**ELECTROPHYSIOLOGIC RESPONSES / AUDITORY NEUROSCIENCE**

Poster # 1 - ELECT01

**The Effect of EphA4 Signaling Mutations on Auditory Function**  
*Michelle Gerringer, BS; Lincoln Gray, PhD, James Madison University, Harrisonburg, VA*

Eph/ephrin family proteins are known to be important in the development of the auditory system. EphA4 receptor tyrosine kinase proteins are axon-guidance molecules which aid in target selection and help to maintain tonotopicity in the auditory brainstem and midbrain. The goal of our study was to determine the functional effects of EphA4 lacZ mutations on auditory processing. We recorded Auditory Brainstem Response (ABR) measures on EphA4 mutant mice prior to four months of age and compared them to a control group of wildtype littermates. ABR wave latency and threshold analysis in heterozygous mice showed no significant differences from their wildtype littermates. Comparison of homozygous mutant mice to wildtype controls showed significant auditory effects including elevated ABR thresholds for 8kHz toneburst, 12 kHz toneburst, and click stimuli and prolonged wave latencies for 8 kHz stimulus only. Deficits in auditory function seen in mutant mice provide evidence that EphA4 proteins are necessary for normal auditory function. Our findings support the role of EphA4 in the development of the auditory system both functionally and structurally.

Poster # 2 - ELECT02

**Subcortical Plasticity in First-Time Hearing Aid Users**  
*Mentored Student Research Poster Award*
Many older adults express dissatisfaction with hearing aids despite improvements in hearing aid technology. This satisfaction may arise from deficits in the central auditory system associated with aging and/or hearing loss. Limited information exists regarding amplification effects on central auditory processing in older adults. The present study assesses the effects of amplification on the subcortical representation of speech in first-time hearing aid users at the time of the hearing aid fitting and at 6 months post-fitting. Frequency following responses to the syllable [ga] were obtained in sound field in aided and unaided conditions for three presentation levels. Reduced spectral amplitudes were noted in the temporal envelope and temporal fine structure of aided responses after six months of hearing aid use. Unaided responses indicated reduced spectral amplitudes at 6-months post-fitting in the temporal envelope only. No differences were noted in the temporal fine structure of the unaided responses. Response fidelity (as assessed by stimulus-to-response correlations) actually decreased after six months of hearing aid use. These findings suggest that subcortical speech encoding changes with hearing aid use over six months, indicating a need to consider long-term effects of amplification during hearing aid follow-up visits.

Poster # 3 - ELECT03

**Cochlear Delays in Ears with Normal Hearing and Hearing Loss**  
Mentored Student Research Poster Award

*James Lewis, PhD; Judy Kopun, MA; Stephen Neely; Michael Gorga, PhD*, Boys Town National Research Hospital, Omaha, NE

Behavioral tuning curves in ears with cochlear hearing loss (HL) exhibit lower Q-values compared to normal hearing (NH) ears. As such, broader tuning is often cited as a consequence of HL. However, behavioral studies traditionally compare tuning between NH and HL ears at equal stimulus sensation levels (SL), with the effect that higher sound pressure levels (SPL) are presented to HL ears. Cochlear tuning becomes increasingly broad as stimulus level increases, even in ears with NH, and the broader tuning observed in ears with HL may reflect level-dependent changes in cochlear processing, instead of HL-induced changes. To test this hypothesis, cochlear delays, a measure of tuning founded in filter theory, were compared between 22 NH ears and 15 ears with mild-to-moderate HL. Delays were derived from tone-burst auditory brainstem response wave V latencies. When stimulus level was equated in SL, delays were shorter in ears with HL. Conversely, delays were similar between NH and HL ears when stimulus level was equated in SPL. These observations suggest that, in ears with mild-to-moderate HL, the effect of stimulus level on tuning is large relative to the effect of HL. In turn, supra-threshold cochlear tuning appears to be generally unaffected by mild-to-moderate HL.

Poster # 4 - ELECT04

**Auditory Steady-State Responses to Simultaneous Air- and Bone-Conducted Stimuli**

*Linda Hood, PhD; Lindsey Rentmeester, AuD*, Vanderbilt University, Franklin, TN  
*Rafael Delgado, PhD; Guillermo Savio, PhD*, Intelligent Hearing Systems, Miami, FL  
*Susan Stangl, AuD*, Boys Town National Research Hospital, Omaha, NE

This report provides data from infants using procedures that combine simultaneous air- and bone-conduction stimulation using an Auditory Steady State Response (ASSR) paradigm. The overall goal of
this research is to better detect mild hearing losses and to differentiate sensorineural and conductive components. Data were acquired using a simultaneous dual-tone stimulus (500 Hz and 2000 Hz) with one signal presented through an insert earphone and the other through a bone vibrator. ASSR data were recorded from 10 infants in the NICU at intensity levels of 70 to 10 dB SPL. Response amplitudes were higher via bone conduction than air conduction for infants, suggesting the possibility of a slight conductive hearing loss. Adult amplitudes, obtained from a previous study, were higher than infant amplitudes. These data demonstrate that the proposed technique can be used in testing newborns in the NICU, even with monitoring equipment in the environment. The data further suggest that this technique is sensitive to slight conductive hearing loss, demonstrated by air-bone amplitude differences. The next steps will incorporate an intensity-ramping method in subjects with sensorineural and conductive hearing losses, and in a large infant population to evaluate potential of this paradigm in hearing screening. [Supported by NIH-NIDCD R43DC011432]

Poster # 5 - ELECT05

**Electrococchleography and Auditory Brainstem Response Using Continuous Loop Averaging Deconvolution**

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Using Continuous Loop Averaging Deconvolution (CLAD) in electrococchleography (ECochG) and auditory brainstem response (ABR), the effects of testing at very high stimulus rates may have the potential to help diagnose disorders such as vestibular migraine (VM); however, a body of normative data using the CLAD technique must first be established. ECochG and ABR were measured simultaneously from a tympanic membrane electrode and surface electrodes on the forehead and mastoid. Participants included 20 healthy individuals for normative data and three VM patients for pilot study. Normative data showed that the action potential (AP) of the ECochG and ABR waves I, III, and V decreased in amplitude and increased in latency as the stimulus rate was increased from 7.1 clicks/s up to 507.81 clicks/s. The summing potential (SP) of the ECochG, however, stayed relatively stable, resulting in increased SP/AP ratios with increasing rate. The SP/AP amplitude ratio showed more stability than amplitude findings, thus it is recommended for use in evaluation of cochlear and neural response. Pilot results from the VM patients revealed similar trends to normative data. Results from this normative study and pilot VM data may be helpful in improving the diagnostic utility of CLAD in distinguishing inner ear disorders.

Poster # 6 - ELECT06

**Objective Estimate of the Masker Phase Effect**

*Niall Klyn, MA, The Ohio State University, Columbus, OH*

In order to better understand the auditory system’s response to complex sounds, this study aims to obtain objective estimates of the masker phase effect (MPE) using the auditory brainstem response (ABR). At present, there is no published research that demonstrates that the MPE is observable in evoked response thresholds in humans. This study therefore helps to bridge the gap between our understanding of the observed cochlear mechanics from animal models and the behavioral responses in humans. Preliminary data are reported from normal hearing adults, using the presence of wave V to establish threshold. Stimuli consisted of 4 kHz tone bursts along with Schroeder complexes with an F0 of 100 Hz
and including harmonics from 200-5000 Hz. The complexes with rising instantaneous frequencies produced more masking than that of the complexes with falling instantaneous frequencies, consistent with the human behavioral studies and with the physiological reports on animal cochleas. These data are consistent the interpretation that the falling complexes interact with the phase curvature of the basilar membrane to produce a peakier response and therefore less masking.

Poster # 7 - ELECT07

**Differential Pitch Processing at the Brainstem Level in Chinese Newborns**
Grant R. Hollister, BS; Fuh-cherng Jeng, PhD; Kristen A. Mitchell; John T. Sabol, Ohio University, Athens, OH
Meng-shin Chou, MD; Chia-der Lin, PhD, China Medical University Hospital

This study examined whether newborns are able to track various pitch contours equally during their immediate postnatal days. The frequency-following response (FFR), a scalp-recorded potential that does not require the listener’s active feedback, is a non-invasive method to study the pitch-processing mechanisms in the human brainstem. A set of four contrastive, monosyllabic Mandarin pitch contours (/yi1/ flat, /yi2/ rising, /yi3/ dipping, and /yi4/ falling) was used to elicit FFs in fifty-five Chinese newborns (1-3 days old). Continuous brainwaves were recorded to extract the FFs to each pitch contour. Pitch Strength, defined as the peak-to-trough amplitude in the normalized autocorrelation output, was computed to represent the overall amplitude at the fundamental frequency and its harmonics for each recording. Results demonstrated that the FFs to each pitch contour were significantly larger than those obtained in a control condition. Importantly, the rising and dipping pitch contours produced significantly larger Pitch Strengths than the flat and falling pitch contours (p<0.001). In conclusion, differential brainstem processing to the various pitch contours was observed during the early stages of life. These findings expand our knowledge in pitch-processing and have implications in developing diagnostic and rehabilitative protocols for individuals with hearing, speech, and language impairments.

Poster # 8 - ELECT08

**Interactions Between Speech Stimuli and Masker Types Measured by AERPs**
Katharine Fitzharris, AuD; Jeffrey Martin, PhD; Ross Roeser, PhD, The University Of Texas At Dallas/ Callier Center For Communication Disorders, Dallas, TX

The detrimental effects of background noise on communication abilities have been well documented with behavioral measures. Several auditory event-related potentials (AERPs) studies have illustrated stimulus effects on speech-in-noise (SIN) performance, e.g., signal and masker type, but there are very few studies which have used whole word stimuli, which is the standard in behavioral testing. The aim of this study was to use AERPs to evaluate the interaction between type of background noise (speech-shaped noise or multi-talker babble) and speech stimuli (syllable or whole word) in young adults. This study is unique in that the signal-to-noise ratio (SNR) utilized in the noise conditions was determined by each participant’s behavioral accuracy. Similar to many available behavioral tests, SNR thresholds were established at 60% correct using an adaptive behavioral protocol. Average AERPs amplitudes were analyzed for the N1, P2, and P3 components. Preliminary results of four participants indicate that even when behavioral accuracy is controlled across participants, the understanding of babble-masked-signals requires more processing resources than noise-masked-signals. These results agree with previous research utilizing syllable stimuli.
Poster # 9 - ELECT09

**Background Noise Reduces Trial-by-Trial Phase Locking of Auditory Evoked Potentials**
*Tess Koerner, BA, Yang Zhang, PhD, University Of Minnesota, Minneapolis, MN*

Listeners with sensorineural hearing loss often complain of difficulties understanding speech in background noise. These listeners also tend to show a wide range of variability in speech perception in noise performance. In order to examine the neural processes underlying speech perception in noise, auditory event-related potentials (AERPs) were recorded from normal-hearing listeners in response to three consonant-vowel syllables in quiet and in a speech-babble background noise during a passive listening paradigm. N1-P2 responses were analyzed in terms of latency and amplitude. Trial-by-trial time-frequency analysis was also performed in delta, theta, and alpha frequency bands to examine how the N1-P2 responses changed as a function of reduced neural phase locking to the speech stimuli in noise. As expected, AERP latencies increased and amplitudes decreased in noise compared to the quiet listening condition. Moreover, noise significantly reduced neural phase locking for all the speech stimuli, which may help explain some of the variability in neural responses to speech in noise. Time-frequency data based on individual trial analysis represents a promising approach to understanding the cortical mechanisms underlying the effects of noise on neural and behavioral measures of speech perception.

Poster # 10 - ELECT10

**Electrophysiological Evidence for Binaural Processing in Auditory Brainstem and Cortex**
*Allison Heller, BS; Cynthia Fowler, PhD, University Of Wisconsin-Madison, Madison, WI
Elizabeth Leigh, PhD, William S. Middleton Memorial Veterans Hospital, Madison, WI*

Binaural hearing allows people to understand speech in noisy backgrounds and to localize the direction of sounds in the environment. A better understanding of binaural processing may lead to improvements in communication for people who have binaural deficits. The purpose of this investigation is to determine binaural function of the auditory system from the periphery to the cortex. Monaural and binaural responses to tonal (500 and 2000 Hz) and speech (/ba/) signals were used to determine binaural interaction component of the auditory brainstem (ABR), middle-latency (AMLR), and late-latency responses (ALLR). Left and right monaural responses were summed to form the predicted binaural response (L+R). The binaural response (BIN) was subtracted from the L+R to produce the binaural interaction component (BIC) for each of the potentials. Results showed that the BIC ratio (BIC/L+R) for 500 Hz was larger than for 2000 Hz in the AMLR. The BIC ratio for the ALLR doubled compared to the AMLR at 500 Hz. The BIC ratio was largest for /ba/ in the ALLR. Implications of these results for binaural processing will be discussed.

Poster # 11 - ELECT11

**Can ECAP Polarity Sensitivity be used to Estimate Neural Health?**
*Michelle Hughes, PhD; Rachel Scheperle, PhD; Jacquelyn Baudhuin, AuD; Jenny Goehring, AuD, Boys Town National Research Hospital, Omaha, NE*

Recent evidence suggests that the typical cathodic-leading biphasic current pulse is less effective at stimulating the deafened human auditory system than an anodic-leading pulse. Modeling studies suggest that both cathodic and anodic polarities are effective at eliciting action potentials when peripheral
processes are intact, whereas anodic polarity is more effective at stimulating the auditory nerve when peripheral processes are absent. Thus, smaller differences in the electrically evoked compound action potential (ECAP) responses between polarities (polarity sensitivity) may be indicative of better neural survival. Polarity sensitivity will be quantified as the difference in slope of the ECAP amplitude growth function (AGF) obtained with anodic- versus cathodic-leading biphasic pulses. The goal is to compare polarity sensitivity to (1) the slope of the AGF obtained in the standard cathodic-leading condition (where shallower slopes have been shown to relate to poorer nerve survival) and (2) speech perception. Respective hypotheses are that individuals with greater polarity sensitivity will demonstrate (1) shallower AGF slopes in the cathodic condition and (2) poorer speech understanding, consistent with poorer neural survival. Preliminary data show a significant correlation between polarity sensitivity and speech perception, where individuals with smaller slope differences showed better performance.

**Poster # 12 - ELECT12**

**Behavioral and Electrophysiological Responses to Mandarin Acoustic Chimeras**

*John Sabol, BS; Fuh-cherng Jeng, PhD; Grant Hollister; Jessica Kenny,* Ohio University, Athens, OH
*Meng-shih Chou, MD; Chia-der Lin, MD; Ching-Hua Chen, Yung-An Tsou,* China Medical University Hospital

Previous research has shown the usefulness of utilizing auditory chimeras (i.e., interchanging the envelope and fine-structure of two different sounds) in assessing a listener’s perception of the envelope and fine-structure for an acoustic stimulus. However, research comparing and contrasting behavioral and electrophysiological responses to this stimulus type is lacking. The purpose of this study was to examine the physiological underpinnings of pitch processing and their relationships to the listener’s perception of auditory chimeras. Two sets of chimeric stimuli were constructed by interchanging the envelopes and fine-structures of the rising /yi2/ and falling /yi4/ Mandarin pitch contours that were filtered through 1-64 frequency banks. Behavioral discrimination tasks (through a single-interval, two-alternative, forced-choice paradigm) and electrophysiological measurements (through the envelope-following response to voice pitch obtained via validated scalp-recorded potential methods) were measured from two groups, native speakers of tonal and non-tonal languages. Frequency Error and Pitch Strength were calculated to represent the accuracy and magnitude of neural phase-locking at the brainstem level. A two-way ANOVA showed significance (p<0.05) within and across the filter-bank and language-background factors for the behavioral measurements to the Mandarin chimeras, while the envelope-following response demonstrated a significance across filter-bank, but not for language-background.

**Poster # 13 - ELECT13**

**Electrophysiologic Evidence of Gap Detection**

*Cynthia Chow, BS; Allison Heller; Cynthia Fowler, PhD,* UW-Madison, Madison, WI
*Elizabeth Leigh-Paffenroth,* William S. Middleton Memorial Veterans Hospital, Madison, WI

Temporal auditory processing is imperative for accurate speech comprehension. Age related differences in the ability of the auditory system to process temporal aspects of sound have been reported. The purpose of this study was to determine if gap evoked cortical responses could be measured in normal hearing individuals. Cortical evoked responses were produced by 0ms, 6ms, 16ms, 41ms and 61ms gaps under passive listening conditions in noise. Participants included 10 normal hearing listeners between 20-30 years of age. Preliminary data reveals P2 from the trailing marker increased as the gap widened.
from 0 to 61ms. Gap responses could be reliably recorded; however, there appears to be some inter-subject variation. Assessment of stimuli and recording parameters and future use of these results will be discussed.

Poster # 14 - ELECT14

Cortical Auditory-Evoked Potentials and Speech-in-Noise Performance in Older Adults  T35
Research Trainee Poster
Brandon Madsen, BA, University Of Minnesota, Minneapolis, MN
Tina Penman, AuD; Paul Pendergraft, AuD; Curtis Billings, PhD, National Center For Rehabilitative Auditory Research, Portland, OR

Speech in background noise is one of the most difficult listening environments for patients with hearing loss. Yet there is currently no reliable way of assessing speech-in-noise perception in patients who are unable to provide reliable behavioral results. Previous studies have suggested that it may be possible to predict speech-in-noise ability using cortical auditory-evoked potentials (CAEPs). This study’s goals were to examine the relationship between evoked potentials and perception in a group of older adults (age 60-78, four males, six females) with hearing impairment (OHI) and to examine the effect of noise type and signal-to-noise ratio (SNR) on both CAEPs and behavioral performance. Ten OHI participants underwent speech-in-noise CAEP testing in conditions that varied in noise type (continuous, four-talker babble, and one-talker modulated - all speech-shaped in spectrum) and SNR (-3, +3, and +9 dB). Behavioral measures of speech recognition in noise were used to look for correlations with CAEP data. Cognitive testing was done to investigate the potential influence of cognition on other results. Preliminary results suggest that SNR and noise type variations produce significant differences in CAEP waveforms that follow a predictable pattern. These results may prove useful in better understanding, diagnosing, and treating speech-in-noise difficulties clinically.

Poster # 15 - ELECT15

Effects of Background Babble on Foreign and Native Accent Perception
Kelsey Gleason, Montclair State University, Morris Plains, NJ

Event-related potentials (ERPs) are a non-invasive method of mapping brain activity during cognitive processing. In this study, ERPs were used to determine to what extent neurophysiological indices of semantic processing are affected by native and non-native stimuli under adverse listening situations. This study will extend the findings of Yesis’ (2011), which evaluated subjects in quiet conditions. In this study, subjects were tested using SPIN sentences under four listening conditions: 1) semantically related sentences spoken by a native speaker of English 2) semantically related sentences spoken by a non-native speaker of English 3) semantically unrelated sentences spoken by a native speaker of English and 4) semantically unrelated sentences spoken by a non-native speaker of English. All conditions were presented with two-talked babble in the background. Based off of available research, we hypothesized that the foreign accent in noise results will show an increase in the amplitude and latency of the N400 when compared to native accent in noise. Additionally, we hypothesized that the N400 effect will not be as large for the subjects being tested in noise than it was for subjects tested in quiet due to the inability of subjects to access auditory semantic processing.

Poster # 16 – ELECT16
Electrophysiological Responses to Gaps in Noise at Different Stimulation Rates
Khalid Alhussaini, MS; Jorge Bohorquez, PhD; Ozcan Ozdamar, PhD, University Of Miami, Dept. Biomedical Engineering, King Saud University, Dept. Biomedical Technology, Coral Gables, FL

Behavioral Gap Detection Threshold (BGDT) and Long Latency Responses (LLRs) have been used as a tool to evaluate temporal resolution. In this study, early Auditory Evoked Potentials (AEPs) were recorded in addition to LLRs and BGDT. BGDTs were obtained from seven young, normal hearing subjects (average 5.8ms). Two gap durations (9ms, 12ms), 3ms and 6ms above average BGDT, were used in EP study. LLRs were investigated with gaps delivered at the rate of 0.5Hz while Auditory Brainstem and Middle Latency Responses (ABR/MLR) where elicited by gaps delivered at 5Hz and 40Hz. ABRs and MLRs couldn't be properly recorded at 0.5Hz rate due to poor SNR. Transient responses evoked by 40Hz stimuli were obtained by deconvolution. LLRs were characterized by P1 (~0.4-V) followed by N1-P2 (~3-V). N1-P2 amplitude was larger for longer gap. For higher rates a similar P1 was also consistently present. Noise offset generated a negativity at around 10-12ms followed by a positivity elicited by the noise onset. At 40Hz responses displayed repetitive peaks after P1 similar to click MLRs. Gaps responses appear to be generated similar to standard AEPs in responses to stimulation rate. This response, however, is modified according to noise onset and offset and gap duration.

AMPLIFICATION / HEARING TECHNOLOGY / REHABILITATION

Poster # 17 - AMP01

Comparing Two Listening Effort Measures for Hearing Aid Outcome Testing
Jani Johnson, PhD; Jingjing Xu, PhD; Robyn Cox, PhD, University Of Memphis, Memphis, TN
Paul Pendergraft, AuD, Portland VA Medical Center, Portland, OR

Conventional measures of speech understanding performance are an important hearing aid outcome; however, they might not reflect subtle improvements in listening effort that certain types of modern hearing aid processing are purported to deliver. To provide a more complete picture of benefit, researchers have recommended that listening effort should be evaluated in addition to speech understanding when hearing aid outcomes are tested. The purpose of the present study was to evaluate two measures of listening effort regarding their suitability for inclusion in such a hearing aid outcome testing protocol. The methods considered in this study were a measure of self-reported listening effort and a word-recall dual-task paradigm. Participants were 32 normal-hearing adults. Both listening effort measures were administered in conjunction with a measure of speech understanding. Each measure was evaluated with regard to: impact on speech intelligibility performance, relationship to the other measure, validity, and sensitivity. Overall, the results suggested that the self-report listening effort measure was more appropriate than the word-recall dual-task measure for inclusion in a comprehensive hearing aid outcome testing protocol. (Supported by NIDCD)

Poster # 18 - AMP02

Laboratory Comparison of PSAPs and Hearing Aids
Jingjing Xu, PhD; Jani Johnson, PhD; Robyn Cox, PhD; Danielle Breitbart, School Of Communication Sciences And Disorders, University Of Memphis, Memphis, TN
Personal Sound Amplification Products (PSAPs) are devices that are intended to amplify environmental sounds but not to compensate for hearing impairment. However, many high quality PSAPs have advertised features that are similar to modern hearing aids. Given the advantages of lower cost and easier accessibility relative to hearing aids, PSAPs could potentially benefit some hearing-impaired listeners. The purpose of this study was to compare everyday sounds after processing using PSAPs and hearing aids. Two PSAPs, two premium, and two basic hearing aids were programmed for an average mild-to-moderate hearing loss. Three types of everyday sounds: speech, noises, and music, were recorded through each device. Twenty adults with mild-to-moderate hearing loss listened to these recorded sounds monaurally using an insert earphone. Listeners' preferred device for each sound was determined using a double round-robin paired-comparison tournament. Results showed that for speech, all hearing aids were significantly more preferred than both PSAPs. However, there were no significant differences in preference for PSAP, premium, and basic conditions with music or noise. Additionally, premium hearing aids were not significantly preferred over basic hearing aids with any stimulus. Thus, for non-speech sounds, high quality PSAPs performed similarly to modern hearing aids.

Poster # 19 - AMP03

**Approaches to Improving Hearing Aid Orientation**

*Gabrielle Saunders, PhD; M. Samantha Lewis, PhD; Sara Sell, AuD; Jay Vachhani, AuD; Katherine Groon, MS; Charlotte Morse-Fortier,* National Center For Rehabilitative Auditory Research (NCRAR), Portland, OR

Despite evidence that hearing aids provide benefit for hearing-impaired individuals, and that untreated hearing loss has negative consequences, many individuals use their hearing aids less than would be considered optimal. Studies indicate that a lack of knowledge of how to use the hearing aids, or an inability to do so, in part explains why. Data suggest that inadequate hearing-aid orientation (HAO) is a likely factor in this, but other factors, such as low health literacy, poor manual dexterity/haptic sensitivity, visual impairment, or problems with learning and memory also play a role. Evidence for why a patient-centered approach, that takes health literacy universal precautions, cognition, vision and manual dexterity into account, will be presented using data from an ongoing comparative effectiveness trial of HAO. In that study, three forms of patient-centered HAO (a personalized hearing-aid information guide, provision of HAO via DVD, and provision of HAO using the teach-back technique) are being compared with standard of care HAO.

Poster # 20 - AMP04

**Inter-Rater Reliability of a New Hearing Aid Outcome Measure**

*Charlotte Morse-Fortier, BA; M. Samantha Lewis, PhD; Sara Sell, AuD; Jay Vachhani, AuD; Katherine Groon, MS; Gabrielle Saunders, PhD,* National Center For Rehabilitative Auditory Research, Portland, OR

Hearing aid use is often inconsistent among people with hearing loss. Previous research has suggested that lack of knowledge about the use and care of hearing aids can in part explain why. If hearing health care professionals were able to easily assess hearing aid competency, they could determine and reinstruct the specific skills their patients were struggling with, which could greatly improve rates of hearing aid use. This study aims to determine the inter-rater reliability of a new measure called the Hearing Aid Skills and Knowledge test (HASK). The HASK is based on the Practical Hearing Aid Skills test (PHAST-R; Doherty & Desjardins, 2009) but includes assessment of knowledge as well as hearing aid handling skills. Twelve skills important for the successful use and care of hearing aids are evaluated.
Four to eight weeks being fit with bilateral amplification in the Portland VA Health Care System, first time hearing aid users completed the HASK. HASK testing was videotaped, and scored by six different clinicians. Results regarding inter-rater reliability will be presented with a view to determining whether the HASK could reliably be implemented in audiology clinics as a tool for assessing hearing aid handling skills.

