically valid stimuli, using multiple talkers as stimuli to avoid learning of indexical cues. Secondary, we addressed whether this relationship diminished with more complex noise and the addition of visual cues. Sixty-five adults with hearing loss passed the Montreal Cognitive Assessment, and WM was measured with the Reading Span (RS) and the Word Auditory Recognition and Recall Measure (WARRM). Speech perception was measured using the Multimodal Lexical Sentence Test (MLST-A) in 4 conditions: auditory and auditory-visual cues, and speech-shaped noise (SSN) and 4-talker babble. Four multiple-regression analyses were performed with dependent variables of each MLST-A condition. Predictors were age, better-ear hearing, RS and WARRM recall. Both measures of WM had weaker correlations to speech perception than previously reported. The WARRM was a slightly better predictor than RS for all MLST-A conditions. Better-ear hearing and WM explained 35-50% of the variance across MLST conditions. As the MLST-A conditions grew more 'real world,' WM abilities explained less of the variance in speech perception. (NIH NIDCD R01 DC012769-04)

Poster # 135 - (SPAD14)

The Effects of Language on the Graphical Speech Intelligibility Index
In-Ki Jin, PhD; Kyung Ju Lee, Hallym University, Chuncheon
James Kates, MS; Kathryn Arehart, PhD, University Of Colorado, Boulder, Boulder, CO

Graphical methods for calculating Speech Intelligibility Index (SII) like the count-the-dot audiogram are useful tools in quantifying how much audibility is restored due to amplification for individuals having hearing loss. The band-importance function (BIF), which is one of important components for the SII, depends on the language. Thus, language may affect the prediction of audibility using the graphical SII. This study aimed to apply BIFs to the development and comparison of graphical SIIs for English, Korean, and Mandarin. To derive graphical SIIs for English, Korean, and Mandarin, the authors used BIF data for the three languages and calculated dynamic ranges (DRs) using the same stimuli which were used to derive the BIF of each language. To compare predicted audibility (SII values) among graphical SIIs for the three languages, the authors used a sample of unaided and aided hearing thresholds. The graphical SIIs

for English, Korean, and Mandarin yielded different aided and unaided audibility values for the same audiogram configurations. Because the graphical SII helps patients to easily understand their unaided and aided audibility, it could be a useful tool for counseling in the clinic. Because people speak different languages, the greatest accuracy will be achieved using the language-specific graphical SII.

Poster # 136 - (SPAD15)

Perception of Emotional Speech by Listeners with Hearing Aids
Huiwen Goy, MA; Kathy Pichora-Fuller, PhD, University Of Toronto, Mississauga, ON
Gurjit Singh, PhD, Phonak Canada, Toronto, ON
Frank Russo, PhD, Ryerson University, Toronto, ON

A talker's emotional state is one important type of information carried by the speech signal. While the frequency and amplitude compression performed by hearing aids may make speech easier to understand, little is known about how such processing affects users' perception of emotion in speech. This study investigated how hearing aid use affected the perception of emotion in speech and the recognition of speech spoken with emotion. Listeners were hearing aid users who were tested with and without their aids in separate sessions. They heard sentences spoken by a young female actor portraying different vocal emotions, and were asked to report the keyword and identify the portrayed emotion. The use of hearing aids improved listeners' word recognition performance from 43% correct (unaided) to 68% correct (aided). In contrast, hearing aids did not improve listeners' emotion identification (38% unaided, compared to 40% aided). Emotions that were more easily identified were not necessarily the same emotions associated with better word recognition. We conclude that the types of information carried by the speech signal are differentially affected by hearing aids; in this case, hearing aids improved the recognition of what was spoken but not the identification of vocal emotion.

Poster # 137 - (SPAD16)

Adaptive Methods for Comparing Listener Preferences across Masker Conditions
Doug Brungart, PhD; Lynn Bielski, PhD, Walter Reed National Military Medical Center, Bethesda, MD
Eric Thompson, PhD; Nandini Iyer, PhD, Wright Patterson Air Force Base Research Lab, WPAFB, OH
Pat Zurek, PhD; Jay Desloge, PhD, Sensimetrics Corporation, Malden, MA

When listeners perform speech perception tasks for extended periods several factors might make one type of listening environment more preferable than another even in cases where overall speech intelligibility equal. Listeners were presented with pairs of trials in two different listening conditions, and, after each pair of trials, they indicated which of the two conditions they would prefer to listen to additional trials in. They were then asked to complete a random number of additional trials (from 1 to 5) in the condition they selected prior the next trial, where they again had to select their preference. An adaptive technique was used to adjust the overall and relative SNRs of two listening configurations to the point where either: 1) overall intelligibility was equalized across the two conditions; or 2) the relative preference of the two conditions was equalized across the conditions. Assuming listeners attempt to minimize the total effort required for the task; these results can be interpreted to reflect differences in listening effort across conditions. Preliminary results comparing Audio-Only and Audio-Visual conditions

suggest listeners will tolerate a lower SNR in the AV condition, but require a higher percent correct than the AO condition to consistently chose it.

