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POSTER ABSTRACTS

Topic areas and poster numbers:

AUDITORY PROCESSING

Category: Auditory Processing

Poster #: 001

Development of a Rapid Pitch Discrimination Test for Cochlear Implant Users: Response Time Window Determination

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Objectives: To determine the optimal response time window for a novel rapid pitch discrimination test being developed for cochlear implant users.

Design: Study Design: Cross-sectional survey. 12 cochlear implant users and 13 normal hearing users completed our pitch discrimination test through a Qualtrix study distributed online.

Methods: A rapid pitch test composed of repeated notes of a C4 chromatic scale was developed. The first semitone played was C4, and pitches were incrementally increased by a single semitone until C5. The stimuli consisted of a pseudo-randomized number of repeats of each semitone (0.5s) presented at a rate of one note per second. Participants were instructed to press a button only when they heard a change in pitch.

Participants were assigned a true positive response if they responded appropriately to a change in pitch within a given time window. Three analyses were conducted on the same set of data using varying response time windows of 2, 3 and 4 seconds. In the first analysis, users were scored positively if they replied within 3 seconds of a true pitch change. In the second analysis, users were scored positively if they replied within 2 seconds of a pitch change, reflecting a more specific test. In the final analysis, users were scored positively if they replied within 4 seconds of a true pitch change, reflecting a more sensitive test. We then calculated accuracy, precision, recall, and F1 score for participants based on these three different time windows.

Results: Twenty-five participants completed this survey, with 12 cochlear implant (CI) users and 13 normal hearing (NH) users. When using a window cutoff of 3 seconds, CI users had lower precision (0.78 vs. 0.93, $p=0.06$), recall (0.66 vs. 1.00, $p<0.001$), accuracy (0.93 vs. 0.99, $p=0.001$), and F1-score (0.67 vs. 0.96, $p<0.001$) than NH. When using a window cutoff of 2 seconds, differences between CI and NH users' accuracy (0.63 vs. 0.85, $p=0.21$), recall (0.58 vs. 0.91, $p=0.06$), accuracy (0.91 vs. 0.97, $p=0.53$), and F1 score (0.57 vs. 0.88, $p=0.08$) were no longer statistically significant. When using a window cutoff of 4 seconds, CI users had lower precision (0.82 vs. 0.93, $p=0.40$), recall (0.70 vs. 1.00, $p=0.001$), accuracy (0.94 vs. 0.99, $p=0.49$), and F1 score (0.71 vs. 0.96, $p=0.09$).

Conclusions: This study suggests that a 3 second response time window is most optimal for this rapid pitch discrimination test. When using a 2 second window, NH users performed more poorly, possibly reflecting an overly difficult test with a response time window time that was too short. When using a 4 second threshold, differences between CI and NH user scores were diminished, possibly reflecting an overly long response time window. We therefore recommend the use of a 3 second response time window for evaluating pitch discrimination using this novel rapid test designed for use in the clinic.

Category: Auditory Processing

Poster #: 002

Effect of Attention and Background Noise on Hemispheric Differences in CAEPs

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Objectives: Cortical hemispheres exhibit specialization for distinct auditory processing mechanisms, with both attention and background noise known to modulate these cortical processes. In this study, we evaluated the interactive nature of attention and background noise on the hemispheric differences in Cortical Auditory Evoked Potentials (CAEPs).

Design: 30 young adults (18-35 years) with clinically normal hearing (PTA< 15 dB HL in both ears) were considered for the study. CAEPs were recorded from each participant in response to disyllabic speech sounds presented either in quiet or in the presence of speech-shaped noise (+10 dB SNR) using a 256-channel EEG equipment. Further, under both background conditions, CAEPs were recorded while the participants actively responded to the target sound (active attention) or while they watched muted close-captioned video (passive attention). After pre-processing the raw EEG data, N1 amplitudes were calculated separately for each hemisphere using averaged epochs from electrodes on the right and left hemispheres across the four conditions.

Results: A repeated measures ANOVA revealed significant main effects of Attention and hemisphere, as well as a significant interaction between Attention and Hemisphere. Post-hoc t-tests showed significantly larger N1 amplitudes for the left hemisphere for all conditions except the passive attention condition in the SSN background.

Conclusions: Results showed that active attention resulted in significantly larger N1 amplitudes irrespective of the background condition. However, during passive attention, there was no such left-hemispheric dominance in the presence of background noise. Although previous research points towards a progressive shift towards the right hemisphere with increasingly complex listening situations, to the best of our knowledge, no previous study has explored the interaction between attention and background noise on hemispheric asymmetry. The outcomes from our study show that hemispheric asymmetry needs to be explored in conjunction with the nuances of cognitive mechanisms.

Category: Auditory Processing

Poster #: 003

Socioeconomic Status and Basic Auditory Processing in Young Adults

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Objectives: This study investigates the relationship between socioeconomic status and basic auditory processing in young adults, addressing a significant gap in research that predominantly focuses on complex auditory stimuli. While previous studies have established links between socioeconomic status

and central auditory processing, the influence of socioeconomic status on fundamental auditory functions, such as frequency discrimination, remains largely unexplored. Additionally, this research examines how socioeconomic status interacts with working memory in the context of basic auditory processing.

Design: Utilizing the Portable Auditory Rapid Testing battery, we assessed temporal fine structure and spectrotemporal sensitivity in a sample of 38 participants (11 men, 27 women; mean age = 19.28 years, SD = 1.63; age range 18-26 years). Each testing session lasted approximately 100 minutes and included tasks such as gap detection, diotic frequency modulation, and dichotic frequency modulation for temporal fine structure evaluation, as well as spectral, temporal, and spectrotemporal modulation tasks for spectrotemporal sensitivity assessment. Socioeconomic status metrics were adapted from Hollingshead's Four Factor Index of Social Status, incorporating parental education, parental occupation, and individual educational attainment. Working memory was measured using the List Sorting Working Memory component from the NIH Toolbox Cognition Battery.

Results: The analysis revealed no significant correlations between socioeconomic status indicators and temporal fine structure or spectrotemporal sensitivity tests. Furthermore, multiple linear regression analyses showed that neither maternal education nor sorting working memory significantly influenced any auditory processing outcomes, including gap detection and spectrotemporal sensitivity measures.

Conclusions: In conclusion, this study found no significant relationships between socioeconomic status and basic auditory processing abilities in young adults, which contrasts with previous findings suggesting such connections. These discrepancies may be attributed to differences in age and methodology. Moreover, no interactive effects of working memory and maternal education on auditory processing were observed, likely due to the fundamental nature of the tasks employed. While these results suggest that collecting socioeconomic status data may not be critical for assessing auditory processing in this demographic, limitations such as sample size and age focus highlight the necessity for further research.

Category: Auditory Processing

Poster #: 004

Nonword Repetition Assessing Auditory and Cognitive Abilities in CI users

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Objectives: Phonological processing skills in adults with cochlear implants (CIs) may be influenced by both hearing loss experienced prior to implantation and the spectro-temporally degraded CI signal. Previous research in different listener populations has shown that a nonword repetition task (NWRT) is a useful measure of phonological processing, likely relying on working memory, reading ability, as well as age. However, NWRT performance has not been widely studied in adults with cochlear implants (CIs).

The objective of the present study was to assess whether CI users would show variability in NWRT performance with hearing loss and age impacting their phonological processing skills compared to their normal hearing (NH) peers. We hypothesized that CI users would perform more poorly on NWRT and show a relatively stronger aging effect relative to normal hearing. We further hypothesized that NWRT performance would be related to the cognitive functions dependent on phonological processing skills, influencing individual differences in results.

Design: In this study, 49 postlingual adult CI users (aged 45-87) and 43 NH individuals (aged 50-81) participated. CI users all had more than one year of CI use. Participants completed the NWRT, consisting of 40 nonwords (one to four syllables, ten per length), presented audio-visually by a male talker. Participants' responses were recorded and scored as a total percentage of correct nonwords. Participants also completed a battery of auditory and visual cognitive tasks including spectro-temporal processing (SMRT), reading efficiency (TOWRE), and working memory (forward digit-span). The test battery was used to examine the contributions of these skills to NWRT performance.

Results: Consistent with our first hypothesis, results indicated a statistically significant difference between the NH and CI groups on the NWRT task ($t=15.07$, $p< 0.001$). NH participants had a mean score of 87.5%, while the mean score for CI users was 43.6%. Regression analysis showed an age effect within CI group, NWRT performance declining with advancing age ($p< 0.05$), but not observed in the NH group ($p > 0.05$). Consistent with our second hypothesis, preliminary analyses of the associated variables with NWRT performance in CI participants suggested that there was a moderately strong correlation ($r = 0.56$) of auditory processing abilities as measured by SMRT and a moderate correlation ($r = 0.42$) of reading and phonological abilities as measured by the TOWRE test. Working memory, assessed using the forward digit span task, was most weakly related to NWRT performance ($r= 0.05$).