Poster # 21 - AMP05

The Effects of Noise on Acceptable Noise Level Measures
Megan Lane, BA; Carol Mackersie, PhD, SDSU/UCSD, La Jolla, CA

Intolerance to background noise is a common problem for persons with hearing loss and a leading cause of hearing aid rejection. Thus, a better understanding of the factors underlying sound tolerance problems is needed. This project quantifies the relative contribution of four sound-tolerance domains: loudness, annoyance, distraction, and communication interference. The specific aim was to determine the effect of noise type on the relative contribution of the domains to the ANL judgments. Acceptable Noise Level was measured in 30 normal hearing participants using sentences presented in restaurant and in speech-weighted steady-state noise. Participants were asked to select the domain that most strongly influenced their ANL judgment to measure the relative contribution of each domain. Participants were asked to complete absolute ratings of each domain for each noise type. The ANL for the steady-state noise was higher than the ANL for the restaurant noise. Annoyance had a greater influence on ANL judgments for steady-state noise, whereas distraction had a greater influence on ANL judgments for restaurant noise. Substantial individual differences were observed for the relative weightings of the four domains. Results suggest that the determinants of sound tolerance vary with the nature of the background noise and with the individual listener.

Poster # 22 - AMP06

Clinical Relevance of the Constructs Underlying the HHIA
Kathryn Shaughnessy Schwartz, PhD, Old Dominion University, Norfolk, VA
Samantha Kleindienst, PhD; Greta Stamper, PhD; David Zapala, PhD, Mayo Clinic Florida, Jacksonville, FL
Jamie Bogle, PhD, Mayo Clinic Arizona, Scottsdale, AZ

Newly proposed standards for clinical psychometric measures have recently been published. The Hearing Handicap Inventory for Adults (HHIA) is a psychometric measure widely used to evaluate self-reported communication difficulty. The HHIA consists of two subscales: Social/Situational and Emotional. In past reports, we have demonstrated that the standard factor analysis validation methods did not correspond to these two subscales. Instead, a new factor structure was identified. We proposed a two-factor solution and created two new corresponding subscales: Hearing Difficulty and Withdrawal Tendency. The purpose of this research was to determine whether these new subscales demonstrated sufficient construct validity using the newly proposed psychometric standards. Over 5000 patients with hearing loss evaluated at the Mayo Clinic Florida, completed the HHIA. Three goodness of fit measures (2, RMSEA, SRMR) were calculated to test the accuracy by which observed scores fit the expected factor structure. On each measure the results failed to meet the criteria required for clinical use. Nevertheless, the newly identified factor structure provides insights into the underlying constructs of communication difficulties encountered in this population. We believe these constructs more accurately reflect the nature of communication impairment and can serve as the basis for improved aural rehabilitation strategies.
Audibility and Spectral Resolution Influence Performance and Preference for Frequency Composition  
Jenna Browning, BS, The University Of North Carolina At Chapel Hill, Chapel Hill, NC  
Marc Brennan, PhD; Meredith Spratford, AuD; Ryan Mccreery, PhD, Boys Town National Research Hospital, Omaha, NE  

Frequency-lowering signal processing strategies have been developed to provide audibility of high-frequency sounds that are inaudible with conventional hearing aid processing due to hearing aid bandwidth limitations and the listener’s degree of hearing loss. The purpose of this project was to evaluate how audibility and spectral resolution influence speech recognition and listener preference for a novel frequency-lowering algorithm known as frequency composition. Sixteen children and twenty adults with mild to severe sensorineural hearing loss were tested to determine spectral resolution, speech recognition ability in adaptive background noise, and listener preference using a sound quality questionnaire. Speech recognition was tested in 3 conditions: (1) using the listener¬øs personal hearing aids, (2) using a hearing aid simulator with frequency composition off, and (3) using a hearing aid simulator with frequency composition on. Significant variability in preference and speech recognition benefit was observed. Listeners with audible bandwidth less than 6 kHz with conventional processing, children, and listeners with good spectral resolution obtained the most improvement in speech recognition with frequency composition. Listener preference for frequency composition was not consistently associated with improved recognition. These results suggest that candidacy for frequency composition should be based on the audible bandwidth, age, and spectral resolution of the listener.

Speech Perception and Electrophysiological Outcomes with ReadMyQuips Auditory Training Program  
Aparna Rao, PhD; Luodi Yu, MA; Yang Zhang, PhD, University Of Minnesota, Minneapolis, MN  
Dania Rishiq, PhD; Harvey Abrams, PhD, Starkey Hearing Technologies, Eden Prairie, MN

The study aimed at investigating effectiveness of ReadMyQuips (RMQ), an auditory training program, using speech perception and electrophysiological measures. Participants were adults with mild to moderate hearing loss who were first-time hearing aid users. RMQ is an audio-visual tutorial designed to improve speech perception in noisy environments. After 4 weeks of hearing aid use, the experimental group completed the RMQ training in 4 weeks, and the control group received listening training using audiobooks during the same period. Evoked potentials and Hearing in Noise (HINT) tests were administered at pre-fitting, post-fitting and post-training to assess effects of hearing aid use and effects of RMQ training. An oddball paradigm allowed tracking of changes in P3b and P3a cortical potentials to targets and distractors, respectively. After 4 weeks of amplification, HINT results did not show a statistically significant change, but there was a significant P3a reduction. The P3b changes were correlated with improvement in d prime in the selective attention task. After the training phase, this correlation remained in the experimental group, but not in the control group. Similarly, HINT testing showed improved speech perception only in the experimental group. RMQ led to specific gains in speech perception and auditory selective attention.
Poster # 25 - AMP09

Bilateral Hearing Aid Benefits in Complex Environments: Hearing Loss Effects
Todd Ricketts, PhD; Erin Picou, PhD, Vanderbilt Medical Center, Nashville, TN

Previous research has shown several advantages for bilateral hearing aid fittings. Compared to unilateral fittings, bilateral fittings often yield better spatialization, improved speech recognition when the speech and noise are spatially separated, improved sound quality, and improved subjective listening effort. However, the reported magnitude of these benefits has been generally small and limited to artificial laboratory environments. In addition, no previous research has reported the magnitude of these benefits when visual cues were available. This research examined subjective and objective performance differences between unilateral and bilateral fittings in complex laboratory listening environments requiring real world skills, in two groups of hearing aid wearers, who were differentiated by their degree of hearing loss (moderate versus severe). All advanced hearing aid features were disabled since no work to date has shown an interaction between advanced technologies and improved bilateral advantages. The results revealed small but significant speech recognition advantages in both groups. The magnitude of subjective benefits and gross localization benefits increased with increasing hearing loss. There was a complex relationship between the presence or absence of vision, degree of hearing loss, talker location, and the magnitude of bilateral advantage. Clinical implications related to selection and counselling will be discussed.

Poster # 26 - AMP10

Pilot Study of Acoustic Therapies for Tinnitus Suppression T35 Research Trainee Poster
Maggie Schad, BS, University Of Cincinnati, Cincinnati, OH
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Acoustic therapies in conjunction with counselling have been shown to benefit patients suffering from tinnitus. Although extensive research has been done regarding tinnitus, there is no standardized form of acoustic therapy. This pilot study assesses the potential efficacy of two types of acoustic therapies, based on previous studies, to suppress and reduce the functional effects of tinnitus with the use of tinnitus pitch matching (PM). These therapies were administered without counselling. The acoustic therapies were individually tailored to each participant and delivered using an iPod Nano. The types of acoustic therapies were notched noise (1-12 kHz notched within a 1 octave range centered around the PM frequency) and matched noise (1 octave wide band of noise centered around the PM frequency). The placebo noise consisted of low frequency noise (250-700 Hz noise band), well below the participants’ PM frequency. Thirty participants were randomized into one of these three groups and instructed to listen to the acoustic therapy for 6 hours a day for 2 weeks. Outcome measures were recorded at 0, 2 and 4 weeks. The results will serve as preliminary evidence for a larger study.

Poster # 27 - AMP11

Is Repeating Audio Helpful in Real-World Environments
Karrie Recker, AuD; Buye Xu, PhD; Dan Ritter, MS, Starkey Hearing Technologies, Eden Prairie, MN
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In real-world environments, if a hearing-impaired person misses what is said, he will ask for repetition. If this happens often, it could be annoying and embarrassing for both parties. A potential solution to this problem is to provide the hearing-impaired listener with technology that allows him to repeat what was just said. Two studies were conducted examining the efficacy of such a solution—one used seven normal-hearing listeners and the other used eight hearing-impaired listeners. All participants were given an iPod that was tethered to an EarPod microphone (normal-hearing listeners) or a hearing-aid microphone (hearing-impaired listeners). Study participants wore the device for 2-3 weeks in their everyday environments and evaluated whether repeating missed audio was helpful. If it was not helpful, they were asked to indicate (using the iPod) the reason why it was not helpful (i.e. the signal was poor, the correct amount of audio was not recorded or the individual did not have time to repeat back the missed information). During their testing, participants evaluated several playback durations (1-20 seconds), two different methods of initiating audio playback (the iPod interface and a push button) and immediate vs. delayed playback. Detailed results, and their clinical implications, will be discussed.

Poster # 28 - AMP12

**Effects Of Telecoil Programming On Speech Understanding In Induction Loops**

*Chelsea Gavin; Joan Besing, PhD; Ilse Wambacq, PhD; Maris Appelbaum, AuD, Montclair State University, Bloomfield, NJ*

The purpose of this study was to determine if a programmed telecoil setting used in an induction loop system promotes better speech understanding than a default telecoil setting or a programmed microphone setting. The data were collected in quiet and in noise. Patient satisfaction was also recorded in the same listening conditions. Keyword scoring of the IEEE sentences was used to assess speech understanding in each condition. A locally constructed preference instrument was used to evaluate patient satisfaction. A 3 x 2 repeated measures ANOVA was used to evaluate the speech recognition scores. Not surprisingly all participants had better speech understanding in quiet than in noise. There were significant differences in performance when comparing the results for the programmed telecoil setting and the microphone program. Comparing the results obtained with a programmed telecoil and the default telecoil setting indicates that there is no decrement in word recognition when using the default telecoil setting. Patient satisfaction results were evaluated and found to be consistent with the speech recognition findings. Therefore programming the telecoil promotes better speech understanding in an induction loop system in quiet and in noise.

Poster # 29 - AMP13

**Hearing Health Behavior Change in Adults**

*Melissa Frederick, AuD; Gabrielle Saunders, PhD; Shienpei Silverman, MS, NCRAR, Portland, OR Ariane Laplante-Levesque, PhD; Lisbeth Dons Jensen, MS; Claus Nielsen, Eriksholm Research Centre*

Successful hearing aid rehabilitation depends to a large extent on people’s beliefs about hearing disability and hearing aids (Knudsen et al. 2010). This study examines models of Health Behavior Change commonly used in health psychology and their application to adults seeking hearing help for the first time. This study focuses on the Health Belief Model (Rosenstock 1966) and the Transtheoretical Model (Prochaska & DiClemente 1983). It investigates the utility of these two theories in describing Health Behavior Change in terms of hearing aid uptake. The Hearing Beliefs and Attitudes of approximately 200
adults seeking hearing healthcare for the first time was assessed at two time intervals: immediately following an appointment with audiology, and six months post-appointment. The following questionnaires were utilized: the Hearing Beliefs Questionnaire (targeting the Health Belief Model: Saunders et al, 2013), the University of Rhode Island Change Assessment (targeting the Transtheoretical Model: McConnaughy et al, 1983), the Hearing Handicap Inventory, Psychosocial Impact of Hearing Loss/Assistive Devices, International Outcome Inventory for Hearing Aids, and a demographics questionnaire. The Hearing Beliefs and Attitudes profiles at baseline will be presented, along with the relationships among groups who ultimately did and did not seek amplification when assessed at the six month follow-up. The applicability of the health behavior theory as it is applied to those seeking help and acquiring hearing aids will also be examined.

Poster # 30 - AMP14

Comparison of Simulation Models for Cartilage Conduction Sound

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Harry Levitt, MD, Advanced Hearing Concepts Inc., Bodega Bay, CA

When aural cartilage is vibrated, the vibrated cartilage generates sound directly in an external auditory canal and it can be heard clearly. Although the concept of the cartilage conduction can be applied to the various speech communication and music industrial fields (e.g., smartphone, music player, and hearing aid), the performance of the device can not be defined because the calibration methods are different from those of the current air and bone conduction devices. Thus, the aim of this study was to simulate the cartilage conduction sound (CCS) using a head and torso simulator (HATS) and an aural cartilage simulator (polyurethane resin pipe). Using the HATS, we found that the simulated CCS in the frequency range greater than 2 kHz corresponded to the measured CCS, averaged among seven participants. Using a skull bone model with the aural cartilage simulator, we found that the simulated CCS in the frequency range lower than 1.5 kHz agreed with the measured CCS. Therefore, a combination of these two methods can be used to estimate the CCS with high accuracy. The HATS and the cartilage simulator can represent sound propagation and resonance caused by the pinna and the external auditory canal, respectively.

Poster # 31 - AMP15

Benefit of Cartilage Conduction Hearing Aids to Aural Atresia

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Harry Levitt, PhD, The City University of New York, CA

Bone conduction (BC) hearing aid or bone anchored hearing aid (BAHA) is an alternative device to air conduction hearing aid for the patients with aural atresia. Unfortunately, fixation problems prevent the long term use for a BC hearing aid and surgery is required for BAHA. Hosoi found that by attaching a transducer to the aural cartilage a relatively loud sound is audile with a negligibly small fixation pressure. This form of conduction is referred to as cartilage conduction (CC). A new hearing aid utilizing CC may generate a great benefit to the patients with aural atresia. In this study, a devised CC hearing aid was fitted to ten patients with congenital aural atresia, and its benefits were evaluated by audiometric tests. In four subjects, we compared its benefits with those of a BC hearing aid and BAHA. As a result, the improvement of hearing was observed in all subjects. The gains and speech recognition scores of CC were
not inferior to those of the other two devices. Considering the advantage of CC hearing aid (Surgery is not required, and the transducer is lightweight with negligibly small contact pressure), it is considered as a practical device.

Poster # 32 - AMP16

Use of LENA to Quantify Hearing Aid Outcomes  Mentored Student Research Poster Award
Kelsey Klein, BA; Ruth Bentler, PhD; Yu-hsiang Wu, PhD, Department Of Communication Sciences And Disorders, University Of Iowa, Iowa City, IA

Understanding users' experiences with hearing aids is key to optimizing hearing aid outcomes. The present study used the Language Environment Analysis (LENA) system as a novel approach to measuring the effect of hearing aids on older adults' real-world auditory environments. Eighteen adults (11 males, seven females) aged 64 to 82 wore a LENA digital language processor for six to eight days while not wearing hearing aids and six to eight days after several weeks of hearing aid use. Variables examined included average number of adult words per hour and percentage of overall time spent around meaningful speech, distant speech, TV and electronic sounds, noise, and silence. Paired two-tailed t-tests revealed no significant differences between the unaided and aided conditions in any auditory categories. Wide individual variation existed within certain categories, such as time spent around TV and electronic sound (unaided M=25.6%, SD=16.0, aided M=24.7%, SD=17.9) and average adult word count per hour (unaided M=1699, SD=698, aided M=1514, SD=713). These variable results indicate the need for clinicians to consider the auditory needs and experiences of clients on an individualized basis. This study supports the feasibility of using LENA as a measure of hearing aid outcomes with older adults.

Poster # 33 - AMP17

Fricative Production After Fitting Frequency Compression Hearing Aids: Listener Evaluation
Kanae Nishi, PhD; Judy Kopun, MA; Evan Cordrey; Patricia Stelmachowicz, PhD, Boys Town National Research Hospital, Omaha, NE

In the previous study, we examined longitudinal changes in acoustic properties of eight fricative/affricate consonants recorded by a 10-year-old male with bilateral, severe-to-profound, sensorineural hearing loss one week before, two weeks after, and approximately 8 months after fitting of nonlinear frequency compression hearing aids. The results suggested that the greatest change in speech production occurred by two weeks after fitting, but a few consonants continued to approximate measurements for age-matched participants with normal hearing by 8 months. The present study evaluated whether these acoustic changes were communicatively meaningful. Ten normal-hearing judges identified fricatives/affricates in consonant-vowel or vowel-consonant syllables excised from speech samples recorded by the target subject and the normal-hearing age-matched peers. Results showed that, the intelligibility of some consonants was comparable to that of normal-hearing subjects across all visits while a few consonants with low intelligibility prior to fitting with frequency compression more closely approximated to that of normal-hearing peers by 8 months after the fitting. These results, while encouraging, should not be generalized to other users of frequency compression hearing aids, as they are dependent on individual hearing configuration, frequency compression settings, motor control, and cognitive factors.

Poster # 34 - AMP18
Can Cognitive Screening Tests Explain Recognition of Distorted Speech?
*Jing Shen, PhD; Pamela Souza, PhD, Northwestern University, Evanston, IL*
*Melinda Anderson, PhD; Kathryn Arehart, PhD; James Kates, PhD; Ramesh Muralimanohar, MS, University of Colorado at Boulder, Boulder, CO*

Similar to hearing, cognition (e.g., working memory, executive functions) often decline in older listeners. Reduced cognitive abilities has been associated with poor speech-in-noise recognition and differing response to distorted speech (as from background noise and/or some types of signal processing amplification). Most previous studies used cognitive measures designed for the laboratory (such as formal tests of working memory) which may not be suitable within the time constraints of a clinical appointment. The recently introduced Montreal Cognitive Assessment (MoCA) (Nasreddine, et al., 2005) was designed as a dementia screening measure, but incorporates measures of attention, working memory, executive functions, visual-spatial ability, and language skill. In this analysis we explored whether MoCA scores would show similar relationships to recognition of distorted speech as more formal, laboratory-based metrics of cognition. Participants were older listeners with mild-to-moderate sensorineural hearing loss. Intelligibility scores were obtained for sentences presented in background noise and processed with fast-acting multichannel wide-dynamic range compression and frequency lowering (via simulated amplification processing). Results suggest that MoCA could be used to characterize cognitive abilities relative to recognition of amplified speech in noise. The relationship between MoCA scores and traditional cognitive measures (working memory and executive functions) will be discussed. [Work supported by NIH]

Poster # 35 - AMP19

Validity of Ecological Momentary Assessment in Audiology
*Yu-Hsiang Wu, PhD; Elizabeth Stangl, AuD, University Of Iowa, Iowa City, IA*

Ecological Momentary Assessment (EMA) is a methodology that involves repeated collection of real-time data describing subjects’ experiences in natural environments. EMA can be implemented using low-tech journals/diaries or high-tech smartphones. Although EMA has been used to assess hearing aid outcomes, its validity in audiology has not been established. Two studies designed to examine the validity of EMA are presented. In the first study hearing aid users were asked to rate their degree of speech understanding in a laboratory and describe the characteristics of semi-controlled real-world environments. The self-reported speech understanding and environmental characteristics were found to be highly consistent with those measured or described by examiners, suggesting that individuals can accurately report their listening experiences in EMA. In the second study participants were asked to (1) carry dosimeters to measure sound levels and (2) report listening experiences using EMA in their natural environments for one week. The relationship between dosimeter and EMA results was found to be consistent with theoretically relevant constructs (e.g., higher dosimeter sound levels were associated with poorer speech understanding), confirming the construct validity of EMA. Taken together, the two studies suggest that EMA is a valid methodology in audiology. [Work supported by NIH/NIDCD grants R03DC012551]

Poster # 36 - AMP20
Motivation For Change During Early Stages of Age-Related Hearing Loss

Carly Maldonado, BS; Karen Doherty, PhD, Syracuse University, Syracuse, NY

Age-related hearing loss progresses gradually and is often difficult to detect in its early stages. It can take people years, or even decades, to be motivated to seek help for their hearing difficulties. This study investigated adults’ motivation for change during the early stages of an age-related hearing loss. Participants ranged in age from 45 to 69 and were divided into two groups based on their hearing thresholds. One group had a mild to moderate sensorineural hearing loss and the other had normal hearing thresholds. All participants self-reported that they had difficulty hearing in some listening situations, but did not know if they had a hearing loss. Differences in hearing thresholds, hearing handicap, extended high frequency hearing thresholds, speech recognition in noise, working memory, and attitudes towards wearing hearing aids were assessed to determine what motivates an individual who is experiencing the early stages of age-related hearing loss to take action for his or her hearing problems. The relationship between these factors and the participants’ stage of motivation was assessed. Motivation to take action was measured using the University of Rhode Island Change Assessment.

Poster # 37 - AMP21

Acoustic Modeling of Reverberant Speech Processed by Hearing Aids

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Nirmal Srinivasan, PhD; Frederick Gallun, PhD, National Center for Rehabilitative Auditory Research, Portland, OR

Acoustic reverberation is characterized by energy reflections that can distort the spectrotemporal characteristics of a signal. Reverberation has significantly greater effect on the speech comprehension of hearing-impaired individuals; however, there is currently limited information as to how hearing aid processing interacts with reverberation. This study investigates the acoustic effects of compression speed on reverberant speech using two models: envelope difference index (EDI; Fortune, Woodruff, & Preves, 1994) and spectral correlation index (SCI; Gallun & Souza, 2009) and relates the output of these acoustic models to speech recognition by adults with mild-to-moderate hearing loss. The EDI examines the effects of a signal distortion to the temporal envelope, whereas the SCI is a multidimensional model that characterizes signal effects in the modulation domain. The models were retrospectively applied to a set of speech tokens subjected to two conditions: reverberation and compression amplification, both of which were applied at a range of real-world conditions. Both models correlate with behavioral performance suggesting that each model depicts perceptually relevant acoustic information; however, the distortion information described by both models is not equivalent in their predictive capacity and neither is able to completely account for the data. [Work supported by NIH R01 DC60014].

Poster # 38 - AMP22

Effects of WDRC on Perception of High-Frequency Speech Cues

Varsha Hariram, AuD; Andrea Plotkowski; Joshua Alexander, PhD, Purdue University, West Lafayette, IN

Emerging evidence suggests that usable speech information in high-frequency regions is primarily in the temporal envelope. In an attempt to achieve audibility, some forms of wide dynamic range compression (WDRC) might limit transmission of useful high-frequency information by degrading temporal envelope
cues, especially as time consonants are shortened and as compression ratios are increased. This may have perceptual consequences for individuals who need greater amounts of amplification or frequency lowering in order to access high-frequency information. This study demonstrates the extent to which perception of high-frequency phonemes may be affected by different forms of amplification. Hearing-impaired adults identified nonsense syllables (with and without frequency lowering) that were amplified using a hearing aid simulator with linear amplification, fast-acting WDRC, slow-acting WDRC, and a compression algorithm with adaptive time constants. To help explain the observed differences in speech recognition, acoustic analyses of the processed speech signals for each participant and each condition were made to evaluate the effects of audibility and envelope distortion.

Poster # 39 - AMP23

**Examining Relationships between Cognitive Status and Hearing Aid Factors**

*Elizabeth Galster, AuD; Amanda Wolfe, AuD; Alyson Gruhlke, AuD; Jason Galster, PhD, Starkey Hearing Technologies, Eden Prairie, MN*

Research over the past decade has established links between cognition and factors related to hearing aid use and fitting (Pichora-Fuller, 2012). Individuals with poorer cognitive function may receive greater benefit from amplification (Davis, 2003) and may use their hearing aids more (Humes, 2003). The goal of the present study was to investigate relationships between performance on a cognitive screening tool (Montreal Cognitive Assessment; MoCA; Nasreddine et al., 2005) and factors related to hearing aid fittings and outcomes. A retrospective analysis of data collected from individuals who participated in hearing aid clinical trials was completed. As a part of these clinical trials, a battery of testing was performed. This testing included unaided and aided speech recognition in noise, real-ear measures, and several questionnaires. This study examined relationships between participants’ performance on the MoCA and factors related to the hearing aid fitting. Clinical implications of the findings will be reviewed.

Poster # 40 - AMP24

**Real-World Communication Strategies with Amplification**

*Julie Cohen, AuD; Douglas Brungart, PhD, Walter Reed National Military Medical Center, Bethesda, MD Sandra Gordon-Salant, PhD; Mary Barrett; Kerrianne Costantino, University of Maryland, College Park, MD*

Traditional approaches to assessing functional impairment of hearing loss in complex auditory situations have been primarily laboratory based. This may not accurately capture the dynamic behavior of both talkers and listeners in an ecologically valid setting, where communication partners constantly adjust attention and vocal effort in response to the ambient sound level. This study, referred to as the cafeteria study, examined the impact hearing aid settings had on performance in an interactive communicative task while in a restaurant. Listeners were placed in 4-person teams who performed the task with each participant set to a different directional setting in each block of trials. The listeners held a tablet that for each trial instructed them to serve as either the talker (by saying a phrase from the Modified Rhyme Test, e.g., you will mark den please) or as a listener (by selecting a key word from closed set of six rhymes on the tablet). The percent correct, reaction time, and degree of head movement were measured for each listener, as well as sound level for each trial. Preliminary results from a related project that used the cafeteria study paradigm to examine the effects of hearing protection on communication will also be discussed.
Comparison of Frequency Lowering Techniques on Speech Perception in Noise

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Frequency lowering strategies are used to move inaudible, high frequency sound into a lower frequency range. Research to date has not determined if differences in speech perception in noise are observed between the different frequency lowering schemes that are currently available. Ten adults with bilateral, high-frequency hearing loss, were fit with three hearing aids that used either non-linear frequency compression (NFC), linear frequency transposition (LFT), or frequency translation (FT). The hearing aids were matched to NAL real ear targets for compression amplification. The respective FL scheme was adjusted for each aid to provide audibility for a 6300 Hz filtered speech signal in the Audioscan Verifit with the lowest settings possible, while preserving the maximum audible bandwidth. Sentence recognition in noise, subjective measures of sound quality, and a modified version of the speech intelligibility index were measured. FL did not improve sentence recognition compared to WDRC. However, FT resulted in significantly poorer sentence recognition compared to NFC and LFT. The subjective questionnaire showed few differences between conditions. We will also examine at how audibility affected performance. Using the fitting method in this study, FL techniques may not provide benefit in background noise situations.