Poster # 138 - (SPAD17)

Comprehension and Effort for Vocoded Speech Varying in Syntactic Complexity
Eriko Atagi, PhD; Nicole Amichetti, MS; Arthur Wingfield, PhD, Brandeis University, Waltham, MA
Ying-yee Kong, PhD, Northeastern University, Boston, MA

Users' degree of success with their cochlear implants is generally measured by intelligibility for single words or simple sentences. Spoken communication, however, consists of a series of more complex sentences that require greater processing demands. In older adults with hearing loss, such linguistic complexity negatively affects comprehension and encoding of speech due to the extra effort required in the early perceptual stages. Recent studies with young adults listening to vocoded speech suggest that listening effort progressively decreases with increasing spectral resolution, even after intelligibility indicates at-ceiling performance. The present study examined the effort required when older and young adults listened to vocoded speech with varying levels of linguistic complexity (easy [subject relative] and hard [object relative] sentences) at multiple levels of spectral resolution. Response accuracy to questions after each sentence measured listeners' comprehension accuracy; pupil sizes measured listening effort. Results indicate that for both age groups, pupillary response shows a trend towards decreasing listening effort as spectral resolution increases, with older adults exhibiting more effort than young adults. Comprehension accuracy, in contrast, does not differ across age groups. These results suggest that intelligibility measures do not fully capture listeners' success with spoken language understanding.

Poster # 139 - (SPAD18)

Aging and the Recognition of Interrupted Speech
John Grose, PhD; Emily Buss, PhD; Joseph Hall III, PhD, University Of North Carolina At Chapel Hill, Chapel Hill, NC
Heather Porter, PhD, University of Southern California, Los Angeles, CA

This study investigated the effect of age on the ability to integrate sparse speech segments distributed across time, frequency, and ear. The purpose was to determine whether age-related deficits in spectro-temporal integration of speech exist that might contribute to the finding that older listeners exhibit less speech recognition benefit in fluctuating maskers than do younger listeners. Younger, middle-aged, and older listeners (n = 10 per group) with normal/near-normal audiograms listened to IEEE Harvard sentences that had been filtered into two narrow bands centered at 500 Hz and 2500 Hz, where the bandwidths were individually tailored to result in low baseline performance (30-40%) for each band presented alone. These two bands were then square-wave modulated at 10 Hz, either coherently or out of phase, and presented either monaurally or dichotically. Performance was also evaluated with the uninterrupted pair of bands presented either monaurally or dichotically. All age groups showed the same pattern of results with maximum performance seen for the uninterrupted pair of bands (90-100%) and intermediate performance for the other combinations of interrupted segments. These findings suggest that age, per se, does not necessarily result in deficits in spectro-temporal integration of glimpsed speech.

Poster # 140 - (SPAD19)

Effects of Dynamic Pitch on Older Listeners' Speech Recognition in Noise
Jing Shen, PhD; Pamela Souza, PhD, Northwestern University, Evanston, IL

Natural speech has variation in pitch, which serves as an important cue for speech recognition. Dynamic pitch has been shown to improve speech recognition in young listeners with normal hearing. The present study aims to: 1) investigate the effects of dynamic pitch on speech recognition in noise by systematically manipulating the magnitude of pitch variation; 2) explore the influence from envelope modulation in noise on speech recognition; 3) examine the amount of benefit from dynamic pitch on older listeners' speech recognition in noise. Stimuli are low-context sentences with three levels of dynamic pitch strength, embedded in three types of ICRA noises (static, 2-talker babble, 6-talker babble). Speech reception thresholds are measured for young and older listeners with normal hearing. Results to date suggest the effect of dynamic pitch strength on speech recognition in noise varies depending on the modulation depth of the noise. The amount of benefit is also influenced by individual factors of listeners. Implications of evaluating the amount of benefit from dynamic pitch cues for speech recognition in noise are discussed. [Work supported by NIH]

Poster # 141 - (SPAD20)

Teacher & Student Perceptions of Student Classroom Listening Ability
Meredith Spratford, AuD; Ryan Mccreery, PhD, BTNRH, Omaha, NE
Elizabeth Walker, PhD, University Of Iowa, Iowa City, IA

The Speech Spatial and Qualities (SSQ) Questionnaire has been adapted to measure teacher perception of children's listening ability across varying talker and acoustic environments. The current study evaluated the utility of the teacher SSQ as a measure of classroom listening ability for children who are hard of hearing (CHH). Teacher SSQ ratings and student-report of listening ability on the Dockrell & Shield questionnaire (2006) were explored with respect to CHH's aided hearing, speech recognition in noise, language, FM use, and classroom noise level. We examined the relationship between teacher and student report of classroom listening. Fifty-seven first and third grade teachers completed the SSQ and 52 CHH completed the Dockrell & Shield. We predicted that: teachers would rate students with better language, better speech recognition in noise, and higher aided audibility as having less listening difficulty; students in noisier classrooms will report having more difficulty; teachers will underestimate student-report of listening difficulty. Teachers of CHH with better language skills and teachers in noisier classrooms perceived their students as having better listening, controlling for other predictors. Student report of their own listening abilities was positively related to language. There was no relationship between teacher and student perspective of classroom listening ability.

Poster # 142 - (SPAD21)

Effects of Signal Quality on Speech Recognition in Children
Dawna Lewis, PhD; Andrew Dergan; Tessa Mcdermott; Timothy Vallier, MA, Boys Town National Research Hospital, Omaha, NE

Speech recognition requires listeners to process the signal at a variety of levels. The robust nature of speech typically provides listeners with a variety of cues to aid in speech recognition. Children are less able to use many of these cues than adults and, consequently, may be more affected by any degradation of the speech signal. This study examined children's speech recognition under three different types of signal degradation: when the signal itself is (1) severely degraded (sinewave speech) or (2) moderately degraded (amplitude modulated sinewave speech) or (3) when the acoustic environment (background noise) degrades a natural speech signal. Children were asked to repeat any sounds they heard, even if they did not hear complete words or sentences and even if what they heard did not make sense. Responses were scored by phonemes, words and sentences correctly identified. Results revealed significant effects of the type of signal degradation as well as the scoring method. Preliminary results from an ongoing study of children with mild bilateral or unilateral hearing loss also will be shown.