Conclusions: CI participants showed poorer performance and age effect on the NWRT compared to their NH age-matched peers, suggesting that age and hearing loss have combined effects on phonological processing abilities. More accurate NWRT performance in CI adult users was associated with better spectro-temporal resolution, reading abilities, and phonological skills but not working memory. Clinically, NWRT might be a useful tool for the adult CI population to provide a better understanding of phonological processing skills, speech perception abilities, and their interactions with cognitive systems.

Category: Auditory Processing

Poster #: 005

Exploring Shared Genetic Influences on Musical Rhythm Abilities and Hearing Traits

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Objectives: Musical profiles (including abilities and experience) have been shown to be relevant for speech and hearing outcomes (including speech perception in noise). Recent theories posit that these patterns of associations are driven partly by shared genetic influences, similar to what is observed between musicality and other communication-related traits and disorders. Specifically, higher degrees of

musicality have been proposed as a potential genetically-informed resilience factor for age-related hearing loss and other hearing declines in aging. Previous genetic studies have shown that musical rhythm abilities, age-related hearing impairments, and speech perception in noise are all substantially heritable (driven by genetic differences). Further, some genes associated with both musical rhythm abilities and hearing difficulties are involved in inner ear development and structural resilience, which could indicate a potential mechanism affected by shared genetics. Here, we examined the magnitude and direction of genetic correlations between musical rhythm and hearing traits. We hypothesized that musical rhythm abilities would be positively genetically correlated with speech perception in noisy environments, and negatively correlated with hearing difficulty.

Design: We tested genetic correlations using summary statistics from recent genome-wide association studies (GWASs) of (1) musical rhythm abilities (in 23andme participants; N = 606,825); (2) hearing difficulty and speech perception in noise (in UKBioBank participants; N = 362,396). Linkage disequilibrium (LD) score regression models were tested to assess genetic correlations between the two traits. In these GWAS studies, phenotypes were measured as follows: 1) musical rhythm abilities were measured using the validated self-report item "Can you clap in time with a musical beat?" with Yes or No responses; 2) Hearing difficulty was measured using the self-report item "Do you have any difficulty with your hearing" with Yes or No responses; and 3) Speech in noise was measured through a Digit Triplet Test, which had signal-to-noise ratios ranging from − 12 dB to + 8 dB. Speech reception thresholds were averaged across both ears.

Results: Consistent with our hypotheses, higher musical rhythm abilities (specifically, musical beat synchronization abilities) are significantly genetically correlated with (a) decreased presence of age-related hearing difficulties (rG = -0.0855, SE = 0.0258, p = .0009), and (b) better speech perception in noise (i.e. lower speech reception thresholds) (rG = -0.1258, SE = 0.0339, p = .0002).

Conclusions: Results of the study demonstrate novel genetic correlations between musical rhythm abilities and two hearing traits that are susceptible to decline with natural aging processes, extending previously reported genetic findings. Overall, our study finds foundational evidence for genetic links between complex (non-mendelian) musicality and hearing traits. Findings are consistent with our hypothesis that positive correlations at the population level are partly driven by shared genetic influences. These findings have theoretical implications, and clinical applications for the importance of individuals' musicality profiles (including their genetic predispositions for musicality traits) for their hearing health, especially in aging individuals.

Category: Auditory Processing

Poster #: 006

Relationship Between Cognitive and Auditory Processing in Children with Auditory Processing Disorder

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Objectives: Previous studies published from our lab suggest a lack of correlation between cognitive abilities and basic auditory processing in typical young adults, probably owing to the reduced reliance of young adults on cognitive abilities for resolving complex auditory information. However, whether or not school-aged children (8-13 years) with and without auditory processing disorder (APD) exhibit a relationship between cognitive abilities and basic auditory processing measures is underexplored. To fill in this gap, the current study is investigating the relationship between basic auditory processing and cognitive abilities, in school-aged children, with and without APD.

Design: The current study employs a comparative, cross-sectional design involving 40 children aged 8-13 years, comprising 20 children with APD diagnosis, based on the diagnostic criteria defined by the American Speech-Language-Hearing Association, and 20 age-matched typically developing peers. Auditory processing is being assessed using the dichotic FM, gap detection, and diotic FM testing for temporal fine structure (TFS) sensitivity and spectral modulation, temporal modulation, and spectrotemporal modulation testing for evaluating spectrotemporal sensitivity (STS) within the Portable Auditory Rapid Testing (PART) battery. Cognitive abilities are being measured with the National Institutes of Health (NIH) Toolbox Cognition Battery, administered via iPad. This battery provides a comprehensive assessment of cognitive domains, including executive function, episodic memory, language, working memory, and processing speed. Full audiometric testing is performed using air conduction thresholds and high-frequency testing up to 20,000 Hz to confirm normal hearing sensitivity across a broad frequency range.

Results: The study is ongoing, and results will be reported upon completion. To examine the relationship between each basic auditory processing measure and each cognitive test, a series of correlation analyses will be conducted. To control the potential increase in Type I error, a False Discovery Rate correction will be applied to adjust the target p-value. We predict the presence of a bimodal distribution with stronger correlation between cognitive abilities and auditory processing for children with APD and a rather weaker correlation for those without an APD diagnosis.

Conclusions: Findings from the current study will elucidate the relationship between auditory processing and cognitive function in children (with and without APD). These results will guide clinical decision-making on whether to include cognitive testing as part of auditory processing evaluations in children. The current findings will also guide our current understanding on whether including cognitive components along with auditory components is beneficial toward treatment for APD.

Category: Auditory Processing

Poster #: 007

Hidden Hearing Loss Does Not Impair Behavioral Adaptation to Noise

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Objectives: Adaptation to noise refers to the improvement in word-in-noise recognition as words are delayed a few hundred milliseconds in the noise. This adaptation is thought to reflect adjustments of the dynamic range of auditory neurons to the most frequent noise level. Hidden hearing loss (the occurrence of reduced auditory nerve output in the absence of audiometric loss), impairs neural adaptation to loud sound environments. The aim of the present study was to investigate whether hidden hearing loss impairs behavioral adaptation to loud noise in speech recognition.

Design: Methods. For 89 participants (19-86 years) with normal hearing or mild hearing loss, we measured (1) speech reception thresholds (SRTs; signal-to-noise ratios at 50% recognition) for disyllabic words delayed 50 or 800 ms in stationary, speech-shaped noise; (2) audiometric thresholds at a high frequency of 12 kHz; and (3) auditory brainstem responses (ABRs) for clicks presented at 95 and 110 dB ppeSPL. SRTs were measured for fixed noise levels of 55 and 78 dB SPL by adaptively varying the speech level. Adaptation to noise was calculated as the SRT improvement in the long (800-ms) versus the short (50-ms) delay condition. Because adaptation is known to be greater for vocoded than for natural words, words were processed through a tone vocoder. The amplitudes of ABR wave I for the higher click level and its rate of growth with increasing level (slope) were used as indicators of hidden hearing loss.

Results: Adaptation occurred at the two noise levels but was significantly greater at 78 dB SPL than at 55 dB SPL (2.3 vs. 1.3 dB) because the SRTs in the short delay condition were worse for the 78-dBSPL noise than for the 55-dBSPL noise while the SRTs in the long delay condition were similar for the two noise levels. Adaptation was not correlated with any of the indicators of hidden hearing loss or age, even when the potential confounding effect of hearing loss was removed statistically.

Conclusions: We conclude that although hidden hearing loss may impair neural adaptation it does not impair behavioral adaptation to noise in speech recognition. We further conclude that the greater difficulties of older people understanding speech in noise are unlikely due to impaired adaptation to noise.

Category: Auditory Processing

Poster #: 008

Fine-grained Auditory Temporal Processing Deficits in Adults who Stutter

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Objectives: Speech production errors exhibited by individuals who stutter may be a result of underlying deficits in auditory feedback monitoring (internal models for sensory motor processing). The deficits in auditory temporal processing have been found in individuals who stutter. Temporal fine structure is important for speech perception, more so in presence of noise, as noise smears the temporal envelope of speech. Thus, deficits in temporal processing can manifest as impaired speech perception in noise and none of the studies have looked at speech perception in noise in individuals who stutter. So, the first experiment was aimed at assessing speech perception in noise and perception of auditory chimeras

(weighted temporal envelope and fine structure cues) in adults who stutter. In the second experiment we investigated brainstem encoding of both steady and dynamically changing pitch trajectories in adults who stutter. Frequency Following Responses (FFRs) accurately encodes the F0 of the stimulus, even when it is physically absent in the stimulus referred to as 'missing fundamental', which relies on the precise encoding of temporal periodicity cues. However, electrophysiological studies done to investigate brainstem encoding of sound in individuals who stutter have considered analyzing only the onset responses, but not the fine-grained aspects temporal periodicity encoding.