Geriatric Clinic-Based Hearing Intervention for Persons with Dementia

Sara Mamo, PhD; Carrie Nieman, MD; Olivia Nirmalasari, MD; Esther Oh, MD; Frank Lin, PhD, Johns Hopkins University, Baltimore, MD

Recent epidemiological research has demonstrated strong and independent associations between age-related hearing loss and cognitive decline and dementia in older adults. These associations are likely mediated through effects of hearing loss on cognitive load, social isolation, and increased atrophy and structure changes in the brain. Importantly, individuals with preexisting cognitive impairment or dementia are potentially at risk of having further cognitive and functional decline exacerbated by concurrent hearing impairment. The purpose of this study is to provide affordable and accessible hearing intervention to this at-risk population. The intervention is comprised of hearing screening, learning communication strategies and training on how to use of a low-cost amplification device. Our hypothesis is that a one-time aural rehabilitation session with provision of a personal sound amplifier will reduce symptom burden among adults with dementia and age-related hearing loss. Questionnaires are completed by the primary care giver before the intervention and at a 1-month follow-up appointment. The outcome measures assess a variety of domains including depression, function, behavior, communication, burden, and quality of life. The findings will contribute to the development of a sustainable business model that would allow for continued provision of such services at geriatric clinics beyond the scope of this study.

Individual Differences in Self-Adjusted Gain for Noisy Rooms: Effects on Audibility
Noisy restaurants are among the most challenging listening situations for hearing aid users, but little data are available to guide hearing aid fitting for noisy situations. Anecdotal evidence suggests that listeners value comfort over audibility as noise increases. Self-adjustment technology can provide data to empirically answer questions about listener preferences in noise. Previous results indicate that as signal-to-noise ratio (SNR) becomes less favorable, some (but not all) listeners turn down the gain considerably, presumably sacrificing intelligibility for comfort. Data will be presented from listeners with mild to moderate hearing loss who self-adjusted amplification parameters in laboratory simulated restaurant environments. Participants listened using an iPod Touch running a real-time simulation of a multichannel compression hearing aid, with all gain/compression parameters adjustable via a simple user interface (EarMachine). Listeners adjusted amplification parameters while listening to running speech at signal levels of 65 to 70 dBc and SNRs of +10 to -10 dB. Estimates of individual audibility were computed post-hoc for the varying levels and SNRs. Most listeners selected settings that maintained audibility for all but the most negative SNRs. Overall, the data provide information about individual differences regarding the trade-off between reducing noise and maximizing intelligibility.

Poster # 44 - AMP28

**Maximum Acceptable Delay in Hearing Aids Under Noisy Conditions**

*Martin McKinney, PhD; Justin Burwinkel, AuD; Tao Zhang, PhD, Starkey Hearing Technologies, Eden Prairie, MN*

Established practice and previous literature impose limits of less than 10 msec on the overall throughput delay in hearing aids. Larger delays become objectionable due to the interaction between the amplified path and the direct acoustic path [Stone & Moore, 2005 Ear Hear 26(2), 225-235; Stone et al, 2008, Ear Hear, 29(4), 601-167]. This delay limit severely impacts the amount of processing that can take place in a hearing aid. Previous studies looked at the effect of delay in laboratory conditions using a high signal-to-noise ratio. The current study tests the validity of this delay limit under noisy, real-world listening conditions. It is unclear if hearing aid wearers would tolerate larger-than-10msec propagation delays under noisy conditions or in situations that would provide improved signal-to-noise ratio (SNR). Normal-hearing listeners compared processing delays ranging from 4.5 to 20 msec under conditions where the background noise level was 70 dB SPL or greater. Our data suggests that listeners would tolerate longer than established processing delays under such noisy listening conditions.

Poster # 45 - AMP29

**Speech Production Reflects Speech Perception in Listeners with Hearing Loss**

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*Alan Wisler, MS; Andrea Pittman, PhD; Visar Berisha, PhD, Arizona State University, Tempe, AZ*

This study examined the speech production of hearing-impaired adults relative to that of normal-hearing peers. It was hypothesized that both speech perception and production are affected by hearing loss in a predictable fashion. Subtle alterations to production may serve as markers for the effects of hearing loss as well as the benefits of amplification. Seven normal-hearing adults and 15 hearing-impaired adults read aloud TIMIT sentences and repeated NU-6 words in a quiet environment. Hearing-impaired participants...
completed testing in unaided and aided conditions. As expected, word recognition was significantly poorer in the hearing-impaired adults. Speech production was analyzed along 700 acoustic parameters. Multivariate ANOVA revealed that 18 of these features differed significantly across groups in the unaided condition after controlling for gender. Factor analyses accounted for 74% of the variability by grouping the 18 features into 2 principal components characterizing the spectral energy <8000 Hz and the overall spectral shape of the speech production. Pearson correlation coefficients revealed modest but significant relationships between spectral energy and speech perception (0.49) and between spectral shape and hearing level (0.59). These results confirm subtle alterations to speech production with hearing loss.

Analyses of aided speech production will indicate the malleable nature of these alterations.

Poster # 46 - AMP30

**Detecting Changes in Hearing Disability Following Unilateral Hearing Aid Fitting**

*Ryan Irey, MA; Jason Galster, PhD, Starkey Hearing Technologies, Eden Prairie, MN*  
*Charles Bishop, AuD, The University Of Mississippi Medical Center, Jackson, MS*

The Speech, Spatial, and Qualities of Hearing Scale (SSQ; Gatehouse & Noble, 2004) is a self-report measure designed to assess hearing disabilities across several binaural hearing domains. It has been validated in samples of listeners with symmetrical and asymmetrical hearing losses using unilateral and bilateral amplification. However, little is known about the perceived impact of amplification on listeners with near-normal hearing thresholds in the better ear and hearing loss in the poorer ear that can be treated with amplification. This study investigates the subjective impact of unilateral amplification via the SSQ prior to prescription and after a period of adaptation. SSQ responses, word recognition scores, and audiometric data were obtained for 20 participants. Results indicate that the impact of unilateral amplification decreases perceived hearing disabilities evaluated by the SSQ. Further, correlational analyses of SSQ responses with better- and poorer-ear thresholds, and performance measures such as sound field word recognition, suggest that factors previously associated with SSQ responses in populations with binaural hearing loss are different from those with near-normal hearing in the better ear.

Poster # 47 - AMP31

**Evaluating the Communication Participation Item Bank with Hearing Impaired Adults**

*Kristen Birch, BS; Christi Miller, PhD; Carolyn Baylor, PhD, University Of Washington, Seattle, WA*

The treatment goal in audiology is to improve the Quality of Life (QoL) for individuals with hearing loss. However, the field lacks validation measures that include participation restrictions, an area outlined by the World Health Organization as essential to measuring QoL. The Communication Participation Item Bank (CPIB) is a self-report questionnaire that measures restrictions to participation that are important to the fulfillment of life goals. The CPIB has been validated on multiple communication disorders, however it has not been evaluated on adults with hearing loss. Interviews are being conducted with a minimum of 12 individuals with hearing loss. The purpose was to qualitatively evaluate, using a think-out-loud procedure, if the items on the CPIB were relevant for the hearing loss population. The relevance of items on the CPIB questionnaire were variable depending on the subject. While many items are relevant, an emerging trend was that some items focused on speech production, and were not relevant for hearing loss. The instrument does appear to be sensitive to capturing change with treatment (hearing aids). Recommendations for modifying the CPIB will be made based on results of this study.
Temporal Envelope Cues in Frequency-Lowered and Un-Lowered Fricatives
Andrea Plotkowski, BA; Varsha Hariram, AuD; Joshua Alexander, PhD, Purdue University, West Lafayette, IN

High-frequencies critical for fricative identification are often inaudible with conventional amplification. With frequency-extension techniques, including frequency-lowering, it remains unclear what details need to be transmitted to maintain perception. Using normal-hearing listeners, Witte & Alexander (AAS, 2013) manipulated the number of channels and temporal envelope cutoff frequency used for noise- and tone-vocoding in a vowel-consonant identification task and found that most fricatives were impervious to reductions in both spectral and temporal resolution. This study extended previous findings by (1) removing envelopes <8 Hz, and (2) frequency shifting the vocoded bands. The first experiment indicated that /s/ and /z/ were exclusively dependent on envelopes ≤4 Hz, whereas /f/ and /v/ were mostly dependent on envelopes ≤16 Hz. /ð/ and /θ/ depended on both spectral and temporal information, while /ʃ/ depended on both cues to a lesser extent. Findings suggest that spectral resolution can be compromised for most fricatives if gross temporal resolution is preserved. The second experiment tested this in the context of frequency lowering by vocoding wider, higher-frequency analysis bands using narrower, lower-frequency synthesis bands. Interestingly, frequency lowering with noise-vocoding dramatically reduced fricative identification, but not with tone-vocoding. Overall, findings highlight temporal envelope importance for identification of lowered and un-lowered fricatives.

C2Hear: Interactive Multimedia Self-management Programme Benefits First-time Hearing Aid Users
Melanie Ferguson; Marian Brandreth, NIHR Nottingham Hearing Biomedical Research Unit, UK
Will Brassington, Nottingham Audiology Services, Nottingham University Hospitals NHS Trust, UK
Heather Wharrad, University of Nottingham, UK

Hearing aid (HA) fitting alone is not the optimal intervention for people with hearing loss. Adopting additional rehabilitation strategies, such auditory training, motivational engagement and improving patient education may improve users’ success with HAs. Eight interactive, multimedia video tutorials (or reusable learning objects, RLOs) were evaluated in an RCT of 167 first-time HA users; half received the RLOs (RLO+) and half formed a waitlist group (RLO-). RLOs were effective in almost every domain examined. RLO uptake and compliance was high (78% and 94% respectively). 50% watched the RLOs 2+ times suggesting the RLOs were used to self-manage users’ hearing loss and HAs. The RLO+ group had better retention of information, and better practical HA skills than the RLO- group (p<.001). HA use was higher for challenging listening situations and in suboptimal users for the RLO+ group (p<.05). RLOs were rated as highly useful (mean=9/10). Post-evaluation focus groups reported improved awareness and confidence, involvement of family members and sharing RLOs with others. Health economic analysis showed the RLOs were a cost-effective healthcare intervention. With a gap in audiology habilitation for an effective multi-media intervention, the RLOs are now commercially available in the UK, under the brand name C2Hear.
Individuals, Not Ears: A Person-Centred Approach  
Eithne Heffernan; Helen Henshaw; Melanie Ferguson, NIHR Nottingham Hearing Biomedical Research Unit, Nottingham, UK

This research aims to better understand challenges faced by people with hearing loss to inform and align habilitation approaches to their needs. A study to develop a measure of social participation in people with hearing loss (PHL) began with semi-structured interviews to better understand social participation (n= 25 PHL, n=9 hearing healthcare professionals). The results showed that social participation in PHL is complex. People may become socially withdrawn due to diminished confidence, may be unaware of their own isolation, and may find their attempts to participate blocked by others. Some individuals successfully participate in many events, but struggle in events they value most, suggesting it is not sufficient to measure participation using the frequency of events attended. A second study showed it was feasible to use the Ida Motivational tools within a UK public sector audiology clinic. The effectiveness of the tools is being examined in a completed RCT of 62 hearing aid users. Finally, a James Lind Alliance Priority Setting Partnership gathered 1209 patient and clinician uncertainties about the treatment of mild-moderate hearing loss. Uncertainties were categorized using the Health Research Classification System. A second stage will generate indicative questions, which patients and clinicians prioritize for research.

**PSYCHOACoustics / HEARING SCIENCE**

Poster # 51 - PSY01

Masking Release for Peak-Clipped Versus Temporal Fine-Structure Speech  
Charlotte Reed, PhD; Joseph Desloge, PhD; Louis Braida, PhD; Agnes Leger, PhD; Zachary Perez, MS,  
Massachusetts Institute Of Technology, Cambridge, MA

A major complaint of hearing-aid users is the difficulty of understanding speech in competing backgrounds. This problem may be compounded by their inability to take advantage of temporal fluctuations in background interference to achieve the gains in intelligibility demonstrated for normal-hearing listeners. Léger et al. (2014) observed that the fluctuating masker benefit (FMB) for hearing-impaired listeners using speech processed to preserve temporal fine-structure (TFS) cues was substantially larger than that observed for either unprocessed speech or for envelope-based speech. This effect may have arisen due to the removal of signal amplitude variation that occurs as part of TFS-speech processing. This poster presents preliminary data exploring this possibility by comparing the intelligibility of TFS speech to simple peak-clipped speech in which amplitude variations are similarly removed. Results are presented for hearing-impaired listeners on a consonant-identification task in backgrounds of continuous and temporally-interrupted noise for unprocessed speech, TFS speech, and peak-clipped speech. Preliminary data indicate that the results obtained with peak-clipping are highly similar to those observed for TFS speech, thus suggesting that the FMB may arise from the greater audibility of the speech signal in both cases.

Poster # 52 - PSY02

Using Dual-Task Paradigms to Assess Listening Effort in School-Aged Children  
T35 Research Trainee Poster
In everyday life, we must often work hard to understand speech, especially in complex situations. This idea has been coined ‘listening effort’, which is described as the ‘attentional requirements to understand speech.’ It is of particular interest when considering children in classroom situations, where acoustical complexities like noise and reverberation are common. To better understand listening effort in children, an age-appropriate task is needed. Dual-task paradigms have been used to assess listening effort in adults. At this time, it is not clear how to best measure listening effort in children. Other researchers have used dual-task paradigms, but these paradigms have not always revealed the expected effects with children, suggesting a more sensitive and age appropriate paradigm to measure listening effort is warranted. The goal of this current project was to examine three dual-task paradigms and their abilities to assess listening effort in school-aged children (9-17 years old). The paradigms included a primary and secondary task. Word recognition was the primary task in each paradigm and secondary tasks varied in either complexity or depth of processing. Data on three dual-task paradigms for 22 normal-hearing children will be presented. Results suggest that the paradigm with the increased depth of processing may not be appropriate for all children.

Poster # 53 - PSY03

**Restoration of Spectral Loudness Summation in Listeners with Hearing Loss**
Daniel Rasetshwane, PhD; Stephen Neely; Michael Gorga, PhD; Judy Kopun, MS; Emily Clark, Boys Town National Research Hospital, Omaha, NE

Loudness summation occurs when listeners with normal hearing (NH) perceive broadband signals as being louder than narrowband signals even though the signals are presented at the same sound pressure level. Loudness summation is reduced in listeners with hearing loss (HL). Suppression is a reduction in the cochlear response to one sound by the simultaneous presentation of another sound, plays an important role in the processing of broadband and complex sounds, and is reduced in listeners with HL. Providing amplification that restores suppression and provides wide-dynamic range compression may restore normal loudness for broadband sounds. This study investigated restoration of loudness summation in listeners with HL using an experimental hearing aid that attempts to restore normal suppression and normal loudness. Estimates of loudness summation were obtained in listeners with NH and HL using categorical loudness scaling (CLS). Stimuli were bandpass noise centered at 2000 Hz with bandwidths of 100-6400 Hz. Gain was selected to restore normal loudness based on CLS measurements with pure-tone stimuli. Amplification with suppression resulted in improved loudness summation, compared to compression alone. The present results inform (1) the role of suppression in loudness summation, (2) the development of future loudness models, and (3) advanced HA signal-processing strategies.

Poster # 54 - PSY04

**Auditory Perceptual Filters in Macaque Monkeys**
Jane Burton; Corey Mondul; Margit Dylla; Ramnarayan Ramachandran, Vanderbilt University, Nashville, TN
The auditory system is thought to process complex sounds by utilizing overlapping bandpass filters. The critical band, a measure of filter bandwidth, relates to the spectral extent of masking influences on filter components. The goal of this study was to estimate auditory filter shape in nonhuman primates using the notched noise method. Two macaques were trained to detect tones embedded in noises that were spectrally notched symmetrically and asymmetrically around the tone. Masked tone thresholds decreased with increasing notchwidths and approached unmasked tone thresholds at the widest notchwidths. Critical bands were estimated as the half-power bandwidth of a filter obtained by integrating the threshold vs. half-notchwidth data with a rounded exponential fit. Macaque auditory filters were symmetric at low noise levels and asymmetric at higher noise levels with shallower low-frequency and steeper high-frequency tails. Macaque critical bandwidths were comparable to human critical bands, increased sublinearly with frequency, and did not change with noise level. These data form a basis for investigations of the underlying neuronal mechanisms of perception, and serve as a baseline for studies of auditory processing after hearing loss. Funded by NIH 2T35DC008763-08 (PI: Linda Hood) and 7R01DC11092 (PI: R. Ramachandran) grants to Vanderbilt University.

Poster # 55 - PSY05

**Psychoacoustic Measures of Cochlear Gain Reduction at Speech-Relevant Frequencies**

*Kristina Milvae, AuD; Elizabeth Strickland, PhD, Purdue University, West Lafayette, IN*

Difficulty understanding speech in noisy environments is a common complaint of listeners with hearing loss. One known physiological mechanism that is hypothesized to improve speech understanding in noisy environments is the medial olivocochlear reflex (MOCR). The MOCR acts by reducing gain in the cochlea in response to the acoustic environment. When gain is already reduced, as in cochlear hearing impairment, the MOCR may be less effective. Evidence of cochlear gain reduction has been measured at 4 kHz in psychoacoustic studies. However, other frequency regions are more ecologically relevant and more likely to play a larger role in speech-in-noise perception. Therefore, further exploration of gain reduction at lower frequencies is needed. In this experiment, a growth of masking technique is used to estimate the basilar membrane response at 2 and 4 kHz for listeners with normal hearing. Growth of masking is then measured with preceding acoustic stimulation to investigate cochlear gain change at each frequency. The amount of gain change is compared to subject performance on a speech-in-noise task. It is hypothesized that the magnitude of gain change (estimated MOCR strength) will be positively correlated with performance in speech-in-noise perception. Results and implications will be discussed.

Poster # 56 - PSY06

**Quantifying the Contribution of Specific Frequency Bands to Loudness**  
*Mentored Student Research Poster Award*

*Sara Walker, BS, University Of Nebraska-Lincoln, Lincoln, NE*  
*Brenda Ohlrich, MS; Walt Jesteadt, PhD, Boys Town National Research Hospital, Omaha, NE*

Subjects place greater emphasis on the lowest and highest frequency bands of broadband sounds than current loudness models predict. The goal of the present study was to quantify the contribution of these bands to overall loudness. To that end, seven subjects with normal hearing completed two tasks. In the loudness matching task, subjects adjusted the level of a broadband noise to match the loudness of a second noise with low, mid, or high frequency bands missing. In the loudness judgment task, the two noises were presented at equal levels and subjects indicated which was louder. In both experiments,
stimuli consisted of broadband noises presented at three different levels as well as a condition with levels designed to approximate the long term average spectrum of speech (LTASS). Results of the matching task are consistent with the previously observed low and high frequency emphasis and showed a larger effect when the highest frequency band is removed. Loudness judgment data confirmed these results. Stimuli with all frequency bands were consistently judged to be louder than stimuli missing the highest frequency band. This was true even for LTASS noise, where the highest frequency band contained little energy. [Work supported by NIH].

Poster # 57 - PSY07

**The Importance of Distance and Direction Cues for Acceleration Discrimination**  
*T35 Research Trainee Poster*

*Sarah Fisher, BA; Robert Elrod, Auburn University, Auburn, AL*

*Daniel Ashmead, PhD, Vanderbilt University, Nashville, TN*

**Introduction:** Auditory motion perception is used for everyday activities such as street crossing by pedestrians, and is especially important for persons with visual impairments. However the research literature on auditory acceleration perception is limited. Therefore, this study investigated the use of direction and distance cues in perception of acceleration for tangential motion paths. Methods: Six normal hearing young adults were tested in an anechoic chamber. The sound source (low-pass Gaussian noise) moved on a simulated horizontal path in front of the participant. The first phase was repeated threshold testing using an adaptive staircase procedure, to promote task familiarity and to obtain stable threshold values. During the second phase, participants discriminated between acceleration and deceleration in six different conditions with varying emphasis on distance and direction: tangential motion, circular motion, tangential motion, tangential motion, direct approach, and a true direction approach path. Results: For phase 1, stable auditory thresholds were two to three times higher than reports of visual perception of acceleration. For phase 2, data showed generally worse performance in conditions with less emphasis on directional cues. In fact, distance cues in the tangential motion path may have compromised acceleration discrimination.

Poster # 58 - PSY08

**Contributions by Specific Frequency Bands to Loudness of Broadband Noise**

*Walt Jesteadt, PhD; Oluwaseye Ogun, MD; Brenda Ohlrich, MS; Katyarina Brunette, PhD, Boys Town National Research Hospital, Omaha, NE*

Subjects with normal hearing (NH) and sensorineural hearing loss (HL) compared pairs of noise stimuli and chose the louder noise in each pair. Each noise was made up of 15 bands. Each frequency band was two critical bands wide and the level of each band varied over a 12-dB range from one presentation to the next. The relative contribution of each band to the total loudness of the noise can be determined by computing the correlation between the difference in levels for a given band on every trial and the subject's loudness decision on that trial across 500 trials. This was done for noises with the long-term average speech spectrum (LTASS) and noises with equal levels for all 15 bands, but overall differences in level across conditions. Weights for HL listeners were determined by audibility and the spectrum of the noise stimuli, with bands near the peak of the LTASS noise receiving greatest weight. NH listeners assigned greater weight to the lowest and highest bands, an effect that increased with overall level, but
did not assign greater weight to bands near the peak of the LTASS noise. The results are not predicted by current loudness models. [Work supported by NIH].

Poster # 59 - PSY09

**Effect of Informational and Energetic Maskers on Binaural Listening Advantages**

*Cassandra Bosworth, BA; Janet Koehnke, PhD; Joan Besing, PhD, Montclair State University, Bloomfield, NJ*

*Jaclyn Spitzer, PhD, Montclair State University and Columbia University Medical Center*

In background noise, binaural listening often improves speech understanding over monaural listening. The binaural advantages of summation, squelch, and head shadow effect have been documented to help listeners in noise. Typically, these advantages are studied together as binaural processing or one is studied separately; rarely have each of these advantages been examined independently. Additionally, there is limited research regarding the effects of informational and energetic masking on each of the aforementioned advantages. This study was designed to examine the effect of semantic inference on each binaural listening advantage. Speech recognition thresholds for sentences (SRTs) for young, adults with normal hearing were determined for monaural and binaural listening conditions. Forward and backward two-talker babble were presented from either 00 or ± 900 azimuth; target sentences were presented from 00 azimuth with sentence level changing adaptively based on number of keywords identified correctly. SRTs from the different listening conditions were used to determine the difference due to summation, squelch, and head shadow effect for each masker separately. Data analysis revealed each advantage was significantly different from 0 on Wilcoxon signed rank tests, indicating a significant effect of binaural listening on speech understanding. Further effects of masker type will be discussed.

Poster # 60 - PSY10

**Increased Sensation Level and Bandwidth on Spatial Release from Masking**

*Kasey Jakien, BS; Frederick Gallun, PhD, OHSU And The National Center For Rehabilitative Auditory Research (NCRAR), Portland, OR*

*Sean Kampel, AuD, National Center For Rehabilitative Auditory Research (NCRAR), Portland, OR*

Spatial release from masking (SRM) has been shown to improve listener thresholds and increase speech intelligibility in complex listening environments. Here we document how equating audibility and simulating high-frequency hearing loss or hearing-aid amplification may impact speech-in-speech informational masking. Seventy-one participants varying in age and hearing ability completed two experiments of spatial release with individually processed stimuli taken from the Coordinate Response Measure corpus (CRM). Performance for all listeners, regardless of age or hearing loss, generally improved with an increase in overall sensation level and/or bandwidth, but the improvement was small relative to the benefits of spatial separation. Understanding the influences of sensation level and bandwidth on informational masking may facilitate better understanding of how speech-in-speech stimuli should be processed for optimum intelligibility. This work was supported by the National Institutes of Health (NIH) grant R01 DC011828 and the NCRAR.

Poster # 61 - PSY11

**Spatial Release from Masking: Effects of Simulated Unilateral Hearing Loss**  
*Mentored Student Research Poster Award*
The overall objective of this research is to understand how unilateral hearing loss impacts children’s functional auditory skills. As an initial step towards this overall objective, the purpose of this study was to develop a feasible method to assess the effects of unilateral hearing loss on children’s speech perception and spatial release from masking in the context of substantial informational and energetic masking. Normal-hearing adults completed a monaural and binaural sentence recognition task in the presence of a co-located or spatially separated masker, which was either two-talker speech or speech-shaped noise. Maskers were presented at +90 or -90 degrees azimuth in the horizontal plane. Monaural listening in the sound field was achieved by occluding one ear with a foam earplug and a supra-aural earmuff. Results suggest that (1) the magnitude of spatial release from masking is greater in two-talker speech than in speech-shaped noise, and (2) competing two-talker speech reveals listening difficulties in the monaural conditions that the speech-shaped noise does not. The proposed methodology offers promise for the evaluation of functional auditory skills of children with unilateral hearing loss, and may inform future clinical procedures to identify at-risk children and guide intervention.