Poster # 143 - (SPAD22)

Impact of Room Acoustics and Visual Cues on Children's Ability to Localize Talkers
Dawna Lewis, PhD; Tessa Mcdermott; Abigael Stewart; Timothy Vallier, MA; Matthew Blevins, MS; Andrew Dergan, Boys Town National Research Hospital, Omaha, NE

Children's ability to locate talkers of interest as well as the speed with which they can perform this task may enhance speech understanding in adverse environments. Visually-guided attention (providing a visual cue to the location of the sound) enhances identification of auditory stimuli for adults with NH and hearing loss. The aim of this study was to examine the effects of visual information on children's ability to locate talkers in varying acoustic conditions representative of those that they may experience in classrooms. To examine localization across varying acoustic settings, children with NH (8-12 yrs) were asked to locate talkers in five locations around the listener as they spoke in two conditions: (1) auditory-only and (2) visually guided auditory with a block of color presented on the target screen simultaneously with the auditory signal. Testing was conducted in three classroom acoustic settings: good, typical and poor. Results revealed significant effects of the availability of visual cues and acoustics on children's localization accuracy and looking times. Preliminary results from an ongoing study of children with mild bilateral or unilateral hearing loss also will be shown.

Poster # 144 - (SPAD23)

Impact of Visual Information on Children's Speech Recognition in Noise and Reverberation
Dawna Lewis, PhD; Abigael Stewart; Tessa Mcdermott; Timothy Valllier; Matthew Blevins, MS; Andrew Dergan, Boys Town National Research Hospital, Omaha, NE

While children's ability to locate talkers can enhance speech perception, this may not always be the case. Previous work from our lab has suggested that under some conditions attempts to locate talkers may have a negative impact on speech understanding. The purpose of this study was to examine children how visual cues impact children's ability to locate talkers and recognize low-context sentences. Stimuli were presented from five locations around the listener as (1) auditory-only; (2) visually-guided auditory; or (3) audiovisual as well as (4) a baseline auditory-only condition from 0o azimuth. Acoustics were set to SNR = 3 dB and RT = 0.6 sec. Children were asked to locate the talker as each sentence was presented and

then repeat the sentence. Responses were scored by number of key words (out of 4) correct and by whether the complete sentence was correct. Results revealed significant effects of both condition and scoring method on percent-correct identification. Significant effects of condition also were found for localization accuracy and overall looking time. Preliminary results from an ongoing study of children with mild bilateral or unilateral hearing loss also will be shown.

Poster # 145 - (SPAD24)

Using CASPA to Evaluate Bilingual Children's Speech Perception: Developmental Effects
Jennifer Schmaus; Nancy He; Paula Garcia, PhD; Kanae Nishi, PhD, Boys Town National Research Hospital, Omaha, NE

The Computer-Assisted Speech Perception Assessment (CASPA; Boothroyd 2008) was developed in English (E-CASPA) and Spanish (S-CASPA) to quickly assess speech perception in adults. Research has shown that E-CASPA performance for English-speaking children 5 years and older can be evaluated using adult norms (McCreery et al. 2010). Previously, we have reported that 11 Spanish-English bilingual children (ages 6-12) performed similarly to English-speaking peers on E-CASPA, but performed more poorly on S-CASPA than on E-CASPA (Garcia et al. 2015). The present study examined the combined effects of development and language background with a larger group of normal-hearing Spanish-English bilingual children (ages 5-13). Participants listened to a total of 200 words in each language presented at -10, -5, 0, and 5 dB SNR as well as in quiet. Results show that, in both languages, the youngest children performed more poorly than older children. On E-CASPA, bilingual children performed similarly to their monolingual English peers, suggesting that despite the developmental effect, E-CASPA performance of bilingual children 5 years and older can be evaluated using the norms for English-speaking adults. Contrary to the previous report, no difference was observed between bilingual children's performance on E-CASPA and S-CASPA. The implications of these results will be discussed.

Poster # 146 - (SPAD25)

Sentence Materials to Examine Context Use in School-Age Children
Nancy He; Jennifer Schmaus; Paula Garcia, PhD; Abigael Stewart; Dawna Lewis, PhD; Tessa McDermott; Kanae Nishi, PhD, Boystown National Research Hospital, Omaha, NE

This study reports the process and current status of a project creating a large sentence bank using the cloze-probability method to study the use of context in school-age children. Cloze-probability represents the likelihood that sentence context can trigger the expectation of a specific last word. The goals of the present study were two-fold: (1) to compile and expand existing adult and child cloze-probability sentences; (2) to evaluate the updated sentence bank with school-age children. A large bank of sentences compiled from existing materials was modified to ensure that lexicon and syntax were appropriate for 6-year-old children. For evaluation, the final 855 sentences were presented to 72 children (6-12 years) and 10 adults for an auditory sentence completion task. Results show that there is an approximately equal number of sentences in each decile of cloze probability, across the listener population. Furthermore, both the agreement with adult responses and the number of high-probability sentences increase with age. These results indicate that the cloze-probability represented in this sentence bank is appropriate for

evaluating developmental effects on usage of sentence context. Additional results, future directions, and wider uses of this sentence bank will be discussed.