Design: The first experiment measured speech perception in noise and perception of auditory chimeras in twenty-two adults in the age range of 18 - 26 years, eleven adults who stutter (AWS) and 11 adults who do not stutter (AWNS) using the SNR50-K and custom generated auditory chimeras using sentences.The second experiment measured FFRs in twenty-six adults, thirteen adults who stutter and thirteen who do not stutter for complex tones. The first complex tone (CT) consisted of 1st to 15th harmonic while the complex tone with missing fundamental (CT MF) consisted of 6th to 15th harmonic and had a flat F0 of 100Hz. Another set of complex tones had F0 gliding from 100Hz to 200Hz (referred to as CT & CTMF glides).

Results: Experiment 1: The Bayesian independent samples t-test (BF10) suggested that the lower/better SNR-50 in AWNS (mean = -6.59) (very strong effect) than the tAWS (mean = +0.77) group was 2180 times more likely than the null hypothesis. However, there were no significant differences between the groups in auditory chimera perception.Experiment 2: For the complex tones with steady F0, there was no significant difference between AWS and AWNS in terms of stimulus to response correlation or H1, H2 or H3 amplitudes. However, AWS showed significantly [$F(1,16)=5.74$, $p<0.05$] increased pitch errors for both CT and CTMF glides when compared to AWNS.

Conclusions: The results suggested that AWS needs higher SNR for perceiving speech clearly when compared to AWNS. The error while tracking the pitch was higher in individuals who stutter when compared to individuals who do not stutter as shown by FFRs. In conclusion, the results highlight that individuals who stutter exhibit deficits in encoding of the fine-grained auditory temporal cues, especially rapidly time-varying cues and marked deficits in speech perception in noise.

Category: Auditory Processing

Poster #: 009

Electrophysiological Perspectives on Age-Related Auditory Dysfunction in Older Adults

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Objectives: Objectives: Age-related auditory changes at the cochlear level may impact neural processing across the auditory pathway in the aging auditory system, potentially leading to a decline in speech-in-noise intelligibility in older adults. This study proposes the following specific aims: (1) to explore the potential interrelationship between early and later stages of auditory neural processing in the aging auditory system, and (2) to identify electrophysiological correlates of declines in speech-in-noise intelligibility in older adults.

Design: Design: The study included 30 young normal-hearing adults (YNH, M=21 years), 26 older adults with normal or near-normal hearing (ONH, M=63.9 years) and 26 older adults with age-related hearing loss (OHL, M=72.8 years). Auditory middle latency responses (AMLR) and auditory late latency responses (ALLR) were monaurally and ipsilaterally recorded in separate runs. The synthesized speech /ba/ was presented at 100 dB peSPL in quiet and 12-talker babble noise conditions set at 65 dBA. Pa of AMLR and N1-P2-N2 of ALLR were analyzed and correlated with low-predictability scores of the revised Speech Perception in Noise (R-SPIN-LP) test. The correlations between the Pa component of AMLR and the N1, P2, and N2 components of ALLR were computed for both amplitudes and latencies.

Results: Results: Significant amplitude-based correlations were found in both older groups, but not in the younger group. This suggests that young adults efficiently filter out irrelevant neural information in auditory centers, while there's an information overload in the aging auditory pathway. Latency-based correlations were significant in all groups, indicating the impact of subcortical neural timing on neural transmission time along the auditory pathway. Age-related enhancement of Pa amplitudes and prolongation of N2 latencies were significantly correlated with lower R-SPIN-LP scores in both older groups.

Conclusions: Conclusions: Enhanced Pa amplitudes and prolonged N2 latencies at suprathreshold levels may serve as electrophysiological correlates of age-related declines in speech-in-noise intelligibility. Age-related enhancement of suprathreshold Pa amplitudes may potentially indicate auditory processing deficits at suprathreshold levels. The age-related prolongation of N2 latencies may indicate a slowdown in processing speed for timing information in neural transmission for older adults. Age-related electrophysiological variations in amplitudes and latencies may each reflect distinct neural mechanisms in the aging auditory system.

Category: Auditory Processing

Poster #: 010

Ear Advantage in Reaction Times to Dichotic Tones in Tinnitus

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Objectives: In dichotic listening, listeners generally show higher accuracy and faster responses for the nonverbal stimuli presented in the left ear and for verbal stimuli presented in the right ear. However, for tinnitus patients, the constant perception of noise or ringing in one ear may attract attention to the inputs from that ear, potentially changing such between-ear differences. Therefore, this research aims to investigate whether tinnitus or its laterality impacts ear-level advantages in dichotic listening.

Design: Participants included 28 individuals with (n = 17, mean TFI = 27.15) and without tinnitus (n = 11) who ranged in hearing levels, tinnitus laterality and ages (young control group: mean age = 23.0; young tinnitus group = 25.8; old tinnitus group = 63.8). Participants conducted a go/no-go paradigm under left ear, right ear and dichotic conditions. The targets ('go' stimuli) were: a high-frequency B6 tone in the left ear (single target), a high-frequency G6 tone in the right ear (single target), B6 and G6 tones in both ears (dual targets). The distractors ('no-go' stimuli) were: a low-frequency C#5 tone in the left ear, a

low-frequency A4 tone in the right ear, all other stimulus combinations between low-frequency and high-frequency tones in both ears. Participants were instructed to press a button to targets and suppress their responses to distractors as quickly and accurately as possible. Reaction times and accuracy were measured. Because accuracy exceeded 90% for all participants, our analysis focused on reaction times. Cox proportional hazard regression model for each individual was used to determine between-ear differences by comparing the reaction times to single-target stimuli in one ear against dual-target stimuli in both ears. The Cox PH model has been well established for time-to-event analysis, particularly in this study where the event is the completion of processing musical notes on each trial. It can also provide an insightful analysis of the time course of the ear advantage.

Results: In many cases, participants demonstrated faster response times in one ear when listening to dichotic sounds, but only part of them showed a statistically significant ear advantage. For individuals without tinnitus, 36.4% (n = 4) showed a significant left ear advantage, 27.2% (n = 3) showed a significant right ear advantage and 36.4% (n = 4) show similar performance between ears. Among individuals with tinnitus, such distribution is: 35.3% (n = 6), 5.9% (n = 1) and 58.8% (n = 10), respectively. All participants showed dynamic changes in the ear advantage over time: the extent of ear advantage tended to decrease over time or alternated between right and left ears. Furthermore, for most tinnitus patients (n = 11), the ear advantage is not consistent with their tinnitus laterality.

Conclusions: Findings indicate that tinnitus laterality does not change the between-ear difference in processing efficiency of dichotic pairs of pure tones, which is in contrast to previous work that reported the right ear advantage for speech in noise in tinnitus patients. This research may support future studies on efficient tinnitus musical interventions with binaural or monaural approaches.

COCHLEAR IMPLANTS

Category: Cochlear Implants

Poster #: 011

Early Cochlear Implant Outcomes Predict Long-Term Speech Recognition: Part I

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Objectives: While cochlear implants (CI) are the standard treatment for moderate-to-profound sensorineural hearing loss, speech recognition outcomes remain highly variable. Identifying predictors of long-term outcomes early in the rehabilitation process is critical to guide clinical decision making for individual patients. Part I of this two-part study examines the value of including 1- and 3-month post-CI speech recognition scores to models predicting 12-month outcomes, compared to using preoperative information alone.

Design: In this retrospective analysis, we assessed 361 adult CI users with a post-lingual onset of bilateral hearing loss who were implanted between 2013 and 2021 at a single academic center. Demographic factors (age, duration of deafness) and speech recognition scores (CNC words) were obtained pre-CI and 1-month, 3-months, and 12-months post-CI. We compared nested logistic regression models that predicted whether CI users improved CNC scores at 12-months post-CI; with improvement defined as a CNC score increase exceeding the 95% confidence interval compared to pre-CI CNC score. Model A (pre-CI CNC), Model B (pre-CI CNC, 1- or 3-month CNC), and Model C (pre-CI CNC, 1- or 3-month CNC, age, duration of deafness) were evaluated using sensitivity and specificity at classification cutoffs that maximized Youden's index from receiver operating characteristic curves.

Results: CI users were grouped into those who did or did not improve by 1-month post-CI. Among the non-improvers (42.0%), lower pre-CI CNC scores (p=0.006) and higher 1-month post-CI CNC scores (p=0.007) predicted improvement by 12 months. Age and duration of deafness did not independently correlate with CNC improvement. There were no significant individual predictors of CNC improvement among patients who did not improve by 3 months post-CI (29.0%). Nearly all CI users who improved by 1 month (98%) or 3 months (96%) maintained their improvement status through 12 months. Next, we evaluated the performance of logistic regression models using 1-month post-CI data to predict CNC improvement at 12-months post-CI. Compared to Model A, at the Youden-optimized cut off, Model B slightly decreased sensitivity (83.1% vs. 78.7%), but substantially improved specificity (63.9% vs. 94.0%). After adding age at implantation and duration of deafness as covariates, Model C had a sensitivity of 81.5% and specificity of 89.2%. Using the 3-month post-CI CNC data, Model C achieved the greatest sensitivity (A: 82.8%, B: 87.2%, C: 88.6%) and Model B achieved the greatest specificity (A: 64.4%, B: 90.4%, C: 85.9%).