Poster # 62 - PSY12

Using Cognitive Tasks to Evaluate Listening Effort in Background Noise
Jeffrey DiGiovanni, PhD; Travis Riffle, Ohio University, Athens, OH

Listening in noise is a common complaint of hearing aid users. An emerging body of literature is demonstrating a significant relationship between cognition and listening performance. This experiment was designed to examine the effects of different background noises on auditory cognitive tasks while still maintaining a high-level of intelligibility (90%). We used three cognitive tasks to evaluate auditory working memory: a working memory span task, an attention-switching task, and a language comprehension task. Tasks were completed in quiet and three different types of modulated background noise. Fourteen normal-hearing participants spanning a broad age range took part in this study. Both the working memory span and attention switching tasks were correlated significantly with language comprehension. Also, all three noise types had a significant effect on performance, which supports our hypothesis that all noises used imposed an increase in cognitive load which may impair an individual’s ability to thrive in these situations. The various types of noises allow researchers to choose noises with varying degrees of real-world characteristics as well as experimental control. Further investigation will include comparing these data to age-matched hearing-impaired participants.

Poster # 63 - PSY13

Release from Masking: Behavioral and Physiological Masking Level Differences
Mentored Student Research Poster Award
Sarah McClements, BS; Mary Ellen Scherer; Christopher Clinard, PhD, James Madison University, Harrisonburg, VA

The purposes of this study were 1) to establish the feasibility of measuring physiological masking level differences using the frequency-following response (FFR), and 2) to characterize the relationship between behavioral and physiological measures of masking level differences (MLDs). Ten young adults (ages 21-26) with clinically normal hearing sensitivity participated in this study. Stimuli for behavioral
and physiological conditions were 500 Hz tonebursts presented in one-third octave narrowband noise. Three phase conditions were tested: SoNo, SoNπ, and SπNo. Behavioral MLDs were assessed using an adaptive 2AFC procedure. Physiological MLDs were assessed using the frequency-following response, an auditory evoked potential reliant on phase-locked neural activity. FFR analysis included phase coherence and amplitude measures. Behavioral MLDs were 10.4 dB (std. dev = 4.8) for SoNπ and 8.6 dB (std. dev = 4.4) for the SπNo condition. Physiological MLDs did not indicate a release from masking. Correlations between behavioral and physiological MLDs were -.62 for SoNπ and .45 for SπNo. Robust behavioral MLDs were observed. However, scalp-recorded FFRs did not reflect a release from masking in antiphase conditions. These findings may help to clarify which scalp-recorded auditory evoked potentials reflect binaural processing in humans.

Poster # 64 - PSY14

**The SSQ as a Predictor of Spatial Release from Masking**

_Meghan M. Stansell, BS; Melissa A. Papesh, PhD; Nirmal Kumar Srinivasan, PhD; Sean D. Kampel, AuD; Heather M. Belding, National Center For Rehabilitative Auditory Research (NCRAR), Portland, OR Kasey M. Jakien, Oregon Health and Science University (OHSU), Portland, OR Frederick J. Gallun, PhD, National Center for Rehabilitative Auditory Research (NCRAR) & Oregon Health and Science University (OHSU), Portland, OR_

The Speech, Spatial, and Qualities of Hearing Scale (SSQ) is a questionnaire designed to assess self-reported auditory disability across several domains (Gatehouse and Noble, 2004). Measures such as the SSQ may provide useful clinical information sensitive to subtle suprathreshold auditory dysfunction not typically detected using routine clinical audiometry. Our goal was to determine whether SSQ responses would accurately predict spatial release from masking performance in anechoic and reverberant environments. Target and masker stimuli consisted of Coordinate Response Measure (CRM) sentences presented both over headphones and in an anechoic chamber. Subject groups included young and older normal-hearing listeners, older participants with mild-to-moderate hearing loss, and subjects reporting a history of blast exposure with essentially normal hearing thresholds. The normal-hearing and hearing-impaired groups generally reported their ease of auditory ability as successful (high SSQ scores). Results of performance on speech-on-speech masking were uncorrelated and variable. The blast-exposed subjects consistently reported ease of auditory ability as less successful (lower SSQ scores), compared to age-matched controls. Results of performance of blast-exposed subjects on tests of speech-on-speech masking, compared to age-matched controls, were correlated. Implications for clinical use will be discussed.

Poster # 65 - PSY15

**Phonemic Restoration with Competing Talkers: Age Effects and Envelope Cues**  

_Mentored Student Research Poster Award_

_William J. Bologna, AuD, Department Of Hearing And Speech Sciences, University Of Maryland, College Park, MD; Jayne Ahlstrom, MS; Judy R. Dubno, PhD, Department Of Otolaryngology-head And Neck Surgery, Medical University Of South Carolina, Charleston, SC_

Perception of interrupted speech improves when noise is inserted in silent gaps between speech segments. Modulating the intervening noise by the temporal envelope of the missing speech enhances
this ‘phonemic restoration’ effect for single talkers for younger and older adults. However, these envelope cues may or may not provide benefit in realistic listening environments where competing speech contributes additional masking effects, especially for older adults. To address these questions, the present study assessed the contribution of envelope-modulation cues to phonemic restoration with a competing talker. Younger and older adults with normal hearing listened to sentences that were periodically interrupted with silence or with envelope-modulated noise and presented in quiet or with an unprocessed competing talker. Differences in recognition of sentences interrupted with silence or envelope-modulated noise were determined for sentences presented with or without a competing talker. Measures of amplitude-modulation detection and detection interference, a visual analog of perception of interrupted speech, and a cognitive battery were also included to determine sources of individual differences in phonemic restoration. Results are discussed in terms of age-related changes in perceptual organization and use of envelope cues in complex listening environments. [Work supported by NIH/NIDCD and a AAA Student Investigator Research Grant]

Poster # 66 - PSY16

**Perception of Own Voice Relative Loudness at Different Speaking Levels**

*Dragana Barac-Cikoja, PhD; Kasheen Schultz; Jillian Barney; Rebecca Kingman, Gallaudet University, Washington, DC*

Effects of soft versus loud speech production on relative loudness of speech feedback were investigated in four normally hearing individuals. An adaptive, 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). The subjects’ speech was recorded with a microphone placed above their right ear, and both feedback and replay signals were presented via insert earphones. Based on the subjects’ responses, the replay levels were raised or lowered until the point of subjective equality (PSE) was reached. Relative loudness of the speech feedback was assessed from the difference in sound pressure level (SLP) of each signal (feedback and replay) at the PSE. The subjects were tested in two conditions: speaking in soft versus loud voice. In order to match the loudness of the speech feedback, the subjects consistently set the level of the replay by 2-4 dB lower when speaking loudly compared to speaking softly. The finding is interpreted to reflect the effect of voice-activated peripheral attenuation. The additional bone conducted feedback increases the overall SPL of the live input, and with increasing speaking level, results in greater activation of the acoustic reflex.

Poster # 67 - PSY17

**Inter-pixel Correlation of Decision Weights Estimated Using Several Techniques**

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

Estimating decision weights from listeners allows researchers to gain insights into the listeners’ decision strategies and internal representation of the sensory stimulus. Decision weights are particularly useful for determining the relative influence of different pixels--spectral or temporal segments--of the stimulus on listeners' decision. In comparing the magnitude of estimated weights from different pixels, it is important to take into account any inter-pixel correlation between these weights. Based on Monte-Carlo simulation, a previous study (Dai & Micheyl, 2012, J Acoust Soc Am, 132(5): 3418-3427.) has shown that, in m-alternative recognition tasks, weights estimated using multinominal logistic regression can be
strongly correlated across pixels. Here we extended the study to the popular 2-alternative, forced-choice task and examined the inter-pixel correlation of decision weights estimated with several techniques. In particular, we examined the dependence of inter-pixel correlation of estimated weights on several factors including the number of pixels from which the weights are estimated, the size of the signal to be detected, the amount of internal noise, and the specific technique used for estimating the weights. The results and their implications will be discussed in this presentation.

**SPEECH PERCEPTION**

Poster # 68 - SP01

**Perceived Listener Effort for Disordered Speech: Effect of Stimulus Length**  New Investigator Poster Award

*Kathy Nagle, PhD, Mass. General Hospital Dept. Of Surgery, Boston, MA*

*Tanya Eadie, PhD, University Of Washington Department Of Speech And Hearing Sciences, Seattle, WA*

Perceived listener effort (PLE) is a perceptual dimension used to identify the amount of work necessary to understand speech. Listening effort has been well studied in hearing populations, but understudied in relation to disordered speech. Listeners transcribed and rated samples produced by healthy male speakers using an electrolarynx for PLE and acceptability. Perceived listener effort was shown to be a multidimensional construct highly correlated with intelligibility (r = -0.83) and acceptability (r = -0.88). Acceptability, intelligibility and sentence length significantly predicted 86% of the variance in PLE ratings. Acceptability showed the strongest univariate relationship with PLE as well as a significant unique relationship with PLE when other factors were held constant. The interaction of sentence length and intelligibility on PLE ratings was also significant (p<0.05), with Long (13-15 word) sentences requiring greater effort than equally intelligible Short (5-7 word) sentences. The additional finding that sentence length did not affect acceptability ratings of the same samples suggests that acceptability ratings are made based on a gestalt impression of the stimulus, whereas PLE ratings vary as a function of sentence length, among other variables. Extending research on PLE to disordered speech provides ecological validity and increases understanding of communication breakdowns.

Poster # 69 - SP02

**Aging and Error Patterns in Competing Speech Perception**

*Karen Helfer; Alexandra Jesse, PhD, University Of Massachusetts, Amherst, MA*

Speech perception experiments in which actual participant responses are documented can yield rich sources of data. In competing speech experiments, errors patterns derived from analyzing participants’ incorrect responses may provide a window into how listeners process both to-be-attended and to-be-ignored speech. This poster will present a fine-grained analysis of error patterns made in a competing speech study. Speech understanding, pure-tone thresholds, and selected cognitive abilities were measured in younger, middle-aged, and older listeners. Pairs of sentences were presented to participants in an open-set format. All target sentences were recorded from the same female talker, and all masking sentences were from another female talker. Types of errors were analyzed at both the word level and the sentence level. Analyses showed substantial differences in error patterns among the three listener
groups, as well as significant correlations between types of errors and both high-frequency hearing thresholds and selected cognitive abilities (Work supported by NIDCD R01-012057).

Poster # 70 - SP03

**Effects of Noise and Reverberation on Speech Perception in a Simulated Classroom**  
*T35 Research Trainee Poster*  
Katlyn Bostic, BS, University Of Maryland - College Park, Laurel, MD  
Dawna Lewis, PhD, Boys Town National Research Hospital, Omaha, NE

Background: Studies have shown unoccupied classrooms commonly exceed the standards for noise and reverberation set by ANSI. Speech perception testing of low-predictability (LP) sentences may better represent the effort required to understand new material children encounter in typical classrooms. This study investigated the interaction between noise and reverberation on speech perception of LP sentences in children with normal-hearing, as well as examined the effects of age and receptive vocabulary on speech perception in noise of these sentences. Methods: Speech perception scores of low-predictability sentences were measured in varying reverberation times (0.3, 0.6, and 0.9 s) and signal-to-noise ratios (+6, +3, 0, and -3 dB SNR) in children ages 8-12 years. Results: For both keyword whole-sentence scoring, there was a significant effect of SNR and RT (p<0.001). No significant correlations were observed for age or receptive vocabulary (p>0.05). Conclusion: For both the keyword and whole sentence conditions, performance improved as RT decreased and as SNR increased. This study found no significant correlation between age or receptive vocabulary with speech-perception of LP sentences within the ranges for the current study.

Poster # 71 - SP04

**Effects of Hearing and Cognitive Skills on Priming in Older and Younger Adults**  
*Angela Costanzi, BS; Karen Helfer, PhD; Richard Freyman, PhD, University Of Massachusetts, Amherst, MA*

Previous research has provided evidence that speech understanding declines as people age, especially in situations that include background noise or competing speech. Additional research has suggested that both younger and older adult listeners may benefit from context or priming of a target before the target is presented. This poster will present results of an examination of the benefit priming provides to older adult listeners compared to younger adult listeners in difficult listening situations. Participants were younger (18-25 years) and older (>60 years) adults; all participants completed a hearing test, a battery of cognitive tests, and the priming task. The priming task consisted of 240 sentences in two types of maskers (speech shaped noise and two-talker competition). Half of the time the sentences were visually primed, and half of the time they were not. Participants were asked to select one out of six possible confidence ratings to indicate how confident they were that the target auditory sentence matched the displayed priming sentence. This poster will show results of the analyses comparing the effects of priming between the participant groups, as well as how these effects were influenced by cognitive abilities and hearing loss (Work supported by NIDCD R01-012057 and R01-01625).

Poster # 72 - SP05

**Measuring Effects of Sentence Context on Word Recognition**  
*Charles Ruby, BA, San Diego State University & University Of California, San Diego, Cardiff by the Sea, CA*
A measure of an individual’s sentence-context usage was developed with the long term goals of (1) making the measure clinically viable (short testing time, high reliability) and (2) contributing to planning and outcome assessment in Aural Rehabilitation. Although such a test already exists (the SPIN test) the goal was to increase reliability by increasing the number of test items on which a single score is based. Thirty-two normal hearing adults participated in evaluation of the measure. Word recognition in steady state noise was measured, as a function of Signal-to-Noise Ratio, in thirty-two normal-hearing adults. The stimuli were meaningful and nonsense sentences, each four-words long, presented in sets of ten. Sixteen participants received naturally produced sentences. The other 16 participants received concatenated sentences (words recorded in isolation and combined online). Participants completed two replications of the procedure within a single session. Context effect was assessed with the k-factor (ratio of the logarithms of the error probabilities for meaningful and nonsense sentences). Performance was better with concatenated sentences than with natural sentences. The type of sentence had only a small effect on the magnitude of the context effect. Individual differences of sentence-context usage were not demonstrable in this sample of normal-hearing listeners.

**Performance on SPIN Sentences with Reverberation and Reverberation Plus Noise**

*Yana Shklyar, BA*, St. John's University, New York, NY  
*Jessica King*, University Of Washington  
*Cassandra Bosworth*, Montclair State University  
*Craig Newman, PhD; Sharon Sandridge, PhD*, Cleveland Clinic, Cleveland, OH  
*Anil Lalwani, MD; Jaclyn Spitzer, PhD*, Columbia University Medical Center

The Speech Perception in Noise (SPIN) test was designed to investigate listeners’ utilization of top-down and bottom-up processes in multitalker babble. Real-world adverse listening environments, however, are typically contaminated by reverberation. Previous studies (Sandridge et al., 2005; Spitzer et al., submitted) have demonstrated the SPIN Sentences, when subjected to reverberation, provide an ecologically valid measure of challenges often encountered by hearing impaired listeners. The latter authors used reverberation times (RT) simulating a furnished living room (LR) (RT=600 ms), classroom (CR) (RT=1200 ms) and auditorium/hard hall (HH) (RT=3600 ms) in samples of young normal listeners and cochlear implant recipients. For both samples, performance on the SPIN deteriorated as RT increased. The present study utilized LR and CR conditions in samples of normal hearers and hearing aid users with symmetrical sensorineural hearing loss, eliminating the HH condition which proved too difficult per previous studies. Each sample of participants listened to the SPIN Sentences at 50 dB HL in soundfield. Stimuli were presented in quiet and in speech babble at S/N =+5 dB from a single speaker at 0o azimuth. Performance decreased as a function of increased RT and noise especially for low predictably targets.

**Spectral Resolution and Inherent Temporal Noise Fluctuations in Speech Perception**

*Heather Kreft, MA; Andrew Oxenham, PhD*, University Of Minnesota, Minneapolis, MN
Recent work in normal-hearing listeners suggests that temporal fluctuations inherent in noise play a major role in masking speech [Stone and Moore, J Acoust Soc Am 135:1967-1977 (2014)]. However, this finding does not extend to cochlear-implant users, for whom inherent noise fluctuations have little or no effect [Oxenham and Kreft, Trends in Hearing 18 (2014)]. It is thought that poorer spectral resolution in cochlear-implant users leads to a smearing of the inherent fluctuations and hence a reduction of their influence on masking speech. The present study tested this hypothesis in listeners with mild-to-moderate sensorineural hearing loss. Speech perception was measured in age-matched hearing-impaired and normal-hearing listeners using sentences embedded in maskers that were either speech-shaped noise, inharmonic complex tones (with no inherent fluctuations), or amplitude-modulated complex tones. Results are consistent with the hypothesis: hearing-impaired listeners showed less difference between maskers with and without inherent fluctuations. When normal-hearing listeners were presented with maskers at comparably high levels, their results were similar to those of hearing-impaired listeners. The results support the idea that poorer spectral resolution, through hearing loss or high sound levels, leads to a reduced influence of inherent noise fluctuations in speech masking. [Work supported by NIH grant R01 DC012262.]

Poster # 75 - SP08

**Children’s Perception of Foreign-Accented Speech: The Role of Temperament**  
_Sarah Mabie; Rachael Frush Holt, PhD, The Ohio State University, Columbus, OH_  
_Tessa Bent, PhD, Indiana University, Bloomington, IN_

Individual differences in children’s speech perception are large and have been partially attributed to differences in executive function (Lalonde & Holt, 2014), but much unexplained variability remains. Temperament is a potential influence that has been studied in related fields, such as stuttering (Eggers et al., 2010). We investigated the influence of temperament on individual differences in foreign-accented speech perception and context effects. Eighty 5- to 7-year-old monolingual English children were presented with 60 English sentences produced by either a native English or Mandarin talker (Wildcat Corpus; Van Engen et al., 2010) embedded in multi-talker babble at +8 dB SNR. For 30 sentences, the final (target) word was highly predictive from sentence context and for the other 30, it was not; the same final words appeared in both predictability conditions. Temperament was assessed with the Children’s Behavior Questionnaire (Rothbart, 1996). Semantic context was of similar benefit to children in native and foreign-accent conditions. Children who scored high on Negative Affect (feelings of anger, frustration, sadness) had poorer word recognition in both predictability conditions. These results suggest that higher levels of anger/frustration impede performance on difficult speech perception tasks and that temperament may contribute to individual differences in speech perception.

Poster # 76 - SP09

**Executive Function’s Role in Children’s Perception of Nonnative Speech**  
_Angeila Hill; Rachael Frush Holt, PhD, The Ohio State University, Columbus, OH_  
_Tessa Bent, PhD, Indiana University, Bloomington, IN_

Large individual differences in spoken word recognition have been observed in children with hearing loss and with normal hearing. Executive functions account for some of this variability (Beer et al., 2011; Lalonde & Holt, 2014). Individual performance differences are also evident when listeners are presented with nonnative speech. This study examined the influence of executive function on children’s nonnative
speech perception and context use. Eighty 5- to 7-year-old monolingual English children were presented with 60 English sentences produced by either a native English or Mandarin talker (Wildcat Corpus; Van Engen et al., 2010) embedded in multi-talker babble at +8 dB SNR. For 30 sentences, the final (target) word was highly predictive from sentence context and for the other 30, it was not; the same final words appeared in both predictability conditions. Sentence context facilitated target word recognition similarly for native and nonnative talkers. Children with better working memory and inhibition, as assessed by the Behavior Rating Inventory of Executive Function, performed more accurately on the high predictability nonnative condition. Stronger executive functions appear to support word recognition under adverse listening conditions including both those stemming from the listener (e.g., hearing loss) or, as shown here, the talker (e.g., nonnative speech).

Poster # 77 - SP10

**Recognition of Interrupted Words: Effects of the Interruption Locations**  Mentored Student Research Poster Award  
*Heather Hamm, BS, East Tennessee State University, Johnson City, TN*  
*Richard Wilson, PhD, East Tennessee State University, Phoenix, AZ*

Word-recognition performance for interrupted speech has been determined by varying the duty cycle and ips, but the temporal location of the interruptions has not been studied. A pilot study used two interruption locations on monosyllabic words and found with the majority of words that the interruption location that contained of the first consonant segment of the word produced 17-18% better recognition performance. The current purpose was to determine if and how recognition performance changed as the temporal locations of the silent interruptions were varied throughout the word. Seventy NU-6 words with a carrier phrase were interrupted (10 ips, 50% duty cycle) referenced to the onset of each word. For the remaining nine-interruption conditions, the onset reference sequentially was incremented 10 ms and the interruption scheme again applied, which produced 700 stimulus words that were randomized for each of the 24 young listeners with normal hearing. Across the 10-interruption conditions from 0 ms to 90 ms, mean recognition performance was V-shaped with the best performance at the condition extremes and poorest in the middle conditions. Recognition performance for each word typically was systematic across the 10 interruption conditions with few irregularities. Investigators of interrupted speech should be award of these differences.

Poster # 78 - SP11

**Predictors of Gating Performance in Children with Hearing Loss**  
*Elizabeth Walker, PhD; Jacob Oleson, PhD, University Of Iowa, Iowa City, IA*  
*Meredith Spratford, AuD; Ryan Mccreery, PhD, Boys Town National Research Hospital, Omaha, NE*

The present study compares performance between children who are hard of hearing (CHH) and children with normal hearing (CNH) on a gating speech perception task. Stimuli were high-predictability sentences. The final, target word in each sentence was gated in 50 ms increments starting 100 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. Twenty-four CHH and 24 CNH, ages between 7 and 9 years, completed the task; data collection is currently ongoing. Mixed modeling with repeated measures was used to analyze main effects including age, neighborhood density, and hearing status. The effects of degree of HL, age, receptive vocabulary, and working memory on the
average percentage of gates heard at isolation and acceptance points will also be reported. It is predicted that 1) CNH will require less gates than CHH to identify target words, 2) words from sparse, compared to dense, neighborhoods will be identified earlier, 3) older children will perform better than younger children, and 4) working memory and vocabulary will be predictive of number of gates necessary to identify target words for CHH.

Poster # 79 - SP12

Context Effect on Speech Perception of Hearing Impaired Listeners
SuHyun Jin, PhD; Jingjing Guan, MA; Won So, AuD, University Of Texas, Austin, TX
Bomjun Kwon, PhD, Gallaudet University, Washington, DC

Listeners with hearing loss (HI) often report significant difficulty understanding speech in noise, and demonstrate the individual differences. Several factors such as reduced audibility, abnormal spectral and temporal resolution, have been examined to explain HI listener’s poor speech recognition in noise. However, each of those factors, which are mostly associated with damaged peripheral auditory processing, explains only a relatively small proportion of the variance in speech perception in noise. The purpose of this study is to examine HI listener’s ability to use context cues that are usually accessible to listeners’ central auditory processing. Listener’s ability to use context cues can be measured by k factor (Boothroyd & Nittrouer, 1988). The materials and procedure to measure the k factor have been newly developed by Kwon & Perry (2013). This current study is going to collect normative data from larger sample of listeners with normal hearing in the new Kwon & Perry’s test method and to investigate whether the k-factor of HI listeners is significantly different from the norm. Preliminary data show a similar pattern to what was reported in cochlear implant users (Kwon and Perry, 2013) and indicate contribution of context effect to reduced speech recognition in noise for HI listener.

Poster # 80 - SP13

Age-Related Differences in Listening Effort During Degraded Speech Recognition
Kristi Ward, BS; Jing Shen, PhD, Roxelyn And Richard Pepper Department Of Communication Sciences And Disorders At Northwestern University, Evanston, IL
Pamela Souza, PhD; Tina Grieco-calub, PhD, Roxelyn and Richard Pepper Department of Communication Sciences and Disorders at Northwestern University; Knowles Hearing Center at Northwestern University, Evanston, IL

Listening effort (LE) refers to the amount of cognitive resources needed by an individual to understand speech: more LE is needed with greater degradation of the speech signal. LE is likely dependent on underlying cognitive function. Thus, children may have a limited amount of cognitive resources that can be reallocated during highly degraded speech recognition tasks due to their cognitive immaturity. To test this hypothesis, the current study implements a dual-task paradigm to quantify LE in children (8-12 years old) and young adults (18-25 years old). The dual-task paradigm consists of two simultaneously presented tasks: a primary speech recognition task that is either unprocessed or spectrally degraded by 4-, 6-, or 8-channel noiseband vocoding and a secondary visual sequencing task from which accuracy and reaction time are derived. Performance on the secondary task is used to quantify LE: poorer performance on the visual sequencing task is reflective of greater LE. Preliminary data suggest that children are slower to respond on the secondary task than adults; however, the children’s LE is highly variable. Ongoing data
collection and analyses will further examine how LE is driven by age-related differences in cognitive function.

Poster # 81 - SP14

Understanding the Consonant Confusions of Spanish-English Bilingual Children  Mentored Student Research Poster Award
Andrea Trevino, PhD; Paula Garcia, PhD; Stephen Neely, PhD; Kanae Nishi, PhD, Boys Town National Research Hospital, Omaha, NE
Lydia Rogers, University Of Utah, Salt Lake City, UT

Bilingualism has been identified as a potential disadvantage when perceiving speech in noise. We investigate the extent of this phenomenon for children, aged 6-12, using consonant confusion analyses to track fine-grained differences in acoustic cue perception. The effects of language background (Spanish-English bilingual vs. English monolingual), vowel context, noise, and simulated hearing loss are examined for 13 consonants, presented as vowel-consonant-vowel syllables. A token-specific approach is used throughout the analysis to control for the natural variability of spoken tokens. In general, bilingual and monolingual children show similar consonant recognition scores across signal-to-noise ratios, vowel contexts, and for individual tokens. The consonant confusion analysis shows a token effect; the subtle natural variations in the acoustic cues across multiple tokens of the same consonant can lead to perception of different confusions. These token-specific confusions are shared across both language backgrounds, demonstrating strong similarities in consonant cue perception. Potential acoustic sources of the token-specific confusions are investigated. The same listeners repeated the task with a simulated mild-sloping hearing loss; consonant-specific effects are observed, which are interpreted based on acoustic cues. Our results provide new insight into how Spanish-English bilingual children perceive consonant cues, and emphasize the importance of considering individual token acoustics.