Poster # 147 - (SPAD26)

Cues for Vowel Identification Used by Children with Hearing Impairment
Mark Hedrick, PhD; Kristen Mills, MA; Kelly Yeager, AuD, The University Of Tennessee, Knoxville, TN

Previous research has shown the importance of both transition and formant patterns for vowel identification, and the importance of vowel information for sentence intelligibility. There has been little work, however, investigating perception of vowels by children, particularly children with hearing loss. We examined the effects of cue type and corresponding duration for vowel identification in children aged 4-8 years, either wearing hearing aids or using cochlear implants. Adults with normal hearing and age-matched children with normal hearing served as controls. Participants were presented three naturally-produced /bV/ words sliced into five segments (full initial transition into the vowel, half the transition, full vowel steady-state center, half and quarter the vowel center) in the sound field. Aided participants used their everyday settings on their devices. Participants determined the vowel presented by selecting from corresponding pictures on a computer screen. Results show statistically significant effects of vowel, slice, group, and a slice x group interaction. Further analysis of the interaction showed that adult performance did not vary based on slice duration; however, children demonstrated worsening performance with shorter duration, particularly the children with hearing loss. This may have implications for how children may be able to use vowel information to foster intelligibility.

AMPLIFICATION

Poster # 148 - (AMP10)

Contribution of Aided Audibility to Real-world Hearing Aid Outcomes
Subong Kim, MS; Yu-hsiang Wu, PhD; Elizabeth Stangl, AuD; Ruth Bentler, PhD, The University Of Iowa, Iowa City, IA
Christi Miller, PhD; Christopher Bishop, PhD; Kelly Tremblay, PhD, the University of Washington, Seattle, WA

The relationship between audibility and speech recognition performance has been well established. Evidence also indicates that when hearing aids provide better audibility (i.e., aided audibility), children with hearing impairment tend to have better speech/language development. However, the relationship between aided audibility and real-world hearing aid outcomes for adults remains unknown. The purpose of this study was to examine the contribution of aided audibility to real-world outcomes for adult hearing aid users. Fifty-one adults who have worn hearing aids for at least six months were recruited at two sites (University of Iowa and University of Washington). Aided audibility was quantified by the aided Speech Intelligibility Index (aSII), which was computed using measures of the amplified signal provided by the participants' hearing aids at the ear drum with an input of 65 dB SPL. Hearing aid outcomes were assessed using standardized questionnaires, including APHAB, SADL, HHIE/A and SSQ. Analyses indicated that higher aSII was significantly associated with better outcomes in speech understanding (the

BN subscale of the APHAB) and hearing related handicap (HHIE/A). The implication of the importance for audiologists to ensure audibility when fitting hearing aids will be discussed (Work supported by R01 DC012769-04 awarded to RB and KT).

Poster # 149 - (AMP11)

Acceptable Hearing Aid Throughput Delay for Listeners with Hearing Loss under Noisy Conditions
Justin Burwinkel, AuD; Martin Mckinney, PhD, Starkey Hearing Technologies, Eden Prairie, MN

Previous research has shown that normal hearing listeners can perceive distortions due to hearing aid delays as low as 4 to 5 msec [Agnew & Thornton, 2000, J Am Acad Aud, 11(6), 330-336]. Our previous work differentiated detection from subjective judgment of sound quality, finding that, under noisy conditions, acceptable hearing aid delay can be as long as 20 msec for normal hearing listeners [McKinney et al., 2015, Am Aud Soc]. In the present study, we extend the previous investigation on the subjective acceptability of hearing aid latency to listeners with hearing loss. Participants were fit with experimental hearing aids and asked to compare delays spanning 4.5, 15, 20 and 25 msec. The majority of participants found all delays to be acceptable. When detected, own-voice listening was more frequently reported as being unacceptable than were the delays perceived in the speech of others. Agnew, J., & Thornton, J. M. (2000). Just noticeable and objectionable group delays in digital hearing aids. Journal of the American Academy of Audiology, 11(6), 330-336. McKinney, M.F., Burwinkel, J. and Zhang, T. (2015). Maximum Acceptable Delay in Hearing Aids Under Noisy Conditions. American Auditory Society, Poster Presentation.

Poster # 150 - (AMP12)

Effects of Hearing Aids/Assistive Listening Devices on Implantable Cardiac Devices
Farah Dubaybo, BA; Scott Marrus, MD, PhD; Mitchell Faddis, MD, PhD, Washington University School Of Medicine, St. Louis, MO

BACKGROUND: There is controversy regarding the safety of the use of hearing aids/Assistive Listening Devices (ALDs) and their programming equipment in patients with implantable cardiac devices. Examination of device interaction is crucial, as age at cardiac device implantation is correlated with percentage of aging adults with hearing loss (Lin et al., 2011; Zhan et al., 2008). HYPOTHESIS: Electromagnetic interference from hearing aids/ALDs can be incorrectly interpreted as a biological signal, resulting in inappropriate inhibition of pacemaker output and/or activation of defibrillator output. METHODS: A novel approach using explanted cardiac devices was utilized; pacemakers and defibrillators were attached to unipolar leads and applied to the torso of a volunteer, re-creating the use of the body as an antenna. 'Worst case' scenarios were created by increasing device sensitivity and placing ALDs immediately over the cardiac device. RESULTS: Cardiac devices were monitored using manufacturer-specific programmers providing a continuous display of signals sensed by the device. Data was streamed to the hearing aids/ALDs from an audio source or programming software. None of these maneuvers resulted in a) sensed non-cardiac activity or b) failure to sense native cardiac activity. CONCLUSIONS: These findings indicate hearing aids/ALDs and programming equipment do not interfere with cardiac device function.