Conclusions: Adding early post-CI speech recognition scores improved predictions of long-term outcomes compared to models using pre-operative factors alone. These findings underscore the clinical importance of obtaining early speech recognition scores at 1-month or 3-months post-CI. Specifically, these models

may help identify CI patients early who are at risk of not improving and may need additional resources (e.g., auditory training, advanced programming, increased datalogging) to obtain optimal benefit. In Part II, we will apply this model to an independent dataset from another institution to validate its predictive ability.

Category: Cochlear Implants

Poster #: 012

The Influence of Spectral Tilting to Speech Quality for Cochlear Implant Users

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Objectives: Cochlear implant (CI) users may exhibit preferences in terms of perceived quality when listening to speech that may not be captured by common clinical tests based on speech recognition performance. The current study investigates the sensitivity of the speech quality ratings from CI users to spectral modifications.

Design: Adult CI users were recruited for the current study. All participants had at least 12 months of experience with their CIs. Stimuli were presented to the participants using a research Nucleus 8 processor programmed to the participants MAPs with advanced signal processing disabled (ex: Autosensitivity control, noise reduction etc.). AzBio sentences were presented through direct audio input (DIA) using the MiniMic2+ and a Surface-Pro tablet. Using a custom user interface, each participant first adjusted the overall volume of example AzBio sentences to "loud but comfortable". Participants then completed a blind quality rating task for AzBio sentences under four different spectral filtering conditions. The four conditions included a Reference condition (no filtering), an Anchor condition (energy above 500 Hz removed, designed to provide a low-quality example), a Tilt-Up condition (rising gain at 3 dB/octave), and a Tilt-Down condition (falling gain at 3 dB/octave). On each trial, the participants listened to the same AzBio Sentence under each of the four conditions and rated the quality from poor (0) to excellent (100). Once ratings for all four conditions were submitted, another trial began, until a minimum of 10 trials were completed. For a subset of participants, additional ratings were completed with greater degree of spectral tilt for the Tilt-Up and Tilt-Down conditions (□6 and/or □□ dB/octave). Additionally, equal-loudness contours between 250 and 8000 Hz were estimated using a categorical loudness scaling procedure, where participants provided categorical ratings on the loudness of narrowband stimuli (pure tones and 1/4-octave band-limited noises).

Results: Not all participants rated the Tilt-Up and Tilt-Down conditions as having a lower quality compared to the Reference conditions, even when the degree of spectral tilt was as high as 9 dB/octave. Between the Tilt-Up and Tilt-Down conditions, most participants rated one of them as higher given a sufficiently high degree of spectral tilt. However, the preference for the Tilt-Up versus Tilt-Down conditions was inconsistent among participants and could not be predicted by the slope of the estimated equal-loudness contours.

Conclusions: The perceived sound quality by CI users is relatively robust against modest spectral modifications. The current quality rating procedure enables efficient perceptional comparisons across

multiple signal processing adjustments, offering valuable insights for optimizing CI MAPping and fine-tuning.

Category: Cochlear Implants

Poster #: 013

Cue Weighting by Cochlear Implant Patients for Emotional Prosody Identification

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Objectives: Cochlear implant (CI) recipients have limited access to voice fundamental frequency (F0) information, which in turn is thought to limit their perception of emotional prosody. However, emotional prosody includes other cues, such as duration (speaking rate) and intensity (loudness), which are less reliable but can still be useful if F0 cues are not salient. Our primary objective was to quantify CI recipients' weighting of F0 contours, duration, and intensity cues to identify if an utterance sounded "happy" or "sad", and to compare their cue-weightings to those of typically hearing counterparts. We hypothesized that CI recipients would weigh F0 contour cues less strongly and duration/intensity cues more strongly, compared to typically hearing listeners. A second objective was to compare cue-weightings of prelingually deaf, pediatric CI recipients (implanted by 3 years of age with no experience of usable acoustic hearing) with those of postlingually deaf, adult CI recipients. The adults with CIs had extensive experience with acoustic hearing prior to hearing loss and cochlear implantation. In contrast, prelingually deaf CI recipients gained experience with sounds and speech exclusively through their CIs. We hypothesized that the two populations' different exposure to salient acoustic F0 cues and their different developmental stages might result in different cue-weightings for emotional prosody.

Design: The stimuli were based on an original recording of the sentence "Time to go" produced by an adult female talker in a happy way or a sad way. A set of 125 versions of this sentence was created to have five F0 contours (varying systematically from "happy" to "sad", with F0 values spaced evenly in a logarithmic space). Each of these F0 contours had five durations (shorter durations presumedly associated with the "happy" emotion, longer durations with the "sad" emotion), and five intensity levels (softer sounds presumedly associated with the "sad" emotion, and louder sounds with the "happy" emotion). Participants listened to each of these 125 versions (randomized order) and indicated whether it sounded "happy" or "sad". The results were analyzed using logistic regression methods. Participants were 28 prelingually deaf pediatric CI recipients (school-age except for two young adults), 14 postlingually deaf adult CI recipients, 23 children with typical hearing (school age), and 43 adults with typical hearing (age range comparable to adult CI participants). CI users were tested while listening only with their earlier implanted device.

Results: Results showed that typically hearing adults used F0 contours significantly more than adults and children with CIs. The adults with CIs used duration cues similarly to typically hearing adults, while the prelingually deaf children with CIs used duration cues less than typically hearing adults and typically hearing children. Developmental effects in cue-utilization were observed in both typically developing children and in children with CIs. Intensity cues were not used significantly by any of the four groups.

Conclusions: For the happy-sad contrast in this study, postlingually deaf adults and prelingually deaf children with CIs used dynamic F0 contour cues significantly less than did typically hearing adults. Developmental effects were observed in cue-utilization of both F0 contour cues and duration cues in both children with CIs and typically hearing children.

Category: Cochlear Implants

Poster #: 014

Impact of CI Channel Interaction on Speech and Timbre Identification

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Objectives: Despite advances in cochlear implant technology, recipients still face challenges in processing complex sounds in real-world environments, particularly in understanding speech amid background noise and appreciating music. These difficulties can be attributed to device artifacts, such as adjacent channel interaction. However, the extent to which distorted signals from neighboring electrode channels affect speech-in-noise perception and timbre identification in adult users remains unclear. This study aims to investigate the impact of unwanted channel interaction on fine spectral resolution. We hypothesize that adult cochlear implant users will show significant improvement in speech-in-noise perception and timbre identification when channels with high interaction are selectively deactivated.

Design: This was a prospective study involving 10 adult Advanced Bionics cochlear implant ears. Focused stimulation thresholds were measured for electrodes 2 through 15 using a forward and backward sweep procedure, identifying the electrodes with the highest thresholds as those likely experiencing the most significant channel interaction. An experimental map was created by deactivating these high-threshold electrodes, while the participants' standard clinical map served as a control. The acclimation period for the experimental map was set at 20 minutes. Participants completed speech (vowels, IEEE) and music tests (CAMP Timbre Task) using both the clinical and experimental maps in a randomized order. The timbre test involved identifying eight different musical instruments, representing the four main instrumental classes.

Results: There was no statistically significant difference in performance with vowel recognition in noise, speech perception in noise under challenging, or timbre identification when using the experimental map compared to the clinical map. Study participants performed worse with the experimental map with sentence recognition in noise under the easier condition (Mean Difference: -18.2%; 95% CI: -7.02 to -29.4%; p=.005). Subgroup analyses revealed no difference between the two programming maps on individual instrument identification or instrument classes.

Conclusions: Adult cochlear implant users do not seem to experience significant benefits from reduced channel interaction in the acute setting through selective channel deactivation. These findings may be influenced by several factors, including the limited acclimation period, the small sample size, and individual differences at both the electrode-neuronal interface and the level of neuroplasticity.

Category: Cochlear Implants

Poster #: 015

Longitudinal Speech Recognition Outcomes in Older Cochlear Implant Recipients

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Objectives: Elderly populations are now increasingly more likely to undergo cochlear implantation, as life expectancy and hearing loss prevalence has increased. While age at implantation alone may not be a factor in cochlear implant (CI) candidacy or post-operative performance, little is known regarding how age may affect the ability to adapt to a CI. It is well established that the average time to peak post-operative speech recognition with a CI is approximately 6 months of consistent device use. However, these previous findings have focused on data from younger adults. The aim of this study is to examine the time it takes elderly adults to reach peak post-operative consonant-nucleus-consonant (CNC) word performance with a CI. It is hypothesized that elderly patients will take longer to adapt to their CI compared to younger cohorts.

Design: A retrospective review was completed on patients who underwent cochlear implantation between 2022 and 2024. Patients aged 80 years and older (M=84, SD=4, range=80-93) at activation were classified in the older adult group, whereas patients 75 years and younger (M=59, SD=14, range=27-72) served as a younger adult control group. Patients with prelingual hearing loss onset, retrocochlear pathology, or history of CI revision were excluded from the study. CNC monosyllabic word recognition scores and demographic factors were collected. CNC word scores were compared in the CI-alone condition at 1 month, 3 months, 6 months, and 12 months post-activation within and between groups to determine time to peak CNC performance.