Poster # 82 - SP15

Effects of Noise and Hearing-Loss on Bilingual Children's Consonant Recognition  T35 Research Trainee Poster
Lydia Rogers, BA, Boys Town National Research Hospital & Communication Sciences And Disorders, University Of Utah, Salt Lake City, UT
Andrea Trevino, PhD; Paula Garcia, PhD; Stephen Neely; Kanae Nishi, PhD, Boys Town National Research Hospital, Omaha, NE

The impact of adverse listening conditions and hearing loss on speech perception is greater for children than adults. Yet, little is known of how these factors influence bilinguals. In particular, confounds between language development, language status, and hearing configuration make investigations with bilingual children challenging. The present study attempted to address this issue while controlling for hearing configuration by using a simulated hearing loss with normal-hearing listeners. Simultaneous Spanish-English bilingual (n=11) and English-speaking monolingual (n=12) children aged 6-12 year-old participated. All had age-appropriate nonverbal intelligence. Groups were equivalent in English vocabulary, suggesting high English proficiency in bilinguals. Participants listened to 13 American English consonants in vowel-consonant-vowel syllables at four noise levels (-5, 0, 5 dB SNR, and quiet), and with/without a simulated hearing loss. A small, yet significant overall difference was observed between bilinguals and monolinguals. However, across language groups, 6-7 year-olds performed more
poorly than older children both in noise and with the simulated hearing loss. In addition, consonant recognition scores varied with vowel contexts for both language groups similarly. These results suggest that no special consideration should be necessary for vowel context or noise levels when assessing consonant recognition for bilingual children highly fluent in English.

Poster # 83 - SP16

Using CASPA to Test Speech Recognition in Spanish-English Bilingual Children  Mentored Student Research Poster Award
Paula Garcia, PhD; Andrea Trevino, PhD; Stephen Neely; Kanae Nishi, PhD, Boys Town National Research Hospital, Omaha, NE
Lydia Rosado Rogers, Communication Sciences And Disorders, University Of Utah

Audiologists face a challenge when they need to assess speech recognition performance for bilingual children due to a lack of diagnostic tools that take language background and age into account. This study evaluated both the English and Spanish versions of the Computer-Assisted Speech Perception Assessment Test (E-CASPA and S-CASPA, respectively) for simultaneous Spanish-English bilingual children. Children were screened to ensure age-appropriate expressive vocabulary in English. Spanish-English bilingual children (ages 6-12) were tested on E-CASPA and S-CASPA at -10, -5, and 0 dB SNR. E-CASPA results were also compared to those from English monolingual peers. Responses were scored for whole words and individual phonemes. Across scoring methods, performance in English was similar between monolinguals and bilinguals. However, 6-7 year-old bilingual children performed word and phoneme recognition was poorer in Spanish at -5 and -10 dB SNR. In addition, similar to reports from monolingual English children (McCreery et al. 2010), speech recognition scores in both languages were higher when responses were scored for phonemes rather than words. These results suggest that E-CASPA with phoneme scoring can minimize the influence of age and language background on speech recognition in simultaneous Spanish-English bilingual children 6 years and older, but interpretation of S-CASPA results requires caution.

Poster # 84 - SP17

Recognition and Comprehension of Speech in Noise in School-aged Children
Amanda Griffin, AuD, University Of Massachusetts Amherst, Gardner, MA
Sarah Poissant, PhD; Freyman Richard, PhD, University Of Massachusetts Amherst, Amherst, MA

The current developmental study assessed sentence recognition (Exp. 1) and auditory comprehension (Exp. 2) abilities of children aged 6-12 years old and adults with normal hearing in noisy conditions similar to those experienced in a classroom setting. Children were tested in a sound-treated booth with three loudspeakers placed 1 meter from their heads at -60, 0, and +60 degrees azimuth. In Exp. 1 reception thresholds for sentences in quiet and in noise (speech-spectrum noise or 2-talker child babble) were measured adaptively using HINT-C stimuli. Target and masker signals were either co-located or spatially separated; both asymmetric and symmetric masking conditions were evaluated. Data were evaluated in regards to effects of age, type of masker, and spatial configuration on the amount of spatial release from masking benefit. In Exp. 2, auditory comprehension abilities were tested using short, age-appropriate stories taken from the Test of Narrative Language. Recorded stories were presented in quiet or in the presence of two-talker child babble at three targeted signal-to-noise ratios. Effects of age and listening condition on comprehension performance were examined. Findings contribute to the growing
literature on the development of speech recognition and auditory comprehension in children with normal hearing in noisy environments.

**VESTIBULAR**

Poster # 85 - VEST01

**Vestibular Function and Cognitive Outcomes in Children with Cochlear Implants**

*Megan Thomas, AuD; Kristen Janky, PhD, Boys Town National Research Hospital, Omaha, NE*

Rationale & Hypotheses: Adults with bilateral vestibular loss have shown cognitive dysfunction (Brandt et al. 2005). However, cognitive function in children with vestibular loss has yet to be studied. Vestibular loss is most prevalent in children with cochlear implants (CI), where approximately 50% exhibit some degree of vestibular loss (Cushing, Papsin, Rutak, James, & Gordon, 2008). The purpose of this study was to investigate the effect of vestibular loss on cognitive function in a group of children with CI. Methods: Children with normal hearing (CNH, n = 32) and children with CI (n = 13) participated in this study. All children completed the NIH-Toolbox Cognition test battery and tests of vestibular function. Children with CI (n = 13) were separated into two groups, those with normal vestibular function (CI-NV = 7) and those with significant vestibular loss (CI-VL = 6). Performance on the NIH-Toolbox Cognition test battery was compared between CNH, CI-NV, and CI-VL. Results: Preliminary results suggest that vestibular function in children with CI significantly affects specific subdomains of cognition (working memory and language). Discussion: These results suggest that, like adults with vestibular loss, cognition is affected in children with vestibular loss. This project represents M.D.’s work as a T35 Trainee.

Poster # 86 - VEST02

**Effect of Additional Visual Stimuli on Subjective Visual Vertical testing**

*Courtney Eisenhart, AuD, Audio Professional Hearing Center, York, PA*

*Jorge Gonzalez, PhD; Qing Yue, PhD; Stephen Kokoska, PhD, Bloomsburg University Of Pennsylvania, Bloomsburg, PA*

The Subjective Visual Vertical (SVV) is a commonly utilized tool to test utricular function. During the SVV test, an individual is presented with an offset vertical line and is required to adjust the offset line until he or she perceives it as vertical. Individuals with normal vestibular function adjust the line to within ±2 to 3 degrees of true vertical. The purpose of this study was to determine whether there was a difference in perceived verticality in the presence and absence of an additional visual stimulus. SVV of 30 adults aged 18 to 32 years with normal vestibular function was recorded during four conditions: (1) the traditional SVV, (2) SVV plus a square stimulus centered on the test line, (3) SVV plus a square stimulus offset to the right of the test line, and (4) SVV plus a square stimulus offset to the left of the test line. Participant’s perceptions of verticality in all conditions were assessed and degrees of deviation were analyzed with ANOVA with post-hoc analysis when significant. Overall, the findings indicated that an additional visual stimulus during SVV alters perceived verticality. These findings could be used to establish uniform SVV test protocols without additional visual cues.

Poster # 87 - VEST03
Intra- and Inter-Examiner Reliability of the Video Head Impulse Test
Owen Murnane, PhD; Kristal Riska, PhD; Stephanie Rouse, AuD; Faith Akin, PhD, Vestibular/Balance Research Laboratory, Mountain Home Va Medical Center, Mountain Home, TN

The measurement of eye movement can aid in the detection and localization of vestibular pathology due to the relationship between the function of the vestibular sensory receptors in the inner ear and the eye movements produced by the vestibulo-ocular reflex (VOR). The majority of tests of vestibular function involve the measurement of horizontal eye movements produced by stimuli that activate the horizontal semicircular canals (hSCCs). The video head impulse test (vHIT) is a new clinical test of dynamic SCC function that uses a high-speed digital video camera embedded in light-weight goggles to record head and eye movement during passive head rotations. There are no published data concerning the examiner reliability of the vHIT. A prospective repeated measures design was used to assess test-retest reliability of the hSCC vHIT in young healthy adult participants (n = 44). The vHIT was administered to each participant by each of two different examiners on two different days. A repeated measures analysis of variance was used to determine the effects of examiner, session, and hSCC on the magnitude of VOR gain (eye velocity/head velocity). The intra-class correlation coefficient and the coefficient of repeatability were used to assess intra- and inter-examiner reliability.

Poster # 88 - VEST04

MRI Correlates of Blast and Trauma-Induced Dizziness in Military Personnel
Ramtilak Gattu, MS; Anthony Cacace, PhD; Mark Haacke, PhD, Wayne State University, Detroit, MI
Faith Akin, PhD; Owen Murnane, PhD, VA Medical Center, Mountain Home, TN

Mild traumatic brain injury (mTBI) is a major public healthcare burden that affects over 1.7 million Americans annually; it is also a common injury in individuals returning from military service/combat who were exposed to high-level blast waves emanating from roadside bombs, improvised-explosive devices, or rocket-propelled grenades. These combat-related military exposures often result in physical, psychological, sensory, and cognitive impairments. While vestibular and balance-related dysfunctions in mTBI are well-known, there is a paucity of contemporary brain-imaging data on this topic. Consequently, our knowledge base on central nervous system (CNS) contributions to dizziness and balance-related dysfunctions is extremely limited. Based on a sample of twenty-six veterans with dizziness or imbalance related to blast-exposure and/or mTBI, we used advanced neuroimaging modalities including susceptibility-weighted imaging (SWI) and diffusion- tensor imaging (DTI) to enhance our understanding in this area. DTI was used to evaluate global and regional white matter fractional anisotropy effects; whereas SWI was used to study brain-vasculature microstructural abnormalities. Results from SWI and DTI provide insight into persistent gait, balance, and vestibular-related dysfunctions experienced by some military personnel exposed to blast neurotrauma and those having mTBI. Further development and application of these methodologies will advance our understanding of CNS involvement in this area.

Poster # 89 - VEST05

Vestibulo-ocular Reflex Responses in Anxious and Non-anxious Patients
John Lee, BA; Gary Jacobson, PhD; Devin Mccaslin, PhD, Vanderbilt University, Nashville, TN

T35 Research Trainee Poster
Dizziness is a common cause of postural unsteadiness reported by patients presenting to emergency departments and primary care physician offices. It is attributed primarily to unilateral peripheral vestibular impairment, but can occur due to neurological disease, effects of medication, and/or psychiatric conditions. Evaluation of patients with dizziness caused primarily by anxiety is made difficult by an absence of any clinically significant physiological findings of vestibular impairment. The purpose of this investigation was to better understand the relationship between anxiety and dizziness in patients presenting with normal vestibular/neurotological examinations. In the present study, we compared vestibular responses between non-anxious and anxious patients, as identified by the Hospital Anxiety and Depression Scale, in a cohort of 1314 subjects. Subjects with asymmetric responses were excluded, leaving 732 subjects for analysis. Using independent t-tests to compare vestibulo-ocular reflex responses between patient responses representing the 0-10th- and 90-100th percentile ranges for HADS anxiety subscores, a significant difference in rotary chair gain at 0.32Hz was found. Anxious subjects demonstrated lower rotary chair gain than non-anxious subjects. This finding has not been reported previously and indicates a need for additional research into underlying mechanisms and effects of anxiety on vestibular function.

Poster # 90 - VEST06

**The Effect of Cochlear Implantation on Postural Stability**

*Erin Nelson; Timothy Hullar, MD, Washington University In Saint Louis School Of Medicine, St. Louis, MO*

Objectives: Following cochlear implantation many people report substantial, persistent postoperative imbalance. Our laboratory has found preliminary evidence that environmental sound can have a remarkable impact on balance. This has significant ramifications for understanding how we maintain posture, possible sources of instability, and potential methods for improving postural stability. The present study measured the effect of external sound sources on balance in subjects with cochlear implants. The authors hypothesize that postural stability will improve with audition. Study Design: Ten adults with cochlear implants were tested with an external sound source in all possible hearing conditions, for a maximum of 30 seconds. Subjects stood 1) on a foam pad with eyes closed, arms crossed, and feet together, and 2) on the floor with eyes closed, arms crossed, and in tandem position with toes of the non-dominant foot touching the heel of the dominant foot. Results: Results showed that three of the subjects demonstrated no significant difference in postural stability across hearing conditions, two subjects worsened, and two subjects improved. Conclusions: We recognize that these pilot data may, in fact, reflect variations in imbalance as a function of pre-implantation baseline postural stability, and that further testing and more subjects are needed.

Poster # 91 - VEST07

**Ocular Motility Evaluation of Athletes Post-Concussion**

*John King, PhD; Jorge Gonzalez, PhD; Christopher Kocher; Joseph Hazzard, PhD, Bloomsburg University, Bloomsburg, PA
Alex Kiderman, PhD, Neuro-Kinetics, Pittsburgh, PA*

Repetitive contact is prevalent in many sports and may lead to injuries including concussions and other insults to an athlete¬øs brain. Various tests have been utilized to evaluate athletes following impact to determine whether they should return to play as premature return to play can lead to aggravated brain injury and in some cases, death. Ocular motility evaluation via videonystagmography is a routine
component of current vestibular test batteries. The human oculomotor system is very complex and requires coordination between different brain regions for execution of various eye motions. It is proposed that clinical ocular motility evaluation routinely performed with vestibular patients can be applied to the post-impact evaluation of an athlete, the data of which may be meaningful to the determination of return to play. We will present several case studies of athletes with abnormal ocular motility findings post-impact that recovered over time, which suggests that ocular motility evaluation may be an important tool to include in the evaluation of athletes post-impact.

**PHYSIOLOGY: MIDDLE EAR AND COCHLEA**

Poster # 92 - PHYS01

**Individual Variability in Cochlear Reflectance**

*Stephen Neely; Daniel Rasetshwane, PhD, Boys Town National Research Hospital, Omaha, NE*

Cochlear reflectance (CR) is the cochlear contribution to ear-canal reflectance (ECR). Both ECR and CR measurements exhibit considerable variability across individual ears, similar to other measures of the peripheral auditory system (PAS). A mathematical model of the acoustics and mechanics of the PAS was fit to individual ECR and CR measurements in an attempt to account for sources of individual variability. The ear-canal section of this model is the concatenation of conical sections. The middle-ear section is a two-port network with lumped elements. The cochlear section is a tapered transmission line with a cochlear amplifier (CA) implemented by regions of negative damping. CR calculated for the model was compared to individual measurements from 24 ears with thresholds ranging from -5 to >60 dB HL. Surprisingly, some parameters associated with the middle-ear section had moderately significant correlation with threshold. The correlation of a CA-gain parameter with threshold was highly significant. This observation supports the validity of our modeling and fitting methods. The ability to fit model parameters to individual ears, although still under development, could have clinical relevance in identifying possible middle-ear or inner-hair cell contributions to hearing loss.

Poster # 93 - PHYS02

**Middle Ear Power Absorbance in Rheumatoid Arthritis**

*Bruna Cibin, BS; Ieda Laurindo, MD; Sanches Seisse, PhD; Renata Carvallo, PhD, Universidade De Sao Paulo, Sao Paulo, Brazil*

*Shahnaz Navid, AuD, University of British Columbia, Vancouver, British Columbia*

Background: Rheumatoid arthritis (RA) is an autoimmune disease which causes inflammation and swelling of the joints. Sensorineural and conductive hearing loss have been reported, but the results aren’t in agreement. Middle ear power absorbance may provide better sensitivity to subtle changes in the ossicular joint. Aim: Describe the effects of RA in the auditory system and focus on the middle ear assessment. Material and Methods: This research gathered data from 39 participants, raging age from 26 to 51 years, pooled into three groups: RA1 - RA for ten years or more (15 participants); RA2 - RA for five years or less (9 participants) and normal control (NC) group (15 participants). Immittance 226 Hz probe tone; pure tone and extended high-frequency audiometry and power absorbance were conducted. Results: Mean ages for RA1, RA2 and NC were 41.1, 38.6 and 39.9 years old respectively. The results compared ears between the three groups. Means were analyzed with mixed model ANOVA. Comparison
of immittance measures and power absorbance didn't reveal difference between groups. This study found difference in standard audiometry thresholds and extended high-frequency audiometry comparing RA groups and NC group. Conclusions: The results showed the importance of monitoring potential audiological manifestations in individuals with RA.

Poster # 94 - PHYS03

**Signal Detection in Noise in Rats following TTS**

*Christopher Spankovich, PhD; Edward Lobarinas, PhD; Colleen Le Prell, PhD, University Of Florida, Gainesville, FL*

Noise exposures that generate robust temporary threshold shifts (TTS) but fail to produce permanent threshold shift (PTS) have been suggested to produce damage to low-spontaneous rate auditory fibers resulting in a latent form of hearing loss. To assess the effects of noise exposures associated with deafferentation on listening in noise, we first assessed thresholds in adult SASCO rats via auditory brainstem response (ABR) and behaviorally using a modified noise burst pre-pulse inhibition paradigm with an acoustic cue preceding a 12 PSI airpuff. We also determined signal detection in the presence of competing broadband noise by varying the signal to noise ratio (SNR) between 0-40 dB. Animals were then exposed to a bilateral 8-16 kHz bandpass noise of 109 dB SPL for two hours under ketamine anesthesia. ABR and distortion product otoacoustic emissions (DPOAE) showed a robust 30-40 dB TTS 48 post exposure. A one week follow-up showed complete recovery of thresholds. However, some animals showed reduced ABR wave I amplitudes at the one week post-noise assessment. When animals were re-evaluated behaviorally, those with reduced wave I amplitudes showed poorer signal detection in noise. The data suggest that poorer hearing in noise may correlate with reduced wave I ABR amplitudes even when thresholds in quiet are unaffected.

Poster # 95 - PHYS04

**Inhibition of Human CAPS and OAEs with Contralateral Acoustic Stimulation**

*Spencer Smith, BS; Barbara Cone, PhD, University Of Arizona, Tucson, AZ*

The medial olivocochlear (MOC) system restores the dynamic range of the auditory nerve by reducing the cochlear amplifier’s response to noise. In humans, the inhibitory effect of the MOC system on the cochlear amplifier has traditionally been assayed using contralateral inhibition of otoacoustic emissions paradigms. While these paradigms are informative in terms of quantifying changes in outer hair cell activity during MOC system activation, they reveal little about changes in cochlear output at the level of the auditory nerve. In this study, input/output functions were measured from young normally hearing subjects for click evoked compound action potentials and otoacoustic emissions with and without contralateral acoustic stimulation. The inhibitory effect of the MOC system on both measurements was quantified in terms of effective attenuation (i.e., the horizontal shift in the input/output curve produced by contralateral acoustic stimulation). When enough averaging was done to ensure that the compound action potential measurements were reliable, the effective attenuations for each type of measurement were comparable. In some subjects, the effective attenuations for compound action potentials were larger than those for otoacoustic emissions. These results suggest that contralateral inhibition of otoacoustic emissions measurements may underestimate the suppressive effect of the olivocochlear system.
NOISE-INDUCED AUDITORY DAMAGE

Poster # 96 - NIHL01

Knowledge, Attitudes, Behaviors and Noise Exposure of Baristas  T35 Research Trainee Poster
Alyssa Pursley, BS, National Center For Rehabilitative Auditory Research, St. Louis, MO
Gabrielle Saunders, PhD, National Center For Rehabilitative Auditory Research, Portland, OR

Occupational noise-induced hearing loss is a known hazard in many professions, but some industrial hospitality professions may include workers who are unknowingly exposed to hazardous levels of noise. The study objectives were to examine the daily noise exposure of baristas working in coffee shops and to measure their knowledge, attitudes and behaviors regarding hearing conservation and perceptions of noise in their work environment. Fifteen baristas from six coffee shops in Portland completed the Knowledge, Attitudes and Behaviors questionnaire of Saunders et al. (2013), a sound disturbance survey from Topf (1985), and a structured interview to document perceptions of noise in the work environment. To measure daily noise exposure, eight participants wore a personal dosimeter for three different work shifts. Dosimetry measurements revealed Leq levels between 71 dBA and 83 dBA, with noise doses ranging from 4% to 74% indicating that baristas are not exposed to sound levels above regulatory criterion. Questionnaire results indicate that baristas have low awareness about the hazards of noise, are not opposed to hearing conservation, and rarely use hearing protection when engaged in noisy activities. It is concluded that the baristas here lacked the pertinent education and motivation to commit to invaluable hearing conservation practices.

Effects of Kanamycin on Temporary and Permanent Threshold Shift  T35 Research Trainee Poster
Arnold Munoz, BS, Audiology Department, Montclair State University, Montclair, NJ
Kevin Ohlemiller, Central Institute For The Deaf At Washington University, Department Of Otolaryngology, Washington University School Of Medicine, St Louis, MO

Temporary threshold shift (TTS) and permanent threshold shift (PTS) are the measures used to characterize the effects of noise exposure on hearing sensitivity. The relation between TTS and PTS susceptibility, and the usefulness of TTS prevention as a predictor of PTS prevention, have remained unclear. Therapeutic low dose kanamycin has shown protection against PTS in CBA/J mice at high intensity noise levels. The present study tested whether low dose kanamycin protects similarly against TTS and PTS using a dose-response paradigm in CBA/J mice. We found protection against PTS by kanamycin, but little effect on TTS risk. Results provide support for separate mechanisms underlying TTS and PTS, and suggest limitations on the predictive utility of TTS risk for PTS risk. Further research should expand these results to include other models, exposures, and therapeutics.

EPIDEMIOLOGY

Poster # 98 - EPI01
Diagnostic Services Lack For Iowa Infants Who Fail Hearing Screen
Winnie Chung, AuD; Xidong Deng, PhD, Centers For Disease Control And Prevention, Atlanta, GA
Tammy O'hollearn, MS, Iowa Department of Health, Des Moines, IA

Although 97% of all infants in the US are now routinely screened for significant hearing loss before hospital discharge, 36% of infants who failed their hearing screen have yet to receive recommended diagnostic audiologic services. A lack of pediatric audiology facilities has been indicated as one of the major contributing factors to infants not receiving timely diagnostic services. This lack means families often need to travel greater distances to obtain diagnostic services for their infants. We utilized data from multiple sources (Iowa Early Hearing Detection and Intervention (EHDI) program, US Census American Community Survey and EHDI-Pediatric Audiology Links to Services directory) and analyzed the correlation between an infant who had not received diagnostic services and that infant’s distance to the nearest pediatric audiology facility. Other socio-economic factors, such as mothers’ age, education, and household income level, were also analyzed. Logistic regression analysis indicated that in the state of Iowa, for every increase of 10 miles in distance between an infant's residence and the nearest pediatric audiology facility, the odds of the infant NOT receiving diagnostic services increased by approximately 21%. Strategies to promote access to pediatric audiology facilities will be helpful in increasing the odds that infants receive recommended services.

Poster # 99 - EPI02

A Community-based Hearing Intervention for Older Korean Americans with Hearing Loss: A Pilot Randomized Controlled Study
Janet Choi, MS; Carrie Nieman, MD; Sara Mamo, PhD; Hae-ra Han, PhD; Frank Lin, MD, Johns Hopkins University, Baltimore, MD

Despite increasing evidence of hearing loss in older adults being associated with a decline in overall function, hearing healthcare remains complex and expensive to most older adults. Navigating the hearing healthcare system is challenging for minorities with language and cultural barriers, including older Korean Americans who are predominantly first-generation immigrants. We developed and tested the feasibility of a pilot intervention to provide hearing counseling and affordable amplification devices to older Korean Americans with age-related hearing loss. We implemented the pilot study in a Korean American community in Baltimore targeting 15 older adults 60 years or older. Study consists of 3 phases including 1) development of the intervention through exploratory focus group, 2) randomized pilot study comparing an immediate intervention group to 3-months delayed group, and 3) qualitative evaluation. We developed culturally tailored intervention materials for the study population, focusing on improving hearing related knowledge and empowering the participants to use amplification devices and communication tips. Preliminary implementation showed positive responses from the participants suggesting feasibility of the community-based intervention model in the study population. An intervention delivering hearing counseling and low-cost amplification device to the community can be a feasible and effective approach to improve access to hearing healthcare in ethnic minority older adults with hearing loss.

Poster # 100 - EPI03

Provider Perspectives on the Accessibility of Hearing Healthcare in Arizona
The financial cost of hearing aids is often cited as one of the barriers to hearing aid adoption. This barrier may be especially common in Arizona, as the state has one of the highest poverty rates in the United States (Bishaw & Fontenot, 2014). Using US Census and epidemiologic data, we estimate that approximately 733,986 adult Arizonans have hearing loss, 137,255 of whom are living at or below the poverty line (Lin, Niparko, & Ferrucci, 2011; Bishaw & Fontenot, 2014). This study was conducted to gather provider perspectives on the accessibility of hearing healthcare to low-income adults in Arizona. Information from hearing healthcare professionals (predominantly audiologists and hearing instrument specialists) was gathered using a mixed methods approach. Focus groups were held across the state. Surveys were administered online and at professional meetings via paper format. Results document substantial need for increasing the accessibility and affordability of hearing healthcare to low-income adults and a willingness of providers to participate in efforts to improve access to care. Providers considered many factors to be important when developing and implementing changes to existing service delivery. This research is a collaborative project funded by the Arizona Commission for the Deaf and Hard of Hearing.