Poster # 151 - (AMP13)

Acoustic Effects of Amplitude and Frequency Compression on High-frequency Speech
Joshua Alexander, PhD; Varsha Rallapalli, AuD, Purdue University, West Lafayette, IN

Fricative recognition is challenging for hearing aid users because cues are high frequency and low intensity. Therefore, hearing aids must apply significant amplitude compression to make the full bandwidth (FBW) audible, which distorts temporal envelope information. Alternatively, high-frequency cues can be shifted to lower-frequency regions where thresholds are better, using nonlinear frequency compression (NFC). This study examined how the audibility-distortion tradeoff applies to frequency-lowered speech using 31 hearing-impaired participants who identified seven fricatives with an initial /i/ produced by three female talkers. Stimuli and a carrier phrase were processed with/without NFC and by linear amplification and five amplitude compression varieties. Frequency-compressed filters that precisely aligned 1/3-octave bands between input and output quantified audibility and the modulation-transfer function (MTF) ratio (envelope distortion) relative to the input. Modulation was favorable for slow amplitude compression and linear processing, while audibility was favorable for fast amplitude compression. This tradeoff did not differ between NFC and FBW, which were equally effective at improving fricative recognition. Audibility and MTF ratio were significant predictors of recognition across all phonemes. The FBW/NFC covariate and its interactions were not significant, indicating that audibility and modulation were equally important regardless of whether high-frequency information was processed with FBW or NFC.

Poster # 152 - (AMP14)

Updated SADL Norms for Advanced Digital Technology Hearing Aids
Carole Johnson, PhD; Anna Jilla, MS; Jenna Smith; Kristin Winkler; J. Connor Sullivan, Department Of Communication Sciences And Disorders, University Of Oklahoma Health Sciences Center, Edmond, OK
Jeffrey Danhauer, PhD, University of California, Santa Barbara, CA

Advanced digital technology hearing aids (ADTHAs) mandate new norms for outcome measures (OMs). Further, patients with mild or moderate (MM) self-reported unaided communication difficulty may differ in their satisfaction with ADTHAs than those with moderately-severe and worse (MS+) abilities. Our aims were to determine whether the Hosford-Dunn et al (2000) private practice (PrPr) and Uriarte et alls Australian (A) norms for the Satisfaction with Amplification in Daily Life (SADL) needed to be updated to include ADTHAs dispensed in a PrPr setting and if satisfaction differed for MM and MS+ groups. OMs were sent to 500 patients fit with ADTHAs (< 5 y). Over 150 (M = 74 y) new and experienced ADTHA users completed OMs with 4-frequency PTAs ranging from the mild to the profound range in the better ear(M = 51 dB HL). Our data set indicated similar psychometric properties to PrPr and A norms. Our ADTHA users achieved higher mean Positive Effect subscale scores than the A norms. Alternatively, the A norms had higher mean Service and Cost and Negative Feature subscale scores than ours. The MS+ group's mean score on the Positive Effect subscale was significantly higher than that of the MS+ group. Alternatively, the MM group had markedly higher satisfaction on the Negative Feature subscale than the MS+ users. We will discuss implications for clinical practice and research.

Poster # 153 - (AMP15)

Updated IOI-HA Norms for Advanced Digital Technology Hearing Aids

Carole Johnson, PhD; Anna Marie Jilla, PhD; Jenna Smith; Kristin Winkler; J. Connor Sullivan, Department Of Communication Sciences And Disorders, University Of Oklahoma Health Sciences Center, Edmond, OK
Jeffrey Danhauer, PhD, University of California, Santa Barbara, CA

Advanced digital technology hearing aids (ADTHAs) mandate new norms for outcome measures (OMs) that vary on patients' self-reported unaided listening difficulty. We developed new norms for the International Outcome Inventory for Hearing Aids (IOI-HA) and compared them to the Cox et al's (2003) private-pay (PP) and Smith et al's (2009) veteran sample (VS) studies. OMs were sent to 500 patients fit with ADTHAs (< 5 y) in a private practice (PrPr) setting. Over 150 (M = 74 y) new and experienced ADTHA users with 4-frequency PTAs ranging from the mild to profound range in the better ear (M = 51 dB HL) completed OMs. Psychometric data were similar to the VS norms. Moreover, the VS and our updated PrPr norms achieved greater benefit than the earlier PP data set which were based on analog hearing aid (AHAs) users. ADTHA users with self-reported mild or moderate (MM) unaided listening difficulty had higher mean scores on several questions than peers with moderately-severe and worse abilities (MS+). Moreover, the MM users seemed to be achieving greater gains with ADTHAs than the MS+ group when compared to early PP norms obtained with AHAs. Future research must address establishing norms for OMs in light of patients with different abilities and complex reimbursement models for ADTHAs.