Results: Preliminary results in 16 older adults (≥ 80 years old) suggest that these patients reach their peak CNC word recognition scores later in the first year of activation than younger adults (< 75 years old). Greatest CNC performance in older adults was noted by 12 months post-activation, whereas younger adults demonstrated peak performance by 6 months. For patients< 75 years old, the greatest improvement in performance was observed within the first 6 months following activation. Despite the

difference in timelines for peak performance, there was no trending difference in peak CNC word scores between patient groups.

Conclusions: This study indicates that older adults aged ≥ 80 years may require a longer adaptation period with their CI to reach peak post-operative speech recognition. Continued aural rehabilitation during the first year post-activation is necessary to promote patient success as they adapt to their devices. Although continued research is needed, these results suggest that older adults may require additional post-operative clinician support in the form of supplemental appointments. This population should be appropriately counseled regarding realistic expectations and timelines, which seemingly may differ from younger cohorts.

Category: Cochlear Implants

Poster #: 016

The Effects of Simulated Current Spread on Binaural Fusion

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Objectives: Binaural fusion reflects the ability to fuse signals delivered to the two ears into a single auditory percept. Studies have demonstrated that cochlear implant users are less sensitive than normal hearing listeners to the detrimental effects that interaural place mismatches have on binaural fusion. This has been hypothesized to reflect the broader spread of excitation that occurs because of the broadly spreading nature of electrical stimulation. To determine if the broader spread of electrical stimulation may provide protection against the detrimental effects of interaural place mismatches, normal hearing listeners were tested with a vocoder where simulated current spread was manipulated. Experiment 1 investigated if the detrimental effects of interaural place mismatches on perceived binaural fusion were reduced in the presence of increased simulated current spread. Experiment 2 investigated if increased simulated current spread altered the effects of another manipulation that detrimentally affects binaural fusion: decreased interaural coherence (i.e., the statistical similarity of the signal delivered to the two ears).

Design: Stimuli for both experiments were generated with a noise vocoder where the bandwidth of the noise was systematically varied, simulating different magnitudes of current spread. In Experiment 1, the spectral peak of the stimulus varied across ears to manipulate interaural place mismatch. In Experiment 2, the interaural coherence of the envelopes of the stimulus were varied. Binaural fusion was measured by having participants indicate the number, size, and lateralization of the perceived auditory image(s). Participants were presented with an image depicting a head with a small oval in the center. By turning a dial, they could alter the size and number of the oval(s) to indicate perception of a punctate auditory image, a diffuse auditory image, or two separate auditory images, one near each ear. By pushing down and turning the dial, they could also indicate the lateralization of the perceived auditory image.

Results: In Experiment 1, binaural fusion degraded with increased interaural place mismatch, but at a slower rate when simulated current spread was broader. In Experiment 2, binaural fusion decreased

with decreasing interaural coherence. However, the magnitude of simulated current spread had little to no impact on the effects of interaural coherence on binaural fusion.

Conclusions: The results support the hypothesis that increased current spread protects against some of the detrimental effects of interaural place mismatch on binaural fusion. However, the results suggest that increased current spread does not alter the effects of interaural coherence on binaural fusion.

Category: Cochlear Implants

Poster #: 017

Sentence Recognition Progression in Elderly Cochlear Implant Users

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Objectives: As the elderly population (>80 years of age) is rapidly increasing, and candidacy guidelines for cochlear implantation continue to expand, evidence is needed to inform clinical counseling and decision making for this group. Current evidence suggests that cochlear implant (CI) users with an average age of 60 often reach peak speech perception between three- and six-months post-activation. However, in elderly patients, one might expect that the age-related changes in auditory pathways and central function may require a longer adaptation period to optimize speech understanding. The aim of this study is to identify the amount of time for elderly CI users to reach their peak open-set sentence perception. It is hypothesized that elderly CI patients aged 80 years and older require a longer period of time to reach peak speech understanding in the bimodal (hearing aid and cochlear implant) condition compared to younger adults.

Design: A retrospective chart review was conducted on bimodal CI patients implanted at our center between 2021 - 2023 aged 80 years and over and 75 years and younger at initial activation who were post-lingually deafened. In preliminary data analysis, 11 subjects >80 years of age at initial device activation and 9 young control subjects <75 years of age at initial device activation who met criteria were selected for analysis. AzBio sentence scores in quiet in the bimodal condition were assessed at 1-, 3-, 6-, and 12-months post-activation.

Results: Preliminary data analysis showed no significant differences between the elderly group and control group for 1- , 3- , or 6- months. There was a significant difference noted at 12 months, with control patients demonstrating significantly better AZ Bio performance than those 80+ ($t=9.90$, $p=.005$). While no significant differences have been previously reported between older and younger adults on standard speech perception tasks, our data suggest that peak performance may be achieved later in the elderly cohort. Data collection is ongoing, and future analyses will include a larger cohort and may include data that extends beyond 12 months to assess longer-term outcomes.

Conclusions: These preliminary results suggest elderly cochlear implant users have lower speech perception performance at 12-months post-activation than younger patients. They may require more than 12 months, potentially up to 18- to 24-months, to fully adapt to their devices. The significantly

poorer performance of the elderly group compared to the control group at 12-months post-activation suggests the need for adjusted expectations regarding rate of progress for this population. Clinicians should consider adjusting counseling and follow-up care to reflect the slower progression. These findings may lead to altered management protocols in those >80 years, such as extended follow-up and ongoing auditory training to further promote progression of speech perception beyond the 12-month post-activation mark.

Category: Cochlear Implants

Poster #: 018

Impairments in Visuospatial Memory, Spatial Hearing, and Dynamic Balance Measured with Novel Tools in Children with Cochlear Implants

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Objectives: The present data were collected at the initial stages of a larger study which aims to assess the potential of repetitive learning to improve visuospatial memory, spatial hearing, and dynamic balance in children with cochlear implants (CIs) and varying degrees of vestibular impairment (VI) over the course of a 5-day summer camp. Hypotheses for initial data are that, prior to training, children with concurrent hearing, vestibular, and balance impairments have challenges in tasks of visuo-spatial perception, spatial hearing, and balance relative to typically developing peers.

Design: A total of 54 children (ages 5-13 years) participated in this study. Children using cochlear implants (n=21, mean(SD) age= 10.30 years (2.74)) and children who were typically developing (n=19, mean(SD) age= 9.71 years (2.51)) participated in a 5-day training program held at a summer day camp. Another group of 14 children who were typically developing (mean (SD) age = 8.34 years (2.29)) attended the same summer camp but were not involved in daily training. On the first day of camp, all children completed baseline (start of Day 1) and endpoint (end of Day 5) tests of vestibular and balance function: dynamic visual acuity (DVA), the subjective visual vertical (SVV), and the Bruininks-Oseretsky Test of Motor Proficiency (BOT) balance subtest. Children in the training groups engaged in tasks designed to target visuospatial memory, spatial hearing, and dynamic balance each day for 5 days but only data from day 1 are presented here. Visuospatial memory was assessed using a virtual Morris Water Maze videogame. Spatial hearing was evaluated by measuring auditory lateralization to the left or right side of headphones, with varying interaural level differences (ILDs) and interaural timing differences (ITDs). Dynamic balance and postural stability on a unidirectional rockerboard with and without visual cues were measured through a gyroscope.

Results: The DVA and BOT were impaired in the children with bilateral cochlear implants compared to typically developing peers (DVA: ($F(3) = 11.79$, $p<0.01$); BOT: ($F(3) = 19.72$, $p<0.01$) but there were no significant SVV differences between groups. Within the cochlear implant group, balance ($t(46) = 4.23$, $p<0.01$) and the DVA ($t(46) = -4.82$, $p<0.01$) were significantly poorer in the children with vestibular impairments than in children with hearing loss alone. Children with hearing loss had more challenges

balancing on the rockerboard than children with normal hearing ($F(1) = 10.81$, $p<0.01$) which further worsened in the presence of concurrent vestibular ($F(1) = 20.02$, $p<0.01$) and balance impairments ($F(1) = 12.46$, $p<0.01$). Children with hearing loss took significantly longer than normal hearing peers to complete the visuospatial videogame ($F(1) = 8.67$, $p<0.01$) and their performance tended to worsen in the presence of concurrent vestibular impairment ($t(1) = 3.33$, $p=0.07$). There were no significant group differences for lateralization of ILDs ($F(2) = 2.58$, $p =0.09$).

Conclusions: Spatial perception and balance in children with hearing loss deficits were confirmed using novel tasks administered at a summer day camp and revealed the added impact of vestibular and balance impairments. The mobility of these tools for use outside the clinic or laboratory provides an important new way to test children's spatial abilities as well as to explore the potential for training effects.