Poster # 101 - EPI04

Preparing Community Health Workers to Address Hearing Loss
Daisey Sanchez, BA; Maia Ingram; Frances Harris, PhD; Jill De Zapien; Stephanie Adamovich, PhD; Adriana Sanchez; Sonia Colina, PhD; Nicole Marrone, PhD, University Of Arizona, Tucson, AZ

Along the U.S.-Mexico border, individuals face multiple disparities in accessing hearing health care. These include limited health literacy, language barriers, reduced access to general healthcare and community resources. In this community-based participatory research project, we utilized the community health worker (CHW) model to increase the access to hearing health care. Community health workers are individuals from the community who serve as intermediaries between health professionals and patients. We hypothesized that educating and training CHWs about hearing loss would increase access to culturally relevant hearing health care. Here we describe the training process of 12 CHWs at the Mariposa Community Health Center in Nogales, Arizona. The initial training involved a workshop about the basic anatomy/physiology of the auditory system, the pathophysiology and effects of hearing loss, and communication strategies for those with hearing loss. Preliminary post-outcome results were assessed on a small scale (n=10). Initial results revealed a strong desire among the CHW-øs to address hearing loss by further educating themselves, building community awareness about hearing loss, and providing support and counseling to individuals and family members who have hearing loss. Subsequent training including skill-building activities and direct interaction with patients and their families is currently underway. [Research supported by NIH/NIDCD.]

Poster # 102 - EPI05

Hearing Loss within Families Facing Health Disparities: Applying the ICF
Nicole Marrone, PhD; Maia Ingram, MS; Daisey Sanchez; Adriana Sanchez, University Of Arizona, Tucson, AZ
Although research has shown hearing loss can have a negative impact on the individual directly affected, there has been little research about the impact on family members, particularly within communities facing health disparities. In population-based studies, 90-96% of Mexican-American adults with hearing loss do not have access to hearing healthcare. To begin to reduce this health disparity, we used a community-based participatory research approach to investigate unmet needs of families affected by hearing loss in a rural, predominately Mexican-American community on the U.S.-Mexico border. Community health workers gathered data about hearing loss from community members (n=103) of Nogales, AZ. The data were recorded, transcribed, and then coded using the International Classification of Functioning, Disability, and Health model to characterize the effects of hearing loss on family members. The results highlight the challenges of living with hearing loss in a low-resource community with limited access to healthcare. Findings related to both environmental and personal factors validate the need for a participatory research approach to address this health disparity. These findings have implications for the development of community-based interventions to improve quality of life not only for the individuals with hearing loss, but for their families as well. [Research supported by NIH/NIDCD.]

Poster # 103 - EPI06

Effects of Hearing Loss on Relationships in Mexican American Families
Nicole Marrone, PhD; Maia Ingram, MS; Daisey Sanchez; Adriana Sanchez, University Of Arizona, Tucson, AZ

This study examined the effects of hearing loss on relationships within Mexican American families. There is growing evidence that there are culture-specific factors that influence health outcomes in Hispanic populations. However, it is unknown how cultural beliefs may influence perceived social burdens for persons experiencing hearing loss and their families. While the role of family and respect may contribute to social support as a protective factor, these values may also make individuals susceptible to experiencing negative effects of hearing loss on social relationships. To understand these effects, we analyzed qualitative data from a community needs assessment on hearing loss in Nogales, AZ. Community health workers interviewed persons with hearing loss (n=19) and conducted focus groups with their family members (n=27) about hearing impairment. These were recorded, transcribed, and then coded for the effects of hearing loss on family relationships using the International Classification of Functioning, Disability, and Health model. Hard-of-hearing persons and family members cited numerous ways that hearing loss alters communication, relationships, and the emotional health of families. These findings have implications for the development of community-based interventions to improve quality of life for families facing the combined hardships of hearing loss and health disparities. [Research supported by NIH/NIDCD.]

Poster # 104 - EPI07

Communicating in a Medical Visit with Hearing Loss: Patient-Provider Perspectives
Nicole Marrone, PhD; Maia Ingram, Mph; Frances P. Harris, PhD; Stephanie L. Adamovich, PhD; Daisey Sanchez; Adriana Sanchez; Jill de Zapien; Scott Carvajal, University Of Arizona, Tucson, AZ

Good communication between patients and medical providers is essential to achieving patient-centered care. Spoken communication is a primary method for patients to obtain information needed to follow treatment plans. Hearing loss may impact a patient’s ability to obtain, process, and understand important health information. Using community-based participatory research methods, we conducted a needs
assessment on hearing loss in a rural, federally-qualified health center. Through analyses of community focus groups (n = 59), patient interviews (n = 20), and medical provider interviews (n = 11), multiple perspectives on communication were transcribed and coded within the social-ecological model framework. Patients, family, and providers expressed concerns that hearing loss interferes with communication during medical visits. Patients reported an important role of family members to mediate in communication with physicians. Families reported that hearing loss influences the patient’s ability to comply with physician recommendations. Providers described needs for greater appointment time, strategies, and training for effective communication with patients with hearing loss. These data suggest it will be critical to develop education and training for patients and providers to promote adequate health communication to meet the needs of older adults. [Research supported by NIH/NIDCD.]

Poster # 105 - EPI08

Who Reports Hearing Difficulty in the United States (NHANES), 2005-2010
Kathleen Bainbridge, PhD; Katalin Losonczy, MS; Howard Hoffman, MA, National Institute On Deafness And Other Communication Disorders, Bethesda, MD

One-third of older adults in the United States with audiometrically-determined hearing loss report no difficulty hearing. Self-reported hearing difficulty is a convenient potential screening question in primary care settings and is associated with hearing aid purchase; therefore it is important to understand what determines report. We investigated factors associated with reporting moderate or worse trouble hearing among adults aged ≥70 years stratified by audiometrically-determined hearing loss in a nationally-representative sample of 1645. We computed the pure-tone average (PTA) in each ear of thresholds measured at 500, 1000, and 2000 Hz, because the majority of the speech spectrum occurs within this range. Among adults whose PTA was greater than or equal to 35 dB HL, reporting hearing difficulty is socially patterned. Adults who have at least a high school education (OR=2.6 (1.3, 5.2)) and a higher income-to-poverty ratio (OR=2.3 (1.0, 5.2)) were more likely to report difficulty. Leisure-time noise exposure was associated with a 4-fold increased likelihood of reporting hearing difficulty (OR=3.9 (1.4, 4.0)). Among those without audiometrically-determined hearing loss, men and those who have a history of occupational noise exposure are more likely to report difficulty. People with tinnitus were over twice as likely to report difficulty in both groups.

Poster # 106 - EPI09

Hearing Impairment and Incident Frailty and Falls in Older Adults
Rebecca Kamil, BS, Albert Einstein College Of Medicine, Bronx, NY
Joshua Betz, MS; Frank Lin, MD, Johns Hopkins Center on Aging and Health, Baltimore, MD
Hilsa Ayonayon, PhD, University of California, San Francisco, CA
Suzanne Satterfield, MD, University of Tennessee Health Science Center, Memphis, TN
Becky Brott Powers, MD, Geriatric Research Education and Clinical Center, VA Pittsburgh Healthcare System, Pittsburgh, PA
Eleanor Simonsick, PhD, Johns Hopkins University School of Medicine, Baltimore, MD

Objectives: We aimed to determine if hearing impairment (HI) in older adults is associated with the development of frailty and falls. Methods: Longitudinal analysis of observational data from the Health, Aging and Body Composition study of 2000 participants aged 70-79. Hearing was defined by the pure-tone-average of hearing thresholds at 0.5, 1, 2, and 4 kHz in the better-hearing ear. Frailty was defined as
Factors Associated with the Accuracy of Subjective Assessments of Hearing  
Mentored Student Research Poster Award
Rebecca Kamil, BS, Albert Einstein College Of Medicine, Bronx, NY
Dane Genther, MD, Department Of Otolaryngology-HNS; Johns Hopkins Center Of Aging And Health, Baltimore, MD
Frank Lin, MD, Johns Hopkins Departments of Otolaryngology-Head and Neck Surgery, Geriatric Medicine, Mental Health, and Epidemiology; Johns Hopkins Center of Aging and Health, Baltimore, MD

Objective - Self-reported hearing impairment is often used to gauge objective hearing loss in both clinical settings and research studies. The aim of this study was to examine whether common demographic factors affect the accuracy of subjective hearing in older adults. Methods - We examined 3,557 participants aged 50 and older in the National Health and Nutrition Examination Survey (NHANES) cycles 1999-2006 and 2009-10. We examined the relationship between objective and subjective hearing impairment using percent correct classification and misclassification bias in analyses stratified by gender, age, race/ethnicity, and education. Results - We found that younger participants tended to overestimate and older participants to underestimate their hearing impairment. As women, blacks, and Hispanics increased in age, the accuracy of self-report decreased. Conclusion - The association between subjective and objective hearing differs across gender, age, race/ethnicity, and education and this observation should be considered by clinicians and researchers employing self-reported hearing.

Baltimore HEARS: Development of a Novel Community-Delivered Hearing Care Intervention
Carrie Nieman, MD, Department Of Otolaryngology-HNS, Johns Hopkins School Of Medicine; The Johns Hopkins Center On Aging And Health, Johns Hopkins Medical Institutions, Baltimore, MD
Nicole Marrone, PhD, Department Of Speech, Language, & Hearing Sciences, University Of Arizona, Tucson, AZ
Sarah Szanton, PhD; Elizabeth Tanner, PhD, Department of Community-Public Health, Johns Hopkins School of Nursing, Baltimore, MD
Roland Thorpe, PhD, Department of Health Policy & Management, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD
Frank Lin, MD, Department of Otolaryngology-HNS, Johns Hopkins School of Medicine; The Johns Hopkins Center on Aging and Health, Johns Hopkins Medical Institutions; Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD

The Baltimore HEARS Study is a phased, pilot study to develop and test the feasibility of a novel, community-delivered hearing care intervention. Given the prevalence of age-related hearing impairment...
and resources required to access hearing care, the HEARS Study targets older adults, particularly low-income, minority communities. Baltimore HEARS is a community-delivered intervention designed for hearing impaired older adults and their communication partners and includes: 1) on-site audometric screening, 2) provision of an affordable, accessible listening device, 3) orientation and programming session, and 4) aural rehabilitation. Older adults with hearing impairment were recruited in collaboration with a community organization that provides subsidized independent housing. The HEARS intervention was informed by the social cognitive theory and incorporates principles from a human factors approach to design for older adults. Through a mixed methods approach, focus groups were utilized to tailor the intervention to the community's needs, literacy, and preferences. Preliminary efficacy was assessed through a randomized, 3-month waitlist control and primary outcomes include communication, disability, social engagement, loneliness, depression and quality of life.

**DIAGNOSTIC AUDIOLOGY / OTOLOGY**

Poster # 109 - DX01

**Development of a Disease Surveillance Outcome Measure for Hearing Healthcare**

David Zapala, PhD; Larry Lundy, MD; Samantha Kleindienst, PhD; Greta Stamper, PhD, Mayo Clinic Florida, Jacksonville, FL
Sumitrajit Dhar, PhD; Donald Nielsen, PhD, Northwestern University, Evanston, IL
Brian Neff, MD; Colin Driscoll, MD; Charles Beatty, MD, Mayo Clinic Minnesota, Rochester, MN
David Barrs, MD, Mayo Clinic Arizona, Phoenix, AZ

When the medical evaluation is waived prior to a hearing aid fitting, the burden of detecting ear disease falls to the consumer and the non-physician hearing healthcare provider. The accuracy of non-physician based disease surveillance methods in this setting is unknown. To quantify the accuracy of any potential surveillance method, it is first necessary to establish an outcome scale. The purpose of the study was to: 1) develop a multidimensional rating system to rank ear diseases and conditions by order of importance for detection prior to the hearing aid purchase; and 2) develop a prototype disease detection outcome scale. A core list of 217 conditions likely to be encountered in adults complaining of hearing loss was compiled based on a current literature review. A panel of five experienced neurotologists ranked each condition along three dimensions using a five-point scale. The dimensions were: 1) diagnostic difficulty; 2) consequences of missed identification; and 3) likelihood that hearing loss would be the primary, only, or initial symptom. This poster will review the derived rankings, and demonstrate how they might be used to create an outcome scale to assess the disease detection performance in the hearing aid delivery system.

Poster # 110 - DX02

**Development of a Database for Wideband Acoustic Immitance (WAI) Measures**

Melinda A. Pontes; Susan E. Voss, PhD, Smith College, Northampton, MA
Nicholas J. Horton, PhD, Amherst College

Wideband acoustic immittance (WAI) measures offer a noninvasive diagnostic tool for middle-ear pathologies that might ultimately be used to (1) detect fluid in newborn and infant ears, (2) help identify
the cause of a conductive hearing loss, and (3) monitor changes in middle ear stiffness from intracranial pressure changes. There is no well-established method for investigators to share WAI measurements. The aim of this project is to develop a curated public database. Key factors in the design of the database interface included public accessibility, ease of use, and availability. MySQL was chosen as the database system with access via SQL (structured query language). Three codebooks were created to describe the database tables: Principal Investigator, Subject, and Measurements. A preliminary database will be presented, and feedback from the community at large will be incorporated to make the database more attractive to potential users. Ultimately, WAI measurements published in peer-review journals will be invited to be included in the public database. The development of this database has the potential to strengthen the research within WAI and provide an example of data sharing of biomedical measurements.

Poster # 111 - DX03

**Pure Tone-spondee Threshold Relationships in Functional Hearing Loss: A Test**

*Heekyung Han, MS; Robert S. Schlauch, PhD; Tzu-ling J. Yu, MS; Aparna Rao, PhD,* Department Of Speech-language-hearing Sciences, University Of Minnesota, Minneapolis, MN

Clinically, the spondee threshold (ST) shows close agreement with a low-frequency pure-tone average (PTA) in cooperative clients. However, a significant ST-PTA discrepancy occurs in persons feigning losses. Typically, the ST is 13-dB lower than the PTA. This result is consistent with the scientific belief that loudness grows more rapidly for speech than for tones and that persons feigning a loss use an internal loudness yardstick. This study measured the loudness magnitude estimates for pure tones (500 & 1000 Hz), vowels, spondees words, and speech-shaped noise (SSN) as a function of level and compared the results to expected clinical differences. 24 adults with normal hearing participated. Equal-loudness levels were derived from fitted loudness functions. The equal loudness levels for a 50 dB SPL, 1.0-kHz tone were 37.2, 43.7, and 47.3 dB SPL, for SSN, vowels, and spondees, respectively. The 2.7 dB difference between spondees and the tone at equal loudness became a 15.1 dB difference when the stimuli were converted from dB SPL to dB HL. Thus, most of the clinical discrepancy in functional hearing loss is a result of stimulus calibration differences as hypothesized by Ventry (1976). A computational, dynamic loudness model was qualitatively consistent with the behavioral data.

Poster # 112 - DX04

**Empirical Validation of Binomial Model Estimates for Speech Discrimination Variability**

*Samantha Kleindienst, PhD; David Zapala, PhD; Greta Stamper, PhD; David Walker, AuD; Terri Pratt, AuD; Millicent Garry, MS; Janet Shelfer, AuD,* Mayo Clinic Florida, Jacksonville, FL

*Kathryn Shaughnessy Schwartz, PhD,* Old Dominion University, Norfolk, VA

Estimating the variability of an observed speech score is useful when comparing two scores obtained over different time intervals or comparing scores between ears. The binomial distribution can be used to estimate the variability of an observed speech discrimination score. In this poster, we will summarize the accuracy of binomial estimates when comparing observed scores with scores predicted using the Speech Intelligibility Index (SII) in a large clinic population. Audiometric data, consisting of expected and observed speech discrimination scores, were retrospectively collected from 4471 patients seen at the Mayo Clinic in Florida with age or noise-related hearing loss. Expected speech discrimination scores were calculated using ANSI S3.5-1997 and the appropriate transfer function for the presented speech material.
(NU-6 or CID-W22). The variability between expected and observed scores for this clinic population was compared with binomial estimates of variability. The results demonstrated that variability increased with age and that left ear scores varied slightly more than right ear scores. Predictions of 95% confidence intervals were accurate in patients 70 years of age and younger. Beyond 70 years, binomial estimates underestimated variability, particularly in the left ear. These results have implications for the use of SII models in the clinical setting.

Poster # 113 - DX05

**Protocols of DPOAE Measurements Aimed at Reducing Test Time**
*Jacek Smurzynski, PhD, Department Of Audiology And Speech-language Pathology, East Tennessee State University, Johnson City, TN*
*Thomas Janssen, PhD, Ent Department, Technical Univeristy Munich, Munich, Germany*

Routine clinical distortion product otoacoustic emission (DPOAE) tests use monaural sequential presentation of primary tones. To reduce testing time, multiple DPOAEs (mDPOAEs) can be measured by stimulating the ear with two tone pairs simultaneously. Moreover, both ears can be tested at the same time with a portable device, Sentiero (PATH medical GmbH), equipped with two sound probes. The purpose of the study was to evaluate whether mDPOAE measurements can be done in both ears simultaneously without mutual influence of primary tone pairs in the ipsilateral and the contralateral ear. Data were collected in 20 normal-hearing young adults. The DP-grams were obtained for seven f2-frequencies varying in the 1.5-8-kHz range with the level L2 set at 65 and 45 dB SPL, whereas the level L1 was adjusted according to the scissor paradigm. For each subject, a set of DP-gram data was collected using single- and multi-frequency presentations of the primaries for both monaural and binaural conditions. The mean DPOAE and noise levels collected with mDPOAE and binaural presentation conditions were highly reproducible when compared to those obtained with the single-frequency monaural paradigm. Thus, multi-frequency and binaural measurements could be applied to reduce DPOAE testing time considerably.

Poster # 114 - DX06

**Relations between Domain-specific Sound Tolerance and Executive Function**
*Stephanie Baxter, BA; Carol Mackersie, PhD, San Diego State University, San Diego, CA*

The purpose of the study was to determine factors underlying individual differences in sound tolerance. Differences in executive function and sound tolerance domains (loudness, annoyance, distraction, speech interference) were proposed as factors contributing to a person’s acceptance of background noise. Acceptable noise level (ANL), sound tolerance domains and executive function were measured in 30 participants with normal hearing. ANL was measured using the original ANL stimulus. The speech stimulus was played at the most comfortable level with the background noise level set 3 dB louder than the acceptable level measured. Paired comparisons and absolute ratings were completed to determine which domain(s) had the strongest influence on sound tolerance judgments. Two executive function tests were used: a) reading span test (working memory) b) a task-switching test. Overall, the annoyance domain was the best predictor of ANL. Neither executive function measure was associated with the ANL measure. However, lower reading span scores were associated with higher absolute ratings of speech interference. Higher scores on a general questionnaire about noise sensitivity (Weinstein Noise Sensitivity Scale) were associated with higher ANL values and higher ratings of annoyance. Individual
differences in sound-tolerance profiles suggest that listeners use different criteria in their judgments of noise acceptability.

Poster # 115 - DX07

**Tracking Changes in Bone Conduction Thresholds using Definitions of Progression**  
*John Lee, BA; Linda Hood, PhD, Vanderbilt University, Nashville, TN*

This study continues research to understand appropriate definitions of progressive hearing loss in pediatric populations. Current definitions generally address adult populations, where noise exposure and ototoxicity are primary concerns. The prevalence of conductive overlays in pediatric populations, related to the occurrence of middle ear pathologies, limits the ability to track permanent hearing loss using air conduction thresholds. Establishing criteria for progressive hearing loss using bone conduction (BC) thresholds may provide a method to track underlying sensorineural changes in hearing sensitivity, even in the presence of fluctuating conductive hearing loss. In the present study, we applied existing and modified definitions of progressive hearing loss to BC thresholds in a cohort of 1160 pediatric patients. Only subjects with multiple BC tests over time with fair/good reliability were included. For each subject, differences in BC thresholds between first and most recent test dates were calculated and compared to criteria for progression. Defining progression as a change at one or two unspecified frequencies captured the largest number of subjects. High-frequency definitions were least sensitive. Definitions using unspecified frequencies may be more appropriate for pediatric populations, where BC testing is less frequent and oftentimes limited to only one or two frequencies. [Supported by NIH-NIDCD R24DC012207]

Poster # 116 - DX08

**Optimizing Sampling for Audiogram Estimation**  
*T35 Research Trainee Poster*  
*Brittany Wallace, BS; Xinyu Song, MS; Mitchell Sommers, PhD; Dennis Barbour MD, PhD; Noah Ledbetter, PhD, Washington University In St. Louis School Of Medicine, St. Louis, MO*

The current study investigated a novel algorithm for conducting automated audiograms. While several automated audiometry techniques have been established, the current algorithm utilizes the known benefits of Gaussian processing to arrive at threshold estimations. Twenty native English speakers over the age of 18 were recruited from the Adult Audiology clinic at Washington University and the surrounding area. Participants were randomized into one of two groups. The first group received the traditional audiogram first, followed by the automated audiogram. The second group received the automated audiogram procedure followed by the traditional measure. Stimuli of variable frequency/intensity combinations were presented until a threshold of detection was determined. Results of the two measures were compared utilizing difference measures, in decibels (dB) to quantify the difference between thresholds obtained traditionally and those obtained utilizing the automated algorithm. Overall deviation, in dB, was 4.3 ± 3.0. Results were calculated from data collected from 4 participants for a total of 8 ears. Results indicated good correspondence between the automated and traditional audiograms, as deviation values are well within accepted 10 dB test-retest audiometric standards.

Poster # 117 - DX09
Poster # 118 - DX10

Effects of Lateral Temporal Bone Resection on Bone Conduction Hearing
Rajarshi Pratihar, AuD; Paul W. Gidley, MD; Denise Barringer, MS; Jan S. Lewin, PhD, The University Of Texas MD Anderson Cancer Center, Houston, TX
Shirin Jivani, AuD, Baylor College Of Medicine, Houston, TX

Early stage temporal bone cancer is often treated with lateral temporal bone resection (LTBR). LTBR includes removal of the bony portion of the ear canal, tympanic membrane, malleus, and incus, preserving the stapes and cochlea, followed by reconstruction of the defect using a split-thickness skin graft. The purpose of this study was to determine potential magnitude of cochlear damage following LTBR. A retrospective chart review was conducted of patients (N=163) with LTBR at a large tertiary cancer hospital that was approved by IRB. Patients with a history of radiation or ototoxic chemotherapy, or whose audiometric testing occurred after the start of radiation were excluded. Average pre- and post-bone conduction thresholds (BCTs) were compared at speech frequencies (0.5, 1, 2, 4 kHz) in 21 patients who met inclusion criteria. Pre- and post-treatment imaging was reviewed to determine cochlear injury. No statistically significant change in average BCTs were found postoperatively. 3/21 patients experienced >15 dB hearing decrease despite an intact cochlear structure. Our data suggest that LTBR does not routinely cause cochlear damage. Our findings provide critical information for programming osseointegrated devices. Preservation of binaural hearing after LTBR may also facilitate improved device outcomes. Further research is needed to corroborate our results.

Poster # 119 - DX11

Frequency and Time Domain High-Frequency Ear-Canal Power Reflectance: Middle-Ear Pathology
Gabrielle Merchant, PhD, Massachusetts Eye And Ear Infirmary, Boston, MA
Jonathan Siegel, PhD, Northwestern University, Evanston, IL
Stephen Neely, Boys Town National Research Hospital, Omaha, NE
John Rosowski, PhD; Hideko Heidi Nakajima, PhD, Harvard Medical School, Massachusetts Eye and Ear Infirmary, Boston, MA

Due to frequency limitations in commercially available devices, wideband acoustic immittance and power reflectance (PR) have not been well described at frequencies above 6-8 kHz. Additionally, analyses of these measurements up to this point have focused on the responses to stimulus frequencies below 3-4 kHz, while ignoring high-frequency or time-domain information. We use a novel approach to measure PR that utilizes high-frequency signals and analyzes reflectance in both the frequency and the time domains (time-domain reflectance, TDR). We make reflectance measurements at frequencies as high as 20 kHz in temporal bone preparations that have manipulations to simulate pathology. The extended frequency range provides the increased temporal resolution necessary for time domain analyses. Time-domain reflectance results exhibit small but regular variations due to pathology with statistically significant differences in the timing of parts of the responses that may be explained by differences in the time delay between affected structures. We also investigate a novel external-ear model coupled to several simple middle-ear models designed to describe the transmission of sound utilizing these high-frequency signals. Analysis of the fit model parameters separates different conductive pathological conditions with good selectivity and sensitivity.
Long-Term Stability and Accuracy of Otoacoustic Emissions in Pediatric Ototoxicity Monitoring

Mentored Student Research Poster Award

Olga Stakhovskaya, PhD; Kelly King, PhD; Christopher Zalewski, PhD; Carmen Brewer, PhD, Audiology Unit, NIDCD, NIH, Bethesda, MD

David Adams, MD, NHGRI, NIH, Bethesda, MD

Katherine Warren, MD, Pediatric Oncology Branch, NCI, Bethesda, MD

The objective of this study was to evaluate long-term stability of DPOAEs and assess their use as a proxy for pure-tone thresholds in a pediatric cohort being monitored for ototoxicity in a clinical research setting. We evaluated 45 children (age 3-18 years) with CNS tumors undergoing potentially ototoxic treatment(s) and an untreated comparison group of children without CNS tumors (n=16; age 2-20 years), each with serial pure-tone and DPOAE data. The follow-up period ranged from 6-months to over 4 years. DPOAE amplitude was stable for the untreated comparison and treated groups of children without pure-tone threshold changes in the conventional frequency range. Greater variability in DPOAE amplitude was observed in low and high test frequency ranges in both groups. DPOAE amplitude declined significantly in the treated group with ototoxic hearing changes; the sensitivity of DPOAE amplitude in detecting ototoxicity was greater than 90%. These findings suggest excellent long-term stability of DPOAE amplitude in a clinical pediatric population (provided that middle ear function is not compromised), and indicate that DPOAEs can accurately identify a significant decline in pure-tone hearing. Our data support the use of DPOAE amplitude shifts in a pediatric ototoxicity-monitoring program.