Poster # 154 - (AMP16)

Effects of Working Memory and Amplification on Self-adjusted Time-compressed Speech

Jaclyn Schurman, AuD; Douglas Brungart, PhD, Walter Reed National Military Medical Center, Bethesda, MD
Chelsea Vogel; Sandra Gordon-Salant, PhD, University of Maryland, College Park, College Park, MD

The inability to comprehend fast speech is a common complaint among hearing-impaired listeners. This study examined the effect of working memory (WM) and amplification on the comprehension and intelligibility of time-compressed speech in hearing-impaired listeners. The experiment implemented a paradigm allowing listeners to self-adjust the speaking rate of stories from the Discourse Comprehension Test (DCT) to the fastest speed at which they could still understand the story. Previous results from normal-hearing listeners suggest that listeners with higher WM scores tend to adjust speech to a faster rate than listeners with lower WM scores. However, both groups achieved similar levels of intelligibility and comprehension at the self-adjusted rates. In this study, the viability of self-adjusted speaking rate as a measure of hearing aid benefit was evaluated by having hearing-impaired listeners adjust the speed of DCT stories presented in the free field in both aided and unaided conditions. Comprehension and intelligibility were measured at this individually adjusted rate, together with a new measure of verbal-spatial WM called the Letter Location Task (LLT). The results are discussed in terms of the possible use of a 'most-comfortable' listening speed and the LLT as clinical tools to optimize the fitting of hearing aids.

Poster # 155 - (AMP17)

Effects of Hair on Spectral-Temporal Characteristics of Wind Noise
KingDeK Chung, PhD, Northern Illinois University, DeKalb, IL

Most wind noise in hearing aids measurements are made using a manikin without hair. The objective of this study was to examine whether the presence of hair and hair length affect the spectral and temporal characteristics of wind noise in hearing aids. Two hearing aids were programmed to linear amplification with the highest output limiting thresholds allowable by the fitting software. The frequency responses of the omnidirectional (OMNI) and directional (ADM) microphone modes were matched. Wind noise samples were recorded every 10- from 0-360 in an acoustically treated wind tunnel when the two hearing aids were worn on a Knowles Electronic Manikin for Acoustic Research with no hair, short hair, and long hair. The spectral and temporal characteristics of the wind noise recorded with the hearing aids programmed to OMNI and ADM at wind velocities of 0, 2.3, 4.5, 9.0, and 13.5 m/s were analyzed in 1/3 octave bands from 100-8000 Hz. Results showed that the presence of hair significantly altered the spectral and temporal characteristics of wind noise. Wind noise reduction strategies, their applications to wind noise reduction algorithms, and the use of existing signal processing algorithms (e.g., modulation-based noise reduction algorithms) for wind noise reduction will be discussed.

COCHLEAR IMPLANTS

Poster # 156 - (CI09)

Hybrid Cochlear Implants: What Happens If I Lose Hearing?
Camille Dunn, PhD; Marlan Hansen, MD; Bruce Gantz, MD, University Of Iowa, Iowa City, IA

Introduction: The expanded indications provided by the Hybrid L24 Cochlear Implant System have led many hearing professionals to ask questions about the use of this device. One of the foremost questions asked is what happens if the patient has minimal or no preservation of low-frequency acoustic hearing following implantation. The purpose of this talk will be to discuss possible outcomes for patients who are implanted with a Hybrid electrode, but lose significant residual hearing in the implanted ear following surgery. Methods: Pre- and postoperative audiograms and speech perception performance will be described for patients implanted with a Hybrid cochlear implant. Results: Patients with various levels of low-frequency acoustic hearing preservation can benefit from the Hybrid L24 Implant System. These patients demonstrate significant benefits, including the ability to understand speech in adverse listening conditions as well as their overall quality of life. Conclusion: It is important for hearing professionals to understand the various outcomes associated with patients implanted with a Hybrid L24 cochlear implant. While the goal of this device is to preserve the anatomy of the inner ear, in cases where patients maintain minimal or no low-frequency acoustic hearing, benefits still surpass their preoperative performance.

Poster # 157 - (CI10)

Current Profile of Adults Presenting for Preoperative Cochlear Implant Evaluation
Jourdan Holder, BS; René Gifford, PhD, Vanderbilt University, Nashville, TN

Background: Considerable advancements in cochlear implant (CI) technology (e.g., EAS/Hybrid systems) and assessment materials have yielded expanded criteria. Despite this, it is unclear whether individuals

with better audiometric thresholds and speech understanding are being referred for CI workup and/or pursuing cochlear implantation. Purpose: To characterize the mean auditory and demographic profile of adults presenting for preoperative CI workup. Research Design: Data were collected prospectively for all adult preoperative workups at Vanderbilt from 2013 to 2015. Study Sample: 288 adults (253 postlingually deafened), mean age of 62 years. Methods: Each individual was assessed using the minimum speech test battery, spectral modulation detection, subjective questionnaires, and cognitive screening. Results: Mean CNC word scores, AzBio sentence scores, and pure tone average (PTA) for postlingually deafened adults were 12%, 15%, and 88 dB HL, respectively, for the ear to be implanted. 14% of individuals met labeled indications for Hybrid-L. Conclusions: Results suggest a minimal improvement in mean speech understanding and PTA evaluated at CI workup compared to previous studies. Greater awareness and insurance accessibility may be needed to make CI technology available to the greater EAS/Hybrid qualifying population as well as individuals meeting conventional CI criteria.