Category: Cochlear Implants

Poster #: 019

Social and Communication Experiences of High vs Low CI Usage CI Listeners

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Objectives: Cochlear implants (CIs) significantly improve hearing and communication abilities for individuals with moderate-to-severe hearing loss, but vast unexplained individual differences in CI outcomes remain. Datalogging is a feature that tracks device usage patterns and auditory environments to help professionals improve hearing outcomes. Previous studies have shown that patients with early CI use with datalogging beyond 12 hours a day achieve better speech recognition scores in quiet environments. However, predicting long-term outcomes for post-lingual cochlear implant patients remains difficult, as there is limited understanding of the experiences and outcomes of patients with low early CI wear time. Integrating objective datalogging with subjective experiences could help clinicians identify patients at risk for poor long-term CI performance. This research aims to investigate the relationship between the actual device wear time in different listening environments and self-reported quality of life and communication abilities. We hypothesize that CI users with higher wear times 1) experience a greater variety of complex auditory and social environments, also assessed through datalogging, compared to CI users with lower wear time and 2) report better outcomes on subjective measures of communication abilities and quality of life.

Design: Datalogging was obtained from 28 post-lingually deafened adult CI users at 1- and 3- months post-CI activation. Participants also completed the following self-report questionnaires assessing social isolation, aural rehabilitation, and hearing-related quality of life (Cochlear Implant Quality of Life; CIQOL-35). To compare outcomes between low and high usage participants, the twenty-eight participants were

divided into two groups based on the overall group median CI usage (12.9 hours per day) during the first month of activation. Datalogging and self-report questionnaires were evaluated across groups at each time point.

Results: Participants in the low CI usage group (average of 8.96 hours of use a day) encountered a more limited range of listening environments, spending only 35% of their usage time in complex listening settings. In contrast, participants in the high usage group (average of 14.03 hours of use a day) spent over 44% of their time in environments with speech in noise, general noise, or music. Additionally, participants in the low usage group had higher social isolation scores, suggesting lower overall social participation. These participants also completed fewer aural rehabilitation activities and did not use assistive listening devices. At the three-month mark, self-reported data indicated that low-usage participants had a lower average emotional score (55.6) on the CIQOL compared to the high-usage group's average score (62.9). Additionally, low-usage participants reported less improvement in listening abilities on the rehabilitation questionnaire.

Conclusions: These findings provide preliminary evidence that individuals with higher total CI usage time also have more variable auditory and social experiences, and report better early outcomes shortly after activation. This may provide a more holistic understanding of device use and qualitative differences in the everyday environments of adult CI users, and the relationship of these qualitative experiences with subjective outcomes. A more comprehensive understanding of the everyday experiences of CI users may help clinicians predict patient success and inform rehabilitation and counseling approaches.

Category: Cochlear Implants

Poster #: 020

Impact of Tonotopic Preservation on Cochlear Implant Performance

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Objectives: The use of electrocochleography (ECochG) during cochlear implantation has become a growing research topic to assess cochlear health, optimize cochlear implant (CI) performance, and support hearing preservation efforts after implantation. While much of the previous research focuses on using ECochG as a measure of cochlear health (ECochG-total response) or as a tool for hearing preservation, the potential value of ECochG tonotopic patterns has recently become a topic of interest. Intracochlear ECochG responses, recorded across the fully-inserted CI electrode array, offers a unique opportunity to explore the impact of the electrode array on cochlear mechanics. We have observed patients that exhibit tonotopic ECochG patterns, where peak amplitudes align with tonotopic frequency regions (e.g., 250 Hz peaking at the apex and 2000 Hz at the base), while others show non-tonotopic patterns with unpredictable peak locations. We hypothesized that tonotopic patterns of cochlear

activation following electrode insertion would be associated with better cochlear implant performance and that non-tonotopic patterns could be modified to tonotopic patterns with a simple, electrode pull-back. This study aimed to (1) investigate the impact of cochlear activation pattern (tonotopic vs non-tonotopic) on performance and (2) determine if non-tonotopic patterns can be modified to a tonotopic pattern by electrode pull-back.

Design: Intracochlear ECochG measurements were obtained immediately after electrode insertion from 77 CI users implanted with the CI632 electrode array using an electrophysiologic research platform (Cochlear Ltd, Lane Cove, AUS). ECochG responses were recorded on all electrodes in response to ~100 dB SPL stimuli for frequencies of 250, 500, 1000, and 2000 Hz. For each participant, the electrode with the highest ECochG amplitude at each frequency was identified as the best frequency (BF) electrode, generating a unique cross-electrode pattern that was classified as either tonotopic or non-tonotopic. These patterns were then correlated with speech perception scores including: CNC word, AzBio Sentences, and AzBio Sentences in Noise (+10 dB SNR) at 6-months post-activation. In a separate cohort of 36 subjects, the impact of pull-back after over-insertion of the electrode was evaluated using ECochG.

Results: Of the 77 subjects, 45 (58%) exhibited a tonotopic pattern following array insertion, while 32 (42%) exhibited a non-tonotopic pattern. Subjects with a tonotopic pattern demonstrated superior speech perception scores on all measures: CNC word (mean difference: 8.2%; 95% CI: 2.3-14.7%), AzBio sentences in quiet (mean difference: 11.3%; 95% CI: 6.2-16.3%), and AzBio sentences in noise (mean difference: 11.4%; 95% CI: 3.2-11.8%) compared to those with a non-tonotopic pattern. In a separate cohort of 36 subjects with non-tonotopic patterns, we performed a pull-back maneuver after full insertion to achieve a more perimodiolar electrode location. This adjustment successfully converted the sweep pattern to tonotopic in 23 subjects (63.9%).

Conclusions: A tonotopic activation pattern on ECochG across the CI electrode array significantly influences postoperative CI performance in patients with a perimodiolar array. Taken together with the finding that electrode pull back can convert non-tonotopic patterns to tonotopic suggests that electrode locations, closer to the modiolus, are superior for this device. Ongoing research is using imaging and cochlear health measures to better understand the impact of intracochlear electrode location on performance.

Category: Cochlear Implants

Poster #: 021

Transcranial Direct Current Stimulation and Auditory Training in Adults with CI

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Objectives: Auditory performance with a cochlear implant (CI) results from a combination of bottom-up and top-down neural processes by a sound deprived brain in response to a novel electrical input. Hearing results are extremely variable across the adult CI population and only a small portion of this variability is understood. Though thought to be generally helpful in improving functional results, auditory

rehabilitation is not consistently beneficial in improving speech perception. Neuroplasticity and learning processes within the central nervous system likely play a central role in auditory rehabilitation with a cochlear implant. The generation of new synaptic connections that arise with enhanced afferent input and engagement with practice protocols are likely the basis of improved speech understanding and other improvements in auditory perception in quiet and in noise. Transcranial direct current stimulation (tDCS) is a form of non-invasive brain stimulation that has shown potential as an adjunct to rehabilitation following stroke and surgical learning. tDCS is thought to work by facilitating neuroplasticity in targeted brain regions. We designed a study to evaluate the safety and feasibility of pairing self-administered tDCS at home with computer-based auditory rehabilitation training and practice in a small cohort of adults with CI.

Design: Adult subjects with unilateral or bilateral severe to profound sensorineural hearing loss and at least one year of CI experience were invited to participate in this study if their speech perception results were less than 65% on sentences and 75% for words. Subjects were fitted with a headband with integrated electrode pads positioned over the parietal region contralateral to the CI (anode) and the forehead ipsilateral to the CI (cathode). Participants were provided with a pre-programmed low-current stimulator (2.0-2.5 mA) and taught how to safely administer daily sessions of tDCS coinciding with assigned computer-based auditory rehabilitation. These sessions occurred daily for 5 days during the week for a total of 20 days. Following in-person training in the lab, home-based treatment sessions were initially monitored remotely using video conferencing, and then performed independently. Daily logs captured any new symptoms or concerns regarding CI performance. Device function, speech perception performance, and subject experience were captured at the end of the first month and again at 6 months.

Results: 127 subjects were eligible to participate in the study and 111 were invited, of which 8 consented. 6 subjects completed one month of treatment and 5 subjects completed the study. There were no reports of altered CI device performance as demonstrated by functioning CI electrodes (none shorted or open from baseline) and speech perception scores. There were some reports of transient mild discomfort at the stimulation site at the beginning of tDCS-a known side effect of tDCS-and there were no adverse events. Speech perception scores were stable across the three study visits.

Conclusions: Preliminary observations suggest that tDCS is safe in terms of integrity of the cochlear prosthesis and patient health. Overall, the protocol combining computer-based training and tDCS at home is feasible for patients using a CI. These multi-modal intervention framework and pilot experience can inform future large-scale studies.

Category: Cochlear Implants

Poster #: 022

Electrically-evoked CAPs in CI Users: Evidence of Peripheral Plasticity?

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Objectives: The purpose of this retrospective study is twofold: (1) to develop an objective analysis tool of electrically-evoked compound action potential (eCAP) growth functions and (2) to characterize these responses in a large clinical database of 7,416 Advanced Bionics cochlear implant (CI) users.