Poster # 120 - DX12

Superior Canal Dehiscence Repair: Power Reflectance, Umbo Velocity, cVEMP, Hearing

Maryanna Owoc, BS; Gabrielle Merchant, PhD; Daniel Lee, MD; John Rosowski, PhD; Hideko Nakajima, MD, Department Of Otolaryngology, Massachusetts Eye And Ear Infirmary, Boston, MA

Cagatay Ulku, MD, Department of Otorhinolaryngology - Head and Neck Surgery, Meram School of Medicine, Necmettin Erbakan University, Konya

Introduction: Previous wideband acoustic power reflectance (PR) and umbo velocity (UV) measurements demonstrate characteristic abnormal patterns in ears with superior canal dehiscence (SCD). We investigate the effects of surgical repair on these mechanical measurements as well as other clinical findings. Methodology: Seventeen patients who underwent middle fossa craniotomy plugging are included. PR, UV, air conduction thresholds (AC), and cervical vestibular evoked myogenic potential (cVEMP) thresholds were measured pre- and post-operatively in these patients. Results: Averaging across all patients revealed significant differences between pre- and post-operative measurements: PR between 585 and 1875 Hz (p<0.001); UV magnitude between 200 and 1000 Hz (p=0.005); and UV phase between 200 and 1000 Hz (p=0.011). Nine of ten patients with low VEMP thresholds (<95% CL of normal) pre-operatively experienced significant threshold increases at 250 and 500 Hz post-operatively (p<0.001). Twelve of sixteen patients with pre- and post-operative AC data exhibited a significant decrease in threshold post-operatively at 250 and 500 Hz (p<0.001). Conclusion: On average, surgical repair resulted in normalization in PR and UV at frequencies sensitive to the mechanical changes associated with a SCD. Furthermore, a majority of patients demonstrated post-operative normalization of cVEMP and AC thresholds.

Poster # 121 - DX13
TEOAE-based Measurement of Middle Ear and Olivocochlear Efferent Reflexes
Shawn Goodman, PhD; Kelsey Dumanch; Weston Adkins, University Of Iowa, Iowa City, IA

Measurement of efferent auditory reflexes may have clinical application for detection of auditory neuropathy spectrum disorder (ANSD) in infants. Both the medial olivocochlear reflex (MOCR) and middle ear muscle reflex (MEMR) are expected to be sensitive to the presence of ANSD. Tests for both reflexes could be easily combined with otoacoustic emission tests that are widely used for universal newborn hearing screenings. Methods for detecting significant MOCR effects in individuals using transient-evoked otoacoustic emissions (TEOAEs) were recently reported (Goodman et al., 2013, JARO). We used these methods to examine both MOCR and MEMR effects in infants. For comparison, similar measurements were made in normal-hearing adults. TEOAEs were measured using clicks presented at a rate of 20/s. Reflexes were elicited using contralateral acoustic stimulation (CAS). Clicks were presented at levels corresponding to 35 dB SL, and CAS at levels corresponding to 35 dB SL and 65 dB SL (for MOCR and MEMR, respectively). TEOAE recordings were analyzed to determine the effects of the reflexes on the OAEs and on the stimulus. MOCR and MEMR effects were evaluated with respect to presence/absence, size, and relative statistical significance. Effects were compared between infants and adults. Implications for detecting ANSD will be discussed.

Poster # 122 - DX14

Evaluating Otoacoustic Emission Shifts due to Middle-ear Pressure with Tympanometry and Wideband Acoustic Impittance
Lynne Marshall, PhD; Judi Lapsley Miller, PhD, Naval Submarine Medical Research Laboratory, Groton, CT Charlotte Reed, PhD, Massachusetts Institute of Technology, Cambridge, MA

Otoacoustic-emission measurements, used to assess inner-ear status, can be affected by negative middle-ear pressure. Negative pressure can affect sound propagation through the middle ear into the inner ear, which can change the effective stimulus level. Negative pressure can also affect sound propagation from the inner ear back through the middle ear and into the ear canal. Thus, otoacoustic-emission measurements may be doubly impinged by negative middle-ear pressure, potentially leading to false-positive significant otoacoustic-emission shifts. We tested wideband acoustic immittance, 226 Hz tympanometry, and transient-evoked otoacoustic emissions in 51 people before and after inducing a middle-ear change with the Toynbee maneuver. As expected, measurements made after the Toynbee maneuver were associated with increased tympanometric peak pressures, increased middle-ear reflectance, and decreased otoacoustic-emission levels. Significant emission shifts were seen even when tympanometric-peak-pressure shifts remained within clinically normal limits. Both tympanometry and wideband acoustic immittance predicted otoacoustic-emission-shift magnitude, but tympanometry produced higher correlations. There may, however, be practical advantages to using wideband immittance because the same equipment and probe fit can be used as for the otoacoustic-emission test. These findings have implications for the use of otoacoustic-emission tests in hearing-conservation programs.

Poster # 123 - DX15

Contralateral Wideband Acoustic Reflex Thresholds: Normative Study and Test-Retest Reliability
Mitchell Frye, BS; Xiao-ming Sun, PhD, Wichita State University, Wichita, KS
A few studies have investigated the application of a wideband acoustic immittance technique in measuring the acoustic reflex (AR) of the stapedius muscle. The present study aimed to collect normative data for contralateral wideband AR (contra-WAR) thresholds in adults and to examine the immediate test-retest reliability. Data were collected in 31 young adults with normal hearing and middle-ear status as defined by seven strict inclusion criteria. Contra-WAR was conducted under ambient pressure with two repetitive tests performed for five activators: 0.5, 1, 2, and 4 kHz pure-tones and broadband noise (BBN). Tests were also performed at tympanometric peak pressure with BBN. Detectability of contra-WAR ranged from 96.7 to 100%. The median threshold was 55 dB SPL for BBN and decreased with activator frequency from 90 dB for 0.5 kHz to 75 dB SPL for 4 kHz. The ratio of 90% range versus median is about 50% for all tests. The mean test-retest difference for all conditions was not significant. Compared with reported clinical AR thresholds, contra-WAR thresholds were similar for 0.5, 1 and 2 kHz but much lower for 4 kHz and BBN activators. Contra-WAR threshold test provides a promising tool with high detectability, good test-retest reliability, and lower thresholds.

Poster # 124 - DX16

**Examining Relationships between Cognitive Status and Demographic and Audiologic Factors**

_Alyson Gruhlke, AuD; Amanda Wolfe, AuD; Elizabeth Galster, AuD; Jason Galster, PhD, Starkey Hearing Technologies, Eden Prairie, MN_

Research has suggested a link between a diagnosis of cognitive impairment or dementia and hearing loss (Dupuis et al., 2014; Gurgel et al., 2014; Lin, Ferrucci, et al., 2011; Lin, Metter, et al., 2011). Of interest for the present study was the relationships between performance on a cognitive screening tool (Montreal Cognitive Assessment; MoCA; Nasreddine et al., 2005) and demographic and audiologic factors. A retrospective analysis of data collected from individuals who expressed interest in participating in hearing aid research was performed. As a part of participants’ qualification examinations, a battery of testing is completed, including, but not limited to, audiometry, word recognition testing, speech recognition in noise testing, cognitive screening, and a lifestyle questionnaire is completed. This study examined the relationships between participants’ performance on the MoCA and other demographic and audiologic factors. Clinical implications of the findings will be reviewed.

Poster # 125 - DX17

**Amino Acids Do Not Inhibit Bacterial Biofilm Formation**

_T35 Research Trainee Poster_

_Mitchell Frye, BS; Katherine Kao, MD; Richard Chole, PhD, Washington University School Of Medicine In St. Louis, St. Louis, MO_

The formation of biofilms on medical and surgical devices (e.g., cochlear implants) by Pseudomonas aeruginosa can lead to severe infections which are sometimes resistant to antibiotic therapy, potentially leading to rejection of implanted devices in addition to other medical complications. However, a number of recent studies including Kolodkin-Gal et al (2010) have suggested that some amino acid concentrations demonstrate inhibitory properties in terms of bacterial biofilm growth and development in vitro. The present study investigates the capability of 16 different amino acid concentrations and combinations to deter biofilm formation for two different otopathic strains of _P. aeruginosa_. We evaluated the difference in biofilm formation in two strains of _P. aeruginosa_ when exposed to D or L amino acids using qualitative and quantitative methods. Qualitatively, there was great variability in biofilm growth patterns/morphology between strains of _P. aeruginosa_. Quantitative analysis of biofilm development
among test conditions revealed measurable disparities in the extent of biofilm growth over the course of 48 hours. While some strains seem to be inhibited by amino acids, this inhibition is inconsistent and both bacterial strain and growth-method dependent. These data suggest that D-amino acids are not reliable for inhibiting biofilm formation in vitro.

Poster # 126 - DX18

Cross-validation of Wideband Reflectance in Newborn Hearing Screen Referrals
Lisa Hunter, PhD, Cincinnati Children’s Hosp & Med Ctr, Cincinnati, OH
Douglas Keefe, PhD; Denis Fitzpatrick, PhD, Boys Town National Research Hospital, Omaha, NE
Patrick Feeney, PhD, NCRAR, Portland, OR

Cross-validation is a model validation technique that can estimate how accurately a predictive model will perform in practice. The study objective was to validate wideband reflectance measures predicting newborn hearing screening (NHS) referrals due to middle-ear dysfunction. Validation used 1325 NHS ear tests including 583 refer tests on transient-evoked otoacoustic emissions. Predictors were constructed from wideband immittance variables (0.25-8 kHz), e.g., absorbance and group delay as functions of frequency and tympanometric pressure in the ear canal, and acoustic reflex thresholds. Analyses addressed risk of Type III errors that might arise from overfitting a substantial number of model parameters. Two-fold cross-validation assessed whether a model developed on one randomly selected dataset (training set) generalized to a second, randomly selected dataset. Cases were randomly assigned to either a training or validation group. Sets of test variables were analyzed as multivariate predictors in their accuracy of classifying NHS outcomes. Receiver operating characteristics curves were constructed to determine optimal cut-points for the training and validation models to determine the sweet spot of maximal prediction balanced against the risk of model over-fitting. The wideband reflectance model performed similarly in the validation group, and thus should generalize to other NHS populations.

Poster # 127 - DX19

Influence of Platinum Chemotherapy Treatments on Several High-Frequency Auditory Measures
Melissa Ho, BA; Laura Dreisbach, PhD, San Diego State University, San Diego, CA
Jonathan Siegel, PhD, Northwestern University, Evanston, IL
Erin Reid, MD, University of California San Diego, La Jolla, CA

Ototoxicity from platinum-containing agents, such as cisplatin and carboplatin, initially affects the basal end of the cochlea. Oxaliplatin, a newer platinum derivative, has not been found to be definitively ototoxic. However, oxaliplatin ototoxicity is cited in case reports, based on hearing thresholds through 8 kHz or self-reports of hearing loss. Ho et al. (2014) examined the influence of oxaliplatin on high-frequency auditory metrics and reported changes over time. However, sensitive objective measures for monitoring high-frequency hearing in chemotherapy patients haven’t been established. In this study, we monitored fifteen patients across either cisplatin, carboplatin, or oxaliplatin treatment at the highest frequencies with responses for each individual. Specifically, middle ear reflectance, behavioral thresholds, spontaneous otoacoustic emissions, and distortion product otoacoustic emission (DPOAE) gross frequency (f2=16-2 kHz; f2/f1=1.2; L1/L2=62/52 dB FPL), concentrated frequency (f2=highest frequency; f2/f1=1.2; L1/L2=62/52 and L1/L2=72/72 dB SPL), level (L2=57, L1=27-67 dB FPL and L1=57, L2=12-67 dB FPL), and ratio (f2/f1=1.1-1.25; L1/L2=62/52 dB FPL) sweeps were monitored.
Preliminary results indicate changes during treatment with degree of change varying depending on the drug administered. Often changes occurred at frequencies unable to be monitored with conventional equipment. Objective high-frequency measures show sensitivity to auditory changes due to platinum chemotherapy treatments.

Poster # 128 - DX20

Use of Wideband Acoustic Immittance to Identify Ears with Otosclerosis
Patrick Feeney, PhD; Daniel Puttermann, AuD; Garnett Mcmillan, PhD, Va National Center For Rehabilitative Auditory Research, Portland, OR
Angela Garinis, PhD, Oregon Hearing Research Center, 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

A wideband acoustic immittance (WAI, 0.25 to 8.0 kHz) test battery was used to identify ears with otosclerosis. Wideband (WB) absorbance and group delay were measured at ambient pressure and in up-swept and down-swept tympanograms. Measurements were obtained in a group of normal-hearing subjects (88 ears, mean age= 36 years) and in two groups of subjects with a diagnosis of otosclerosis; one group with surgical confirmation (16 ears, mean age= 50 years) and another group that did not have surgery (24 ears, mean age= 57 years). For patients that had a stapedotomy, comparisons were also made with post-operative WAI measures collected at 3 and 6 months. Receiver operating characteristic analyses revealed that WB absorbance and group delay were better at classifying ears with otosclerosis than traditional 0.226 kHz tympanometry. Compared with pre-operative measures, post-operative ambient and pressurized absorbance increased from 0.5 to 0.75 kHz and decreased from 2.0 to 4.0 kHz. Additional WB tests including acoustic reflex threshold and chirp-evoked otoacoustic emissions will be used to compare and contrast the groups. Comparisons will also be made with cases of other ossicular disorders. Results are encouraging for the use of a WAI test battery in the assessment of middle ear disorders.

AUDITORY PROCESSING

Poster # 129 - AP01

Hearing Loss, Mental Effort and Fatigue: Not a Simple Relationship
Benjamin Hornsby, PhD; Travis Moore, PhD, Vanderbilt University, Nashville, TN

Recent work suggests fatigue may be a significant issue for adults and children with hearing loss (HL). It is commonly assumed that the increased mental effort required by persons with HL to detect and process auditory stimuli, over time, leads to the subjective experience of fatigue. Here we present data from a series of studies that empirically examine this assumption. Subjective measures of effort and fatigue were obtained following completion of sustained (30-60 minutes), cognitively demanding speech tasks utilizing the Coordinate Response Measure (CRM) as stimuli. Tasks varied from a simple vigilance task to a more complex task requiring answering questions based on multiple CRM messages. Measures of response accuracy and processing speed were obtained. Task difficulty/effort was varied by changing SNR and completing tasks with and without hearing aids. Participants included adults with and without HL. Results suggest relationships between task difficulty, subjective effort ratings and fatigue differ
depending on the task and the presence/absence of HL. The mental effort required to complete a given speech task, and any resulting fatigue, depends upon more than task difficulty alone. Both the presence of HL, use of hearing aids, and applied effort on the task appear to modulate fatigue effects.

Poster # 130 - AP02

**Interacting Effects of Aging and Context on Neural Temporal Processing**

*Alessandro Presacco, MS; Jonathan Z Simon, PhD; Sandra Gordon-Salant, PhD; Samira Anderson, PhD, University Of Maryland, College Park, MD*

Background: Older adults frequently use context to compensate for their hearing-in-noise difficulties. Here we investigated the differing effects of high and low context noise (English vs. Dutch competing sentences) on subcortical and cortical neural speech processing in younger and older adults. Methods: Participants comprised six younger adults and six older adults. Frequency following responses (FFRs) were recorded from electroencephalographic (EEG) data to a 170-ms speech syllable, /da/, while slow oscillations were recorded from Magnetoencephalographic (MEG) data on one-minute speech samples. For both EEG and MEG data four different SNR conditions (+3 dB, 0 dB, -3 dB and -6dB) were recorded in low and high context noise. Results: Paired t-tests showed no differences between context conditions in FFR and MEG recordings in younger adults. In older adults, however, significant differences between high and low context noise conditions were noted for the fundamental frequency amplitude of the FFRs and for the MEG reconstruction of the speech sample. Conclusion: The differing effects of high and low context noise observed in older adults on neural speech processing are consistent with top-down modulation of responses and support the role of selective attention to enhance temporal processing when listening in noise.

Poster # 131 - AP03

**Cognitive Complexity, Cognitive Effort, and Mental Fatigue**

*T35 Research Trainee Poster*

*Sadie Schwarz, BA, The University Of North Carolina - Chapel Hill, Chapel Hill, NC*  
*Benjamin Hornsby, PhD, Vanderbilt University, Nashville, TN*

Accumulating evidence suggests an association between hearing-related listening difficulties and fatigue (Hetu et al., 1988; Hornsby, 2013; Nachtgeaal et al., 2009). It is generally assumed that the increased mental effort required by individuals with hearing loss to communicate optimally leads to the percept of fatigue, however, empirical evidence supporting this linkage is sparse. Here we examine the relationship between variations in mental effort and subjective and behavioral measures of fatigue. Normal-hearing adults answered questions during a speech-in-noise task designed to induce fatigue. Mental effort was varied by changing the question structure from simple to more complex. Participants rated the subjective mental effort required to complete the task. Subjective and behavioral measures of fatigue were also obtained before and after the speech task. Behavioral fatigue was defined as a decrease in sustained attention, measured using a visual vigilance task. Results suggest that increasing task complexity can increase mental effort, although substantial between-subject variability exists. Subjective ratings of fatigue were also impacted by increasing task complexity while behavioral fatigue measures were unaffected. The significant increase in subjective fatigue despite variable changes in mental effort and behavioral fatigue, suggests that factors in addition to mental effort mediate speech-processing related fatigue. [Supported by the NIH National Institute on Deafness and Other Communication Disorders (NIDCD) Short Term Research Traineeship (T35)]
Using the SCAN-A to Identify CAP Deficits in Blast-Exposed Veterans
Heather M. Belding, BS; M. Samantha Lewis, PhD; Michele M. Hutter, MS; Melissa A. Papesh; Robert L. Folmer, PhD; Frederick J. Gallun, PhD, National Center For Rehabilitative Auditory Research, Portland, OR
Marjorie R. Leek, PhD, VA Loma Linda Healthcare System, Loma Linda, CA

Blast-exposed Veterans often complain of hearing difficulties in spite of normal hearing thresholds. This may indicate that blast exposure impairs auditory processing in the central nervous system. The SCAN-A (Keith, 1994; 1995) is a screening test for central auditory processing (CAP) disorders in adults. It is comprised of four auditory subtests. The test is relatively quick (20 minutes) and easy to administer and is widely used in clinics and research studies as a screening measure for CAP deficits. To explore the utility of this screening test in identifying CAP deficits in Veterans exposed to high-intensity blasts during military service, 17 blast-exposed Veterans and 25 age- and hearing-matched control participants were tested using the standard clinical SCAN-A protocol. Based on raw test scores, only 59% of the blast-exposed group scored within the normal range whereas 100% of the control subjects had normal scores. Significant differences were observed between the two groups on 3 of the 4 subtests as well. The difference was largest in the Competing Words subtest where 41% of the blast-exposed subjects fell outside of the normal range. Overall, results suggest that the SCAN-A may be a useful tool to screen for CAP deficits in blast-exposed Veterans.

Audio-visual Asynchronous Speech Recognition by Older and Younger Listeners
Mentored Student Research Poster Award
Hannah Willison, BA, University Of Maryland, College Park, West Hollywood, CA
Maya Freund, University Of Maryland, College Park, Silver Spring, MD
Sandra Gordon-Salant, PhD, University of Maryland, College Park, College Park, MD

The ability to recognize speech generally improves when the listener can use cues from both auditory (A) and visual (V) modalities, especially in noise. Both younger and older listeners demonstrate this AV benefit. When the speech presented via the two modalities is asynchronous, young listeners can still retain the AV benefit over a temporal window of asynchrony of about 200 ms. Because older listeners often have slowed auditory temporal processing, it is possible that auditory slowing enhances the perceived AV asynchrony, rendering the task of integrating an asynchronous AV signal more difficult for older listeners. The present study investigates the temporal window of AV integration for younger and older listeners, during an asynchronous AV speech recognition task using speech stimuli of varying durations. Words (monosyllables, disyllables) and sentences were presented in the AV modality with varying degrees of auditory lead and lag, re: the visual signal in noise to younger and older normal-hearing listeners and older hearing-impaired adults. Results indicate that listener age does not significantly influence the AV integration window. However, stimulus duration and hearing impairment appear to have a substantial impact on the ability to integrate asynchronous AV information.

Influence of Auditory Processing Disorder on the Severity of Speech-sound-disorders
Introduction: Children with speech-sound disorders (SSDs) are a heterogeneous group. A (central) auditory processing disorder ((C)APD) in these children may be an aggravating factor associated with the severity of the speech disorder. Because not all children with SSDs have a (C)APD, it is important to determine which children are more likely to present an auditory disorder. Method: we evaluated the severity of SSD and the auditory processing skills of 27 children (aged from 7;0 to 10;11) divided into two groups based on the results of a (C)APD evaluation. Results: in the presence of a (C)APD associated to a speech disorder, the children tended to have lower scores on phonological assessments. The greater the severity of the SSD, the greater were the chances of having a (C)APD. The use of a cutoff value for the percentage of consonants correct distinguished children with and without (C)APD. Conclusions: The results strengthen the evidence supporting a relationship between the severity of a speech disorder and the presence of a (C)APD and indicate a cutoff value at which children should be evaluated for a (C)APD, emphasizing the importance of using different strategies to increase auditory skills during therapeutic interventions in this group of children.

Poster # 135 - AP07

**Investigation of Auditory Processing Deficits in Patients with Diabetes Mellitus**

*Erin Dula, BS; Brady Workman; Saravan Elangovan, PhD; Jacek Smurzynski, PhD*, East Tennessee State University, Johnson City, TN

The incidence of Diabetes Mellitus (DM) is about 9.6% in the US, and its prevalence is increasing rapidly and globally (NIDDKD, 2007). A common, but under-recognized, complication of DM is hearing difficulties. Although epidemiological studies (Bainbridge, et al., 2008) suggests that individuals with diabetes are twice as likely to have hearing loss as non-diabetic individuals, research on DM-related auditory deficits is relatively sparse and have been inconclusive and/or ambiguous regarding the nature of the hearing loss. We tested the hypothesis that the DM-related listening difficulties are manifestations of subclinical deficit(s) in higher-order auditory processing. Following a routine audiological evaluation, we examined a group of adult DM (Type II) patients with tests that assessed peripheral (high-frequency-audiometry) and central processing (spatial listening, listening in competing noise, temporal processing and contralateral-suppression of OAEs) abilities. Our results indicate elevated high frequency pure-tone (>4 kHz) thresholds, increased difficulty listening in competing noise, poorer spatial listening skills, and poorer temporal processing abilities in the group of DM patients when compared to controls. These results suggest that central auditory processing deficits in patients with DM are more striking than commonly investigated peripheral deficits and thus contribute, and probably exacerbate, the functional listening difficulties experienced by these patients.

Poster # 136 - AP08

**Effects of Sports-Related Concussion on Auditory Processing in University Athletes**

*Abstract: A Holistic Description of Auditory Processing Abilities in University Athletes*  
*Mentored Student Research Poster Award*

*Julianne Ceruti, BA; Stephanie Waryasz; Pradeep Ramanathan*, University Of Connecticut, Storrs, CT

*Frank Musiek, PhD*, University of Arizona, Tucson, AZ
A holistic description of auditory processing abilities in university athletes, a population that is particularly susceptible to head injury, is crucial to developing a sensitive test battery to detect potential auditory processing deficits. The development of a test battery necessitates a within-subject comparison of a variety of behavioral and electrophysiological tests to evaluate patterns of dysfunction in this group. The aim of the present study is to investigate the effects of concussion on temporal processing, dichotic listening, binaural processing and neural synchrony utilizing clinical tests. Fifteen athletes with heterogeneous sports histories of concussion and normal peripheral hearing were administered a behavioral test battery, which consisted of dichotic rhyme (DR), masking level difference (MLD) and Gaps in Noise (GIN) test, as well as a electrophysiological test battery, which consisted of auditory brainstem response (ABR, cABR) and auditory late response (ALR). Preliminary analyses reveal abnormal ABR classifications and a significantly larger right ear advantage on DR in the high severity concussion group relative to the low severity group. Further statistical analysis and examination of the data will aim to incorporate electrophysiological results and determine potential risk factors for auditory processing deficits associated with head injury in athletics.

Poster # 137 – AP09

The Influence of Musical Training and Maturation on Pitch Perception and Memory
Aurora Weaver, AuD; Jeffrey Digiovanni, PhD; Dennis Ries, PhD, Ohio University, Athens, OH

The purpose of this study was to determine the influence of musical training on various auditory and memory processes in persons with normal auditory, attention, and memory function at various stages of training and maturation. Previous research shows that musical training influences sound processing not only within the brain through learning-based processes, but also at the pre-attentive level within the brainstem. Such training strengthens processes in the auditory and motor domains, as well as central processes. This study investigated auditory memory abilities in individuals with Hi and Lo musical training using non-verbal auditory stimuli. Use of non-verbal sounds provided a control for performance characteristics influenced by linguistic knowledge while establishing whether musical training enhances one’s ability to assemble auditory information into accurate and meaningful mental representations. Three experiments evaluated auditory working memory capacity, the interplay between frequency discrimination and capacity, and pitch matching retention. Three different age groups of children and a group of young adults, each split into subgroups comprised of Hi and Lo musical training, participated in these experiments. The outcomes indicate that both musical training and age influence performance for pitch perception, organization and memory tasks with adult-like performance identified by age 14.