Poster # 158 - (CI11)

Spatial Release from Masking in Adults with Bilateral Cochlear Implants
Timothy Davis, AuD; René Gifford, PhD, Vanderbilt University, Nashville, TN

Spatial separation of talkers and distracters produces substantial improvement in speech understanding for normal-hearing listeners. Bilateral cochlear implant (CI) users can benefit from this cue, but to a lesser extent. The conventional method for assessing spatial release from masking (SRM) may not be ideal for implant users, as a distracter at -90o produces maximal interaural time difference (ITD) cues but less than optimal interaural level difference (ILD) cues. CI users are known to be minimally sensitive to ITD cues instead relying on ILD cues for localization and spatial hearing. Thus, it is possible that previous studies have underestimated SRM for CI users. We derived performance-azimuth functions for 10 adults with bilateral CIs by assessing spatial release from masking with the target talker fixed at 0o azimuth, and the distracter placed in 20o increments from 10-90o on both sides. Our results show that 1) maximum SRM (5.3 dB) can occur with the distracter at less than 90o, and 2) SRM can be heavily influenced by whether the distracter is located on the 'better' vs. 'poorer' hearing side.

Poster # 159 - (CI12)

Does Contralateral Amplification Improve the Cochlear Implant Listening Experience?
Todd Ricketts, PhD; Erin Picou, PhD; Kristen D'onofrio, AuD, Vanderbilt University Medical Center, Nashville, TN

Listening effort and the listener's ability to locate a talker of interest quickly and accurately (gross localization) contribute to a listener's overall listening experience. However, little is known about how bimodal listening (e.g. cochlear implant and hearing aid) affects these facets of listening and communication. The purpose of this study was to investigate the effects of hearing device configuration on listening effort and gross localization in a reverberant setting. Adults with cochlear implants and aidable residual hearing in the contralateral ear were evaluated using a dual-task paradigm and a combined memory/gross localization task to measure objective listening effort and gross localization, respectively. Participants were tested in three hearing device configurations: cochlear implant only, hearing aid only, and bimodal listening. A control group of similarly aged listeners with normal hearing

also participated. A favorable signal-to-noise ratio was used in all conditions. Data were analyzed using generalized linear model. In addition, these data were compared to findings from unilateral and bilateral hearing aid conditions in another group of listeners. Results indicate group differences in effort and localization ability. In addition, hearing device configuration affected performance, particularly gross localization. Scientific and clinical implications of the findings will be discussed.

Poster # 160 - (CI13)

The Effects of Bimodal Hearing on Emotional Responses to Sound

Erin Picou, PhD; Kristen D'onofrio, AuD; Todd Ricketts, PhD, Vanderbilt University Medical Center, Nashville, TN

Sounds can have a profound impact on the way people think and feel about the world around them. However, our recent work suggests that hearing loss alters this impact. Specifically, people with hearing loss are less affected by sounds than their peers with normal hearing, potentially influencing the relationship between hearing loss and concomitant negative psychosocial consequences. The purpose of this project was to evaluate the effects of bimodal listening (i.e., cochlear implant and hearing aid) on emotional responses to non-speech sounds (e.g., laughter, crying, music, birds). Participants were adults with bimodal listening experience; a control group of similarly-aged adults with normal hearing also participated. Participants provided subjective ratings of valence (unpleasant/pleasant) and arousal (exciting/calming) for sounds from a published corpus of affective stimuli. Listeners with hearing loss provided ratings with a cochlear implant only, hearing aid only, and bimodal hearing. Data were analyzed using a generalized linear model. Results revealed that, regardless of condition, listeners with hearing loss rated all stimuli as closer to 'neutral' than their peers with normal hearing, suggesting bimodal listeners experience a more limited range of emotional experiences. Individual differences in hearing device configuration and implications for future intervention strategies will be discussed.

Poster # 161 - (CI14)

Overcoming Head-Shadow with Binaural Voice Streaming in Cochlear Implants

Smita Agrawal, PhD, Advanced Bionics. LLC, Valencia, CA

While bilateral cochlear implants (CIs) provide significant benefits, noise still poses a challenge for many CI recipients. When the signal of interest is located towards one ear, the input to the contralateral ear is diminished due to head-shadow. Bilateral benefit in such situations would be further diminished in noise. A possible solution is to stream the ipsilateral input to the contralateral ear, so that head-shadow can be overcome and the input is presented bilaterally. Advanced Bionics Naida CI sound processors have incorporated Phonak's binaural voice stream technology which allows them to stream unilateral input bilaterally. Additionally, the input from the contralateral side is attenuated so the signal of interest from the ipsilateral side has a better signal to noise ratio. This feature is called ZoomControl. The objective of the present study was to evaluate the effectiveness of ZoomControl when speech signal is located towards the listener's poorer or less preferred ear in noise. 12 Advanced Bionics CI recipients were evaluated using AzBio sentences presented in Cantina noise using a multi-speaker array in a soundbooth. Results will be presented at the meeting.