Design: Two models were developed using either a piecewise linear function or a logistic function and non-linear fitting procedure to extract the noise floor, threshold, slope and plateau of 169,159 eCAP growth functions obtained from 10,111 CIs. Fitted eCAPs were then characterized as a function of age, sex, electrode location and CI usage duration.

Results: Both models could successfully fit ~80% of eCAP growth functions. While eCAP N1 and P2 peak latencies remain constant across cochlear location, thresholds varied non-monotonically as a function of electrode placement. Growth function slope and plateau values decreased from from apical to basal electrode locations, varied non-monotonically as a function of age and increased with CI use duration in pediatric patients and young adults (<25 y.o.). Changes in growth function plateau were similar to those on growth function slope. Older patients, on the other hand, saw a decline in eCAP growth function with CI usage duration.

Conclusions: This study provides unparalleled statistical power to analyze the in vivo responses of the spiral ganglion neurons from pediatric patients to elderly populations. The interaction of age at implantation and duration of CI use on eCAP characteristics in young children suggests a plasticity of the auditory nerve in response to electrical stimulation that may lead to benefits in hearing outcomes with early implantation of congenitally deaf children.

Category: Cochlear Implants

Poster #: 023

Enhancing Speech Recognition Testing Efficiency with Rasch Measurement Theory

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Objectives: This study aimed to evaluate the feasibility of short forms and computerized adaptive testing (CAT) to efficiently measure speech recognition ability. Specifically, it tested the fit of the Rasch measurement model to item responses from NU-6 word lists and assessed whether short forms and CAT could maintain measurement precision without compromising accuracy.

Design: Cross-sectional study involving 50 participants (average age 71 years, 70% female) with mild to moderate hearing loss. Participants underwent word recognition testing using two, 50-word NU-6lists. The Rasch measurement model was applied to these word lists to evaluate unidimensionality, item and person fit, and person reliability. Short forms were created by identifying and removing redundant

words, and CAT simulations were conducted to determine the optimal number of words needed for accurate measurement. Pearson correlations and average standard error (SE) were used to compare person measures from short forms and CAT with those from the full word lists.

Results: The NU-6 word lists were unidimensional with negligible number of misfitting words and persons, and person reliability. Two short forms were developed for each list, containing 19 and 11 words. Person measures from the 19-word short forms showed a high linear association with measures from the full word lists (list 1: $r=0.92$, $p<0.0001$, SE 0.76; list 2: $p=0.91$, $p<0.0001$, SE 0.74), while the 11-word short forms had a moderate association (list 1: $r=0.84$, $p<0.0001$, SE 0.99; list 2: $p=0.81$, $p<0.0001$, SE 0.97). Person measures from CAT simulation reached a correlation threshold, $r>0.90$, after 15 to 20 words were administered for both lists. A precision-based stopping rule used an average of 18 (list 1) or 20 (list 2) words. During the presentation, we will also share results from the application of these same Rasch analyses to word, sentences in quiet, and sentences in noise in 50 adult CI users. Moreover, we will discuss the potential of combining word and sentence material into a single speech construct to furt

Conclusions: Short forms with 19 words and CAT can measure speech recognition with high accuracy and precision, significantly reducing the burden on both clinicians and patients. The study supports the use of Rasch measurement model for developing efficient speech recognition tests and highlights its role in personalizing and streamlining the assessment process. These findings have important clinical implications, suggesting that speech recognition measurement can be made more efficient without sacrificing precision, thereby enhancing the overall audiological evaluation and treatment planning.

Category: Cochlear Implants

Poster #: 024

Phonological Reading and Executive Functioning in Adults with Cochlear Implants

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Objectives: Little research has been conducted concerning the interaction between phonological reading skills (the ability to recognize and manipulate the sounds of language) and executive functioning (a set of processes that are necessary for the cognitive control of behavior) in adults with hearing loss. The current study examined the potential association between phonological reading skills, hearing loss, and executive functioning in post-lingually deaf and hard of hearing adults who use cochlear implants. Two hypotheses were tested: 1) adult cochlear implant users have weaker executive functioning and phonological reading skills compared to their hearing peers; 2) adults with hearing loss who use cochlear implants will rely on executive functioning more to complete phonological reading tasks when compared to the typically hearing group of participants.

Design: Thirty-one post-lingually deafened older adults with cochlear implants (CIs) and 43 peers with age-typical hearing (TH) completed measures of phonological reading skills from the Test of Word Reading Efficiency (TOWRE-2) and measures of executive functioning skills from The Learning, Executive and Attention Functioning Scale (LEAF).

Results: A one-tailed t-test revealed that the Hearing group had significantly higher scores than the adults with cochlear implants on the TOWRE-2 Test ($t(69) = 1.96$, $p = .03$). However, there were no significant group differences on subscales of the LEAF, suggesting that participants across groups self-reported comparable levels of executive functioning. Scores on the basic reading skills subtest from the LEAF were negatively correlated with non-words correct from the TOWRE-2 Test for the Hearing group ($r(38) = -.37$, $p = .02$). In contrast, the measures of executive functioning from the LEAF did not correlate with the TOWRE-2 phonological reading tasks for the adults with cochlear implants.

Conclusions: Overall, these findings suggest that neither group of adults used executive function skills during the phonological reading test. The hearing adults used phonics skills to make sense of non-words but adults with cochlear implants did not. These findings contribute to our understanding of hearing loss and phonological reading skills. Future studies are needed to investigate potential barriers to phonological processing and reading in children with dyslexia and hearing loss.

Category: Cochlear Implants

Poster #: 025

Voice Cue Weighting for Gender Identification Impacts Speech Recognition

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Objectives: Voice pitch (fundamental frequency, f0) and resonance (operationalized as vocal tract length, VTL) are important acoustic cues for social and linguistic perception. Adults with normal hearing (NH) use both f0 and VTL to identify a talker's gender based on their voice and can use f0 and VTL in speech-on-speech recognition to segregate the target from masking talker. In contrast, cochlear implant (CI) users do not consistently benefit from differences in f0 and VTL between the target and masking talkers. Whereas traditional auditory measures fail to predict speech-on-speech masking performance in CI users, cue weighting has not yet been investigated. Notably, adult CI users and NH listeners use voice cues to differently to categorize gender: CI users rely primarily on f0, whereas NH listeners use both f0 and VTL. The objective of this study was to identify the association between voice cue weighting for gender identification and performance on a speech-on-speech masking task in NH listeners under CI simulation.

Design: Nineteen NH adults performed a gender identification task and a speech-on-speech masking task. Auditory stimuli for the gender identification task consisted of hVd words synthesized to have one of six f0 values and one of six VTL values (to yield 36 possible f0 x VTL combinations). Listeners heard all synthesized voices in a non-vocoded condition and processed through a 16- and 4-band noise vocoder. In the speech-on-speech masking task, sentences were paired and processed using the same synthesis and vocoder parameters as in the gender identification task. Target/masker pairs were presented at 6 different signal-to-noise ratios and manipulated such that the primary cue available for talker segregation was f0, VTL, both, or neither. Voice cue weights for f0 and VTL were calculated separately for each participant based on performance in the gender identification task. Spearman's rank-order

correlations were used to quantify the association between voice cue weights for gender identification and speech recognition accuracy.

Results: Variability in cue weights was observed across participants (SD = 0.32 for f0 and 0.27 for VTL). Preliminary results indicate that listeners with high perceptual weights for f0 performed more accurately on speech recognition when f0 was the primary cue available to segregate the target from masking talker ($\rho = 0.52$, $p = 0.02$). However, high perceptual weights for VTL were not associated with higher speech recognition accuracy in conditions where VTL was the primary cue available for talker segregation ($\rho = 0.24$, n.s.).

Conclusions: Preliminary results suggest that individual differences in perceptual weighting of voice cues for gender identification are associated with performance in a speech-on-speech masking task. Specifically, listeners who assign high perceptual importance to f0 in gender identification may be better able to use f0 to segregate competing voices than listeners who do not assign high perceptual importance to f0. This finding suggests that abnormal voice cue weighting for gender identification in some CI users may contribute to their difficulties understanding speech in multi-talker conditions. Future work will determine the nature of the relationship between cue weighting and speech recognition in adult CI users.

DIAGNOSTIC AUDIOLOGY / OTOLOGY

Category: Diagnostic Audiology / Otology

Poster #: 026

Accessible Precision Audiology Research Center (APARC) in a Community-Based Innovation District

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Objectives: Over 15% of American adults have difficulty hearing. Alarmingly, those with untreated hearing loss have 46% higher healthcare costs than those without trouble hearing. Despite this, only 1 in 6 people who need hearing aids have ever used them. A contributing factor is that the benefit of hearing aids remains limited due to the lack of diagnostics for the known subtypes of sensorineural hearing loss, e.g., two patients having identical hearing loss clinically, but having vastly different abilities to understand speech in the real world. The APARC team leverages collaborations between audiology, auditory neuroscience, and AI-driven data analytics to create a community involved research lab to collect data from diverse populations using a mechanistically based protocol currently being run on-

campus. We also aim to provide hearing-health information and outreach to under-resourced communities that would typically lack access to quality audiological resources.