Poster # 138 - AP10

Roles of Reading and Auditory-Word Memory Span in Linguistically-Varied Speech
Sherri Smith, PhD, Auditory And Vestibular Dysfunction Research Enhancement Award Program, Veterans Affairs Medical Center, Mountain Home, TN
M. Kathleen Pichora-fuller, PhD, Department Of Psychology, University Of Toronto, Mississauga, Ontario

Individual differences in older listeners’ speech-understanding difficulties could be due to interactions of auditory and cognitive processing abilities. Auditory processing will depend on the individual’s degree and type of hearing loss. In terms of cognitive processing, working memory plays is known to play an important role in listening comprehension. The reading span measure has been used purportedly to
avoid contamination by hearing loss and it has been found to correlate with performance on speech-in-
oise tests. However, variations in auditory processing ability due to hearing loss may be of great
importance in assessing the effort that individuals require to understand speech in varying noise
conditions. Auditory measures of working memory span could add important information beyond that
provided by measures of reading working memory span for listeners whose auditory processing abilities
may vary. We administered a reading span measure and a new auditory word-span measure as well as a
battery of speech-in-noise tests in which the linguistic complexity of the speech target and the degree of
masking were varied. Participants were a group of younger listeners with normal hearing and a group of
older listeners with bilateral sensorineural hearing loss. The results of that study will be presented in this
paper.

Poster # 139 - AP11

**Evaluation of a Binaural Processing Test Battery for Adults**

*Amy Stewart, BA; Christina Roup, The Ohio State University, Columbus, OH*

An auditory processing deficit is a perceptual issue affecting how the central auditory nervous system
understands and makes use of auditory information. Auditory processing disorders are typically
associated with the pediatric population, however, anecdotal clinical evidence and the recent focus on
central auditory effects of traumatic brain injury (TBI) suggests that auditory processing deficits may be
prevalent among adults. Individuals with symptoms of an auditory processing deficit often score within
the normal range on standard clinical assessments. The objective of the current study was to target
measures of binaural processing to identify and characterize auditory processing deficits within the adult
population. Three groups were recruited: adults with subjective listening difficulties, adults with a
history of TBI, and a control group. Binaural processing was measured with: 1) the Revised Speech
Perception in Noise test measured monaurally and binaurally; 2) dichotic word recognition without and
with low-pass filtering measured in the free recall and directed recall conditions; 3) the 500-Hz masking
level difference; and 4) the Listening in Spatialized Noise - Sentences Test. Results suggest that
individuals with subjective listening complaints and individuals with a history of TBI have lower than
normal performance on auditory processing tests within a binaural test battery.

Poster # 140 - AP12

**Effects of High-intensity Blast Exposure on Speech Perception**

*Melissa A. Papesh, PhD; Frederick J. Gallun, PhD; Heather Belding; M. Samantha Lewis, PhD; Robert Folmer,
PhD; Marjorie Leek, PhD, National Center For Rehabilitative Auditory Research, Portland, OR*

Auditory complaints of Veterans exposed to high-intensity blasts often involve difficulty understanding
speech in various contexts such as noisy or reverberant environments and rapidly spoken speech. Such
difficulties often persist in spite of normal hearing thresholds. Though several tests of speech
comprehension are available, some may be more sensitive to deficits in this population than others. This
presentation reviews the performance of both blast-exposed Veterans and age-matched control
participants on a range of speech tests with conditions including time compression, quiet and multitalker
babble backgrounds, and reverberation. Blast-exposed Veterans performed similarly to control
participants on typical tests of speech perception in quiet (Nu-6 word lists). However, conditions
involving background noise (Words-in-Noise and QuickSIN tests) or time-compressed speech (45% compression) revealed poorer average performance in the blast-exposed group compared to controls.
The addition of reverberation in combination with multitalker babble uncovered even greater group differences, with maximal group distinctions found in conditions involving the combination of multitalker babble, reverberation, and time compression. Overall, preliminary results suggest that blast-exposed Veterans’ difficulties with speech perception are best revealed by complex speech tests involving a combination of real-world factors such as background noise, reverberation, and rapid speech rates.

**DISEASES / SYNDROMES / DNA REPAIR**

Poster # 141 - DIS01

**Audiologic Profile of Individuals with Friedreich’s Ataxia**

*Victoria Williams-Sanchez, AuD, PhD; Brendan McAteer, BA; Kasey Craig-Ashley, BA; Amanda Brandino, BA; Michelle Arnold, AuD*, University of South Florida, FL

Friedreich's ataxia (FA) is a debilitating, life-shortening, neurodegenerative disorder affecting motor and sensory systems. The goal of the present work was to investigate the audiologic profile of individuals with FA. Baseline audiological data from twenty patients (9 male and 11 female) diagnosed with FA who were being seen as a part of a larger clinical drug trial (Safety and Efficacy of EPI-743 in Patients With Friedreich’s Ataxia, clinical trials identification: NCT01728064) were examined. FA patients underwent standard audiometric testing and extensive behavioral and electrophysiologic evaluations. The FA group performance was compared to normative data and that of an age-matched cohort of individuals with normal auditory function. Measures that were most sensitive to detect impairments included: acoustic reflex testing, tests of temporal resolution, speech perception in spatialized noise, and multiple rate auditory brainstem responses (ABRs). Based on our findings we recommend an audiological test battery for FA patients that can be used to quantify their hearing-related impairments and track changes in auditory function over time. The battery of tests identified is recommended for use in future FA intervention studies.

Poster # 142 - DIS02

**Audiologists’ Knowledge of, Experiences with, and Attitudes toward LVAS**

*J. Connor Sullivan, BA; Anna Marie Jilla, MA; Kristin Winkler; Carole Johnson, PhD*, University Of Oklahoma Health Sciences Center, Oklahoma City, OK

*Jeffrey Danhauer, PhD*, University of California Santa Barbara, Goleta, CA

Large vestibular aqueduct syndrome (LVAS) is diagnosed when the aqueduct is > 1 mm in diameter, maybe caused by mutations in SLC26A4 gene, and occurs in about 5-15% of all pediatric cases of sensorineural hearing loss (SNHL). One hundred thirty-eight audiologists (~11% response rate), mostly female, with varied years of experience and primary work settings completed a 21-item survey on their knowledge of, experiences with, and attitudes toward LVAS. Three-fourths had seen patients with LVAS; over 1/3 had seen between 4 and 15 patients during the past 5 years. The majority felt comfortable with the audiologic evaluation, hearing aid fitting, counseling of, and referrals for these patients. However, most were not comfortable regarding issues of cochlear implantation. Most knew the common symptoms of LVAS; they were not aware that patients may present with headaches, vision difficulties, and inner ear congenital malformations (i.e., lack of a bony modiolus) or the possible genetic transmission of this
disorder. Overall, results indicated audiologists desired and needed continuing education on this topic to identify and meet the needs of their patients with LVAS and their families.

Poster # 143 - DIS03

Wideband Chirp-Evoked OAEs for Monitoring Ototoxicity in Cystic Fibrosis Patients
Patrick Feeney, PhD; Daniel Puttermann, AuD; Garnett Mcmillan, PhD, National Center For Rehabilitative Auditory Research, Portland, OR
Angela Garinis, PhD, Oregon Hearing Research Center, Portland, OR
Douglas Keefe, PhD; Denis Fitzpatrick, PhD, Boys Town National Research Hospital, Omaha, NE
Lisa Hunter, PhD, Cincinnati Children’s Hospital, Cincinnati, OH

Wideband (WB, 0.79-8.0 kHz) chirp-evoked otoacoustic emissions (WB-CEOAEs) use an extended bandwidth to measure cochlear function compared to traditional transient OAEs. These rapid measurements have the potential to identify early signs of ototoxic hearing loss occurring at high frequencies. The current study investigated the relationship between hearing threshold changes and changes in WB-CEOAEs in 96 patients with cystic fibrosis (mean age= 26 years) who received ototoxic drugs such as aminoglycocides for treatment of infections. Hearing thresholds from 0.25 to 16.0 kHz and WB-CEOAEs recorded at ambient pressure, at tympanometric peak pressure and using an absorbance-weighted chirp were obtained over multiple visits. Results revealed that an increase in hearing threshold was typically positively correlated with a decrease in the CEOAE signal-to-noise ratio (SNR) across all subjects for all OAE types. WB-CEOAE frequencies from 3.0-6.7 kHz, exhibited the largest reduction in CEOAE-SNR for a subset of subjects with significant shifts in hearing threshold within the 9.0 to 16.0 kHz frequency range. Findings suggest that decreases in WB-CEOAE levels are related to increased (poorer) hearing thresholds at higher frequencies, and thus may be useful in a test battery to monitor for an early indication of ototoxicity.

Poster # 144 - DIS04

Bone Morphogenetic Protein Antagonizes Mature Avian Hair Cell Regeneration
Rebecca Lewis, BS; Jesse Keller, MD; Jennifer Stone, PhD, University of Washington, Seattle, WA

Sensory-neural hearing loss due to cochlear hair cell loss is permanent for mammals that do not naturally form new hair cells after damage. Meanwhile, basal papillae (BPs) of birds use hair cell regeneration to restore hearing. Initiating this process requires Atoh1, a gene sufficient for hair cell production during development but not sufficient during hair cell regeneration. Atoh1 expression is reduced by bone morphogenetic proteins (BMPs) during auditory epithelia development, but their role in auditory hair cell regeneration is unknown. During this study, gene expression patterns and number of hair cells are evaluated using in situ hybridization and immunofluorescence, respectively, among mature avian BPs. Undamaged epithelia demonstrate high expression of Bmp4 and low expression of Atoh1. After ototoxic drug damage, Atoh1 expression is high and Bmp4 expression is low. Activating BMP signaling in a damaged BP decreases Atoh1 transcripts and hair cell differentiation. Inhibition of BMP signaling increases Atoh1 transcript and hair cell differentiation. Examination of expression patterns for Bmp4 and related receptor transcripts suggests maintenance of supporting cell quiescence when undamaged. Once damaged, the decrease in BMP activity allows Atoh1 to increase hair cell differentiation. Further study is underway to determine the mechanisms underlying these changes.
Parents of Children with LVAS: Learning from their Journeys

J. Connor Sullivan, BA; Anna Marie Jilla, MA; Kristin Winkler; Carole Johnson, PhD, University Of Oklahoma Health Sciences Center, Oklahoma City, OK
Jeffrey Danhauer, PhD, University of California Santa Barbara, Goleta, CA

Large vestibular aqueduct syndrome (LVAS) is diagnosed when the aqueduct is $> 1$ mm in diameter, maybe caused by mutations in SLC26A4 gene, and occurs in about 5-15% of all pediatric cases of sensorineural hearing loss (SNHL). We surveyed parents of children with LVAS about their experiences with and knowledge of LVAS in addition to their attitudes toward and suggestions for hearing healthcare providers. Ninety parents, mostly mothers, from online social media support groups reported a diagnosis of bilateral LVAS before their children were 6 y of age; most experienced fluctuating, progressive SNHL from time of diagnosis of LVAS to the present. Most children used aural/oral communication, digital hearing aids, and FM systems; nearly one-fifth had (a) cochlear implant(s). The children had experienced balance issues, falling, headaches, head trauma, and vision problems. Most of the parents agreed that their audiologists and otolaryngologists were well trained to meet their needs; their pediatricians, primary-care physicians, and speech-language pathologists were not. Results indicated a need for professional education on this topic. Suggestions for improving counseling and coordination of service provision to families are provided for each type of hearing healthcare professional. Moreover, parents provided tips for caregivers of children newly diagnosed with LVAS.

**COCHLEAR IMPLANTS**

Poster # 146 - Cl01

Production of Word-initial Fricatives in Prelingually-deafened Children with Cochlear Implants: A Preliminary Study

Jing Yang, PhD, University Of Central Arkansas, Conway, AR
Jessica Vadlamudi, AuD; Chao-yang Lee, PhD; Li Xu, PhD, Ohio University, Athens, OH
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This study examined the production of fricatives by prelingually-deafened, Mandarin-speaking children with cochlear implants (CIs). One group of 14 CI children (2.9 to 8.3 years old) and one group of 60 age-matched normal-hearing (NH) children were recorded producing a list of 13 Mandarin words with four fricatives /f, s, ŋ, ŋ/ occurring at the syllable-initial position through a picture naming task. Two phonetically-trained native Mandarin speakers transcribed the fricative productions. The CI children showed much lower accuracy rate and more diverse error patterns on all four fricatives than did the NH peers. Among these four fricatives, both CI and NH showed the highest rate of mispronunciation of /s/. Acoustic analysis was then conducted to examine acoustic measures including duration, normalized amplitude, spectral peak location, and four spectral moments. The results showed that the CI children differed from the NH children in spectral peak location, normalized amplitude, spectral mean, and spectral skewness. In addition, CI children showed less distinctive pattern of acoustic measures as a function of place of articulation than did NH children. In general, these results indicate that the CI
children have not established distinct categories for the Mandarin fricatives in terms of place of articulation.

Poster # 147 - CI02

Voice Emotion Recognition: Developmental Age and Spectral Resolution T35 Research Trainee Poster
Anna Tinnemore, MA, University Of Arizona, Tucson, AZ
Monita Chatterjee, PhD, Boys Town National Research Hospital, Omaha, NE

The ability to recognize a speaker's emotion is an important aspect of communication that is not fully accessible to children and adults with cochlear implants (CI). Studying the ability of children with normal hearing to recognize voice emotion in the absence of facial cues using full-spectrum and CI-simulated speech may provide insight into methods for improving the communication success of those who use CIs. The current study examines the effects of spectral resolution on the emotion recognition ability of different age groups of children with normal hearing. Children between the ages of 6 and 19 were tested on voice emotion recognition using noiseband-vocoded speech with 8 and 16 spectral channels, as well as full-spectrum speech. Results show significant developmental effects in each of the conditions tested (p<0.006). There was also a significant interaction between spectral resolution and age group. However, there were no significant differences in the benefit found by increasing the spectral resolution from 8 to 16 channels between age groups. This means that children of all ages can benefit from increased spectral resolution in their cochlear implants.

Poster # 148 - CI03

The Role of Cognition in Cochlear Implant Outcomes T35 Research Trainee Poster
Nada Hanna, BA; Jill B. Firszt, PhD; Ruth Reeder, MA; Laura Holden, AuD; Noel Dwyer, AuD, Washington University In St. Louis, School Of Medicine, Program In Audiology And Communication Sciences, St. Louis, MO

Cochlear implants restore hearing and enhance speech perception for adults who have bilateral sensorineural hearing loss. However, among cochlear implant recipients there exists large variability in outcome measures that is observed both in quiet and in noise. One approach to understanding this varied performance is to evaluate the role cognitive resources play in speech understanding. The long-term goal of this research is to assess effects of sensory deprivation coupled with sub-optimally represented speech, as provided by the cochlear implant, on cognitive resources used by cochlear implant recipients. A cognitive test battery that included measures of verbal working memory and inhibition along with a behavioral test battery of speech recognition in quiet and noise was administered to a pilot group of recipients. Preliminary results suggest that sentence recognition in noise was not only poorer than in quiet, but also more varied. There was a significant correlation between scores of inhibition and the effect of background noise on sentence understanding. That is, participants with greater inhibition exhibited less negative effects of background noise. Additional study with a larger participant group is needed to better understand the relation between cognition and speech recognition, particularly the varied effect of noise among cochlear implant recipients.

Poster # 149 - CI04
Auditory Training in Noise with Cochlear Implant Recipients  
**T35 Research Trainee Poster**

*Alison Kiolbasa, BS, Program In Audiology And Communication Sciences At Washington University School Of Medicine, St. Louis, MO*  
*Lisa G. Potts, PhD, Washington University In St. Louis School Of Medicine, Department Of Otolaryngology, St. Louis, MO*

Difficulty understanding in background noise is a primary complaint of cochlear implant (CI) recipients. Auditory training is one treatment option implemented to improve a CI recipient's speech recognition. The effectiveness of auditory training, however, varies across studies. This may be due to issues such as individual variability in learning, the type of training implemented and/or the outcome measures used.

The purpose of the present study was to evaluate the effects of auditory training in noise on a CI recipient's speech recognition and everyday functioning. Four CI recipients participated in a five-week auditory training program, which included communication strategy training with Conversations Made Easy and continuous discourse tracking. All auditory training was performed with restaurant-type noise surrounding the participant. Pre- and post-training evaluation included sentence recognition, speech reading, discourse tracking in quiet and noise, as well as a variety of questionnaires. For these participants, discourse tracking showed the largest improvement following auditory training. This may relate to the conversational nature of discourse tracking compared to traditional sentence recognition tests. The questionnaires reflected an increased awareness of communication difficulties, as well as improved implementation of communication strategies. Findings suggest auditory training in noise can improve CI recipients' functional performance in noise.

Poster # 150 - CI05

Speech-on-Speech Recognition for Children with Cochlear Implants  
**Mentored Student Research Poster Award**

*Molly Drescher, BS; Lori Leibold, PhD; Angela Bonino, PhD; Emily Buss, PhD, The University Of North Carolina At Chapel Hill, Chapel Hill, NC*  
*Holly Teagle, AuD; Laura Greaver, The University of North Carolina at Chapel Hill, Durham, NC*

This study compares word recognition in a two-talker masker between children with cochlear implants (CIs) and children with normal hearing. It is hypothesized that the gap in performance between children with CIs and children with normal hearing is greater in a two-talker masker than previously observed in relatively steady-state noise. A secondary goal of this study is to determine if children with CIs benefit from a sex mismatch between the target and the masker talkers, as previously observed for children with normal hearing (e.g., Wightman & Kistler, 2005). Note, however, that postlingually deafened adults with CIs show similar performance for mismatched-sex and same-sex target/masker conditions (e.g., Stickney et al., 2004). Targets were disyllabic words produced by a male or female talker. The masker was two-female-talker speech. Listeners completed testing in male and female target speech conditions using a 4AFC closed-set task. Preliminary data indicate that children with CIs perform more poorly than children with CIs, and that most children with CIs are unable to take advantage of acoustic differences between simultaneously presented male and female voices. These findings indicate greater challenges for children with CIs for recognizing speech in a speech masker than children with normal hearing.

Poster # 151 - CI06

Evaluation of Music Perception in Two Signal Processing Strategies
A key question in the field of cochlear implants is whether contemporary coding strategies enhance postoperative music perception. This prospective randomized study investigated the music discrimination abilities of cochlear implant recipients programmed with either the High Definition Continuous Interleaved Sampling (HDCIS) or Fine Structure Processing (FSP) coding strategy. HDCIS is an envelope encoding strategy, while FSP attempts to deliver both envelope and fine structure information. 33 subjects were enrolled and randomly assigned to listen with either coding strategy at initial activation of the external speech processor. They listened exclusively with the assigned strategy for 6 months. Music perception was evaluated at the 6-month follow-up interval using the Musical Sounds in Cochlear Implants (Mu.S.I.C.) software. Subtests included pitch perception, instrument identification, and rhythm, melody, and chord discrimination. Interim analysis suggests no significant difference on each subtest after 6 months of listening experience for subjects programmed with HDCIS versus FSP. However, to investigate musical perceptual abilities, discrimination tasks may not be sufficient to demonstrate real world differences between coding strategies. The evaluation of signal coding strategies on postoperative outcomes should include assessment of music perception abilities. Review of long-term listening experience is needed to assess how music perception abilities change over time.

Poster # 152 - CI07

**Cognitive Factors and Adaptation to a Novel Cochlear-implant Coding Strategy**

*Naomi Croghan, PhD; Zachary Smith, PhD, Cochlear Ltd., Centennial, CO*

When evaluating novel sound processing schemes for cochlear implants, extended periods of adjustment may be necessary to overcome the effects of prior listening experience. Both auditory and non-auditory factors might influence how individual subjects acclimate to new patterns of stimulation. Recent work has shown that working memory and noise tolerance predict individual differences in benefit from signal-processing parameters in hearing instruments. These factors may also influence a subject’s ability to adapt to a new sound coding strategy. In the current study, a group of experienced cochlear-implant recipients took home a temporally sparse research coding strategy that was radically different from their clinical strategy, ACE. At the end of the 18-week trial, some participants were able to perform as well with the research strategy as with ACE, while others struggled in terms of speech recognition and sound quality. To explore this variability, the Reading Span Test of working memory and the Acceptable Noise Level test were conducted. Working memory was associated with acclimation to a greater extent than noise tolerance. These findings suggest that cognitive factors may play a role in a cochlear implant recipient’s ability to use - or to adapt to - a new sound coding strategy with sparse temporal representation.

Poster # 153 - CI08

**Age-Related Changes in Temporal Resolution Revisited: Findings from CI Users**

*Mentored Student Research Poster Award*

*Bruna Mussoi, AuD; Carolyn Brown, PhD, University Of Iowa, Iowa City, IA*
Age-related changes in temporal resolution are likely an important contributor to the speech perception difficulties observed in the elderly. However, it is difficult to separate the effects of age from those of hearing loss. Cochlear implant (CI) users represent a unique opportunity to determine how aging affects temporal resolution at separate levels of the auditory system in humans, without the confound of differences in peripheral processing. The purpose of this study was to investigate age-related changes in temporal resolution in younger and older cochlear implant (CI) users, by comparing peripheral and central electrophysiologic measures of temporal resolution, as well as their perceptual correlates. The speech processor of the CI was bypassed and electrodes were stimulated directly. Peripherally, temporal resolution was assessed with the rate of recovery of the Electrically Evoked Compound Action Potential using both a single pulse and a pulse train as maskers. Centrally, the Acoustic Change Complex was evoked by gaps of varying duration embedded in constant amplitude pulse trains and recorded from scalp electrodes. The same stimuli were used for psychophysical gap detection. Findings will help understand how advancing age impacts auditory temporal resolution, based on electrophysiological and behavioral measures in CI users.

Poster # 154 - CI09

**Exploring Peripheral Contributions to Loudness: Cochlear Implants**
*Rachel Scheperle, PhD; Michelle Hughes, PhD; Jacquelyn Baudhuin, AuD; Jenny Goehring, AuD, Boys Town National Research Hospital, Omaha, NE*

Considerable effort has been devoted to exploring the use of the electrically evoked compound action potential (ECAP) to assist with cochlear implant programming, particularly for setting the electrical dynamic range. Although ECAP amplitude and loudness increase monotonically with current level, the relation is variable, and ECAP amplitude is not a good predictor of loudness. The purpose of this study is to gain insight into the sources of this variability and to test the hypothesis that spread of neural excitation is a contributing factor. Stimulus conditions include multiple electrode configurations and sites across the array. Categorical scaling will be used to estimate loudness. ECAP amplitude-growth and channel-interaction functions will be obtained to estimate the respective magnitude and breadth of neural-excitation patterns. The relation between ECAP amplitude and loudness growth will be characterized for each stimulus condition. The extent to which the area of the ECAP channel-interaction function (1) accounts for the changes in ECAP amplitude- and loudness-growth functions across stimulus conditions and (2) improves predictions of loudness when combined with ECAP amplitude will be explored.

Poster # 155 - CI10

**Speech Performance in Pediatric Users of Nurotron® Venus’ Cochlear Implants**
*Yuling Li, MA; Beier Qi, MA; Ruijuan Dong, MA; Tianqiu Xu; Chao Meng; Qianqian Guo; Xueqing Chen, MD, Beijing Tongren Hospital, Capital Medical University, Beijing, China*

Objectives: The purpose of this study was to investigate the longitudinal speech performance over 3 years in pediatric users of Nurotron® cochlear implant system. Methods: Mandarin Early Speech Perception (MESP), the Meaningful Use of Speech Scale (MUSS) and Putonghua Chinese Communicative Development Inventory (PCDI) were used to evaluate speech performance in 22 Mandarin-speaking pediatric cochlear implant (CI) users throughout the first 36 months after implantation. Results: All the
subjects demonstrated improvement in speech performance throughout the first 3 years of implant use with mean scores reaching the maximum performance at 36 months after implantation. The median categories of MESP increased from 0.23 pre-operation to 5.57 three years post-implantation. Likewise, the median performances of MUSS, PCDI-comprehension and PCDI-production increase of 5.57% to 73.75%, 55 to 400, and 32 to 384 at the same interval. Conclusion: The children with Nurotron® Venus’ cochlear implants showed considerable gains in speech and language development including tone performance that improved with hearing age.

Poster # 156 - CI11

**Single-Sided Deafness Cochlear-Implant Perception and Simulation: Localization and Spatial-Masking Release**  Mentored Student Research Poster Award
*Coral Dirks, BA; Andrew Oxenham, PhD; Peggy Nelson, PhD*, University Of Minnesota, Twin Cities, Minneapolis, MN

Patients with single-sided deafness (SSD) report difficulty localizing sound and understanding speech in noise, particularly when the speech is on their deaf side. Recently some SSD patients have been fitted with a cochlear implant (CI) on the deaf side, often to alleviate tinnitus. Initial reports suggest that patients’ localization and speech perception may improve with CIs but few formal studies exist. This study tests the ability of SSD + CI listeners and normal-hearing listeners to localize low- and high-frequency sounds and to understand speech in various interferers. The SSD patients are tested with and without their CI, and the normal-hearing listeners are tested with and without noise in one ear to simulate SSD. We hypothesize that SSD patients can benefit from high-frequency interaural level differences, but not from low-frequency interaural time differences. Ability to localize sounds should be of most benefit in speech conditions where informational masking dominates. Pilot data from simulated SSD normal-hearing listeners with the target and masker presented on opposite sides show improvements in speech-to-masker ratio of between 18 and 25 dB, when hearing on the simulated deaf side is restored. These large differences provide potential for improvement when a CI is combined with contralateral normal hearing.