AUDITORY PROCESSING

Poster # 162 - (AP06)

Normative Data and Reference Equivalent Sound Pressure Levels for Circumaural Earphones at Conventional & Extended High-frequencies

Navid Shahnaz, PhD; Ainsley Ma; Shahab Ravanparast, MA, University Of British Columbia, Vancouver, BC

The main goal of this study was to investigate the racial differences in hearing thresholds between Caucasian and Chinese young adults and to provide normative data for equivalent sound-pressure levels (RETSPLs) at conventional (0.25-8 kHz) and extended high frequency (9-16 kHz) using HDA-200, HDA-300, and HDA-280 circumaural earphone. RETSPLs was established on 45 Caucasian (mean age 27 years) and 45 Chinese (mean age 24 years) young normal hearing adults using HDA-200 and 20 Caucasian and 20 Chinese using HAD-200, 300 and 280 (for total of 65 Caucasian and 65 Chinese participants). All participants had normal tympanometric parameters and met the inclusion criterion for the presence of distortion product otoacoustic emission (DPOAE) measures. Hearing thresholds varied differently across frequencies between the two ethnic groups; however, the magnitude of these variations was much smaller than significant threshold shift criteria suggested by ASHA. Sennheiser has recently replaced HDA-200 with a new circumaural earphone, the HDA 300. The obtained RETSPLs for HDA-300 was different than those in the ISO 389-5 (2006) and ANSI S3.6 (2010) standards using the HDA 200 earphones. The current ISO 389-5 (2006) and ANSI S3.6 (2010) standards need to be updated if HDA-300 is being used.

Poster # 163 - (AP07)

Evaluation of the Radioear DD450 Earphone

Clae Smull, BA; Robert Margolis, PhD, University Of Minnesota, Minneapolis, MN

The Radioear DD450 earphone was designed to duplicate the Sennheiser HDA 200 earphone which is out of production. Three characteristics were measured to compare the two earphones. Audiometric thresholds were measured for ten normal-hearing subjects (250 - 16,000 Hz). The audiometer was calibrated to standard HDA 200 reference levels for each earphone. Ambient noise attenuation was measured for a sound-field wideband noise signal with a probe tube method. Occlusion effect was measured with a probe tube inserted into the ear canal and the ear covered or uncovered by the earphone while presenting a bone-conducted signal to the contralateral mastoid. The mean threshold difference was 0.4 dB (-2.2 - 3.8 dB). Ambient noise attenuation ranged from 9 to 44 dB over the range 250 - 8000 Hz and was nearly identical for the two earphones. Occlusion effects were negligible for both earphones over the range 750 - 8000 Hz but were larger for the DD450 in the low-frequencies. The results indicate that the HDA 200 RETSPLs that are in the standards are applicable to the DD450. Both earphones produce equivalent ambient noise attenuation. The DD450 earphone produces low-frequency (< 500 Hz) occlusion effects that are slightly larger than those produced by the HDA 200.

Poster # 164 - (AP08)

Generalization and Resilience to Distractors in Auditory Working Memory
DiGiovanni Jeffrey, PhD; Travis Riffle; Gilmore Carissa; Mikol Jennifer, Ohio University, Athens, OH

The role of attention is important for working memory processes; attentional control delegates what sensory information gets attended for further processing and what does not. As such, attentional control is an important aspect of listening ability, especially in difficult listening situations. Sorqvist et al. (2010; 2012) examined the role of attentional control and its relationship with working memory capacity (WMC) and found that individuals with high WMCs were able to adapt to odd-ball distractors. The goal of the current study is to further Sorqvist et al.'s findings by ascertaining the degree to which individuals with high WMCs are resilient to changes in odd-ball stimuli as well as their ability to generalize this skill to different tasks. Participants listened in tasks requiring rapid switching of attention and inhibition of distractors. Odd-ball distractors as well as the task were varied to assess the degree of resilience and generalization, respectively.

Poster # 165 - (AP09)

Effects of Modality and Linguistic Materials on Memory
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Audiologists can test memory with auditory or visual stimuli. Visual tests are immune to hearing loss, whereas auditory tests are ecologically relevant. In a previous study, an auditory test was preferred to a visual test because it yielded a greater range of working memory scores; however, the linguistic properties of the materials were not matched across tests. In the current study, we compared auditory and visual tests with matched word-level and sentence-level materials. Sixteen young adults with normal hearing participated. All participants completed four tests (2 modalities x 2 linguistic levels). The order of conditions was counter-balanced. In each test, 100 items were presented, with five trials in each of four setsizes (2, 3, 4, 5, 6). The number of words correctly recognized, judged and recalled was measured. Recall decreased with increasing setsize. There were significant main effects on recall of modality (auditory > visual) and linguistic-level (word > sentence) and also a two-way interaction. Recall was best for the auditory word test and worst for the visual sentence test. These results confirm that both modality and the linguistic properties of test materials affect recall and support the use of auditory word tests to maximize the range of scores.

Poster # 166 - (AP10)

Relating Complex Verbal and Non-Verbal Spans to Listening Comprehension
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Working memory is a short-term memory bank that allows information to be both stored and processed. A common assessment of working memory involves a measure of one's working memory capacity: the amount of information one is able to maintain. Studies have shown that simple storage tasks often do not correlate with higher-level cognitive functions, but complex spans that involve both storage and processing are related cognition (Daneman & Carpenter, 1980). The goal of this study was to examine

how verbal and non-verbal span tasks of varying complexity related to listening comprehension performance. The verbal-span tasks consisted of simple forward and reverse digit spans as well as a complex working memory span task. The non-verbal span tasks included a simple adaptive pitch pattern task in which participants recalled patterns of high and low tones, and a complex task that involved pitch pattern recall along with solving mathematical equations. A listening comprehension task was also administered. Results showed that as the complexity of the tasks increased, span lengths decreased. Also, only the verbal complex span task was significantly correlated to listening comprehension, suggesting that complex non-verbal spans do not tap into the same resources that are used for comprehension of verbal stimuli.