Design: APARC synergizes expertise from a large multidisciplinary team to link mechanistic cross-species on-campus work to a large database of human data taken from clinical equipment to further parse the underlying causes of hearing loss. Currently, the Audiology Research Diagnostic Core located on Purdue's West Lafayette campus has seen ~135 subjects in the past year, however diversity in an Indiana college town is limited. To improve diversity of all types (racial, socioeconomic status, and hearing health), a new location was needed. To foster community engagement and support from residents within typically underserved and underrepresented communities, we strove to make the facility a hearing-health access point and community outreach hub in addition to a lab. Further, APARC is cultivating relationships with industry to make standardized hearing assessments accessible for all underserved populations - rural and urban.

Results: A new fully functional lab with areas for community engagement and hearing-health education has been established in Indianapolis' 16-Tech Innovation District, an inaugural spoke in ARPA-H's Investor Catalyst Hub. APARC is uniquely situated next to the Artisan Marketplace food court to help with our goals of providing access to diverse subject populations, as well as to serve as a community hearing-health hub. Additionally, in just a short time since opening the space the potential for wide-ranging collaborations has become a reality, including with Purdue's new Indianapolis campus, Indiana University School of Medicine and Health System, Bulter University's speech program, and Indianapolis-based health focused companies such as Eli Lilly. APARC has also participated in a community Halloween event interacting with ~300 children and their families from the diverse surrounding communities. We will soon start participating in a weekly winter farmers market designed to work with low-income community members through accepting and triple matching the Indiana Supplemental Nutrition Assistance Program. APARC is also working to improve accessibility of standardized mechanistic-based hearing testing through collaborations with Creare LLC to develop an open-source cross-species hearing platform.

Conclusions: Though in its infancy, APARC demonstrates the benefits of research and technology development with a focus on community engagement and cross-disciplinary, cross-species work. Our unique location is facilitating relationships within the community, with new companies, and across campuses.

Category: Diagnostic Audiology / Otology

Poster #: 027

Auren: A Low-Cost Open-Source In-Ear Probe for Hearing Research

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Objectives: The overall objective of this research is to develop an open source hearing research platform that will enable multiple-measure diagnostic hearing research across human and animal species and facilitate collaborative development and the open exchange of new datasets and measurement paradigms within the broader hearing research community worldwide. The platform leverages the existing open-source Tympan audio processing hardware and TabSINT tablet-based mobile app. To augment this base system, the Auren is intended to be a low-cost open-source in-ear probe that can be used for the measurement of wideband acoustic immittance (WAI), otoacoustic emissions (OAEs) and middle ear muscle reflexes (MEMRs). The near-term objective is to deliver a working prototype and to encourage the user community to provide feedback and suggest improvements to increase its usefulness across a broad range of measurements.

Design: The Auren consists of an electronics board with 4 low noise MEMS microphones, two user-selected speakers, a 3-D printed enclosure with modifiable CAD file, two cables, and 3-D printed calibration tubes. It interfaces with the Tympan to record data from the microphones and to control the speakers through user-modifiable firmware. We calibrate the speakers as well as the microphone amplitude and phase using 3D-printed calibration tubes and a reference probe microphone. All these calibration approaches rely on a mathematical model of the acoustics. We verify the calibration of the probe using two verification cavities. These have multiple ports where the probe microphone can sample the pressure amplitude. By combining measurements from the microphones, we reconstruct the 1-D plane wave in the cavities, allowing us to predict the pressure amplitude anywhere in the system. Then we predict the pressure at the probe microphone location based on measurements from at least 2 microphones. Details of the calculations used to generate the calibration of the probe are publicly available on the Auren GitHub repository.

Results: Initial results show excellent agreement (<5dB difference) between the predicted and measured pressures in the validation cavities for frequencies up to 12KHz. Ongoing work includes, developing a user-friendly calibration procedure, and testing its performance with human subjects.

Conclusions: Based on initial testing, the Auren probe offers an opensource alternative to commercial systems for audiology research.

Category: Diagnostic Audiology / Otology

Poster #: 028

Extended High Frequency Hearing in Young, Middle, and Aging Populations

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Objectives: Normative data for extended high frequency (EHF; 8 - 16 kHz) has not been established at present. In order to develop standards for normative hearing data in the standard frequency range (.25 - 8 kHz), the World Health Organization has recommended use of a four-frequency pure tone average (PTA). Although EHF hearing has been linked to speech-in-noise performance, the clinical utility is still not well-established outside of ototoxicity monitoring. Our objectives were to evaluate EHF hearing and further assess the relationship between EHF hearing sensitivity with speech-in-noise performance.

Design: Audiometric and speech-in-noise data were collected on 726 of participants at the University of South Florida. Data with an air bone gap ≥15 dB was excluded. "No response" thresholds were reported as 5 dB above the output limits of the audiometer at that frequency. A 4-frequency PTA was calculated for the standard range (.5, 1, 2, 4 kHz) and for the extended high frequencies (8, 10, 12.5, and 14 kHz) for both the right and left ears. 130 participants also had repeated measurements of their EHF thresholds. Speech-in-noise performance was measured on 80% of participants using the Words-in-Noise test (WIN).

Results: WIN scores were correlated significantly with EHF PTA across the full dataset. WIN scores were also significantly correlated with EHF PTA in participants who had a standard frequency PTA ≤25 dB, indicating that worse EHF hearing is associated with worse WIN scores in individuals with conventionally "normal" hearing. Age was significantly correlated with both standard frequency PTA and EHF PTA. However, this correlation was significantly stronger for the extended high frequency range than the standard frequencies. An effect of sex was also found with men having worse extended high frequency hearing than women. Extended high frequency measurements showed excellent test-retest reliability over up to 3 trials within a year of each other.

Conclusions: Extended high frequency hearing thresholds are correlated with speech-in-noise performance and may contribute to variability in speech-in-noise performance among individuals with similar standard frequency audiometric thresholds. Because of this correlation and excellent test-retest reliability, extended high frequency testing may be a clinically useful addition to standard evaluations.

Category: Diagnostic Audiology / Otology

Poster #: 029

Automatic Speech Recognition in Routine Assessment of Hearing

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Objectives: Since the inception of audiology, tests of word or sentence recognition has been manually scored by the audiologist administering the test. The output is generally a percent correct on that test, or a signal-to-noise ratio (SNR). While this approach has worked well for millions of patients, there remain limitations which have been present since the beginning of audiology. First, audiologists routinely have difficulty accurately administering and scoring tests in a non-native language. This raises the possibility

of inaccurate results, or in tests not being administered at all. Both instances increase the likelihood in disparities of care for non-native speakers of English. Second, audiologists with hearing loss may have difficulty accurately scoring tests of speech recognition. This raises the possibility that audiologists with hearing loss may face discrimination out of fear that they cannot accurately perform a key audiologic test. Finally, while this procedure yields the traditional percent correct (or SNR), this procedure routinely discards information that may provide key data about their speech recognition abilities. For example, the duration of time needed to respond is not considered in any systematic way; this may be a potential measure of listening effort or cognitive load, and is often used anecdotally by audiologists to infer difficulty of patients performing a task. New developments in artificial intelligence and automatic speech recognition (ASR), however, offer the opportunity to address all of these concerns. Here, we have developed a tool to enable automatic scoring of audiologic tests of speech recognition in any language, and also provides information such as response duration of individual patients, and the psychometric function associated with SNR values seen in tests such as the QuickSIN.

Design: his preliminary study includes data from adults (≥18 years) with normal hearing or hearing loss in at least one ear. We designed a real-time speech recognition algorithm utilizing Google and Whisper AI tools, combining local and cloud-based computing. As a first step of validating our approach, but NU-6 lists and QuickSIN sentences from our web-based app were presented to participants who repeated the words or sentences they heard. At the end of each sentence, the ASR system scored the participant response and the response duration. Simultaneously, an audiologist marked the correctly repeated words. This process was then repeated for non-native English tests, and for audiologists with hearing loss.

Results: While preliminary, our results indicate no significant differences between the real-time automatic and manual audiologist scoring in both English and non-English speech materials. Response duration generally increased as the signal-to-noise ratio deteriorated, suggesting a quantifiable approach for measuring listening effort in these participants.

Conclusions: In summary, our preliminary work here uses advances in artificial intelligence to provide a more accurate measure of patient performance. This approach may to reduce disparities in care for non-native speakers, and for audiologists with hearing loss. Finally, the ability to quantify response time may have a number of clinical applications. TAken together, these results suggest that ASR techniques may have a profound impact on future audiologic practice.

Category: Diagnostic Audiology / Otology

Poster #: 030

Non-Linguistic Markers in Hearing Assessment for Diverse Language Speakers

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Objectives: Hearing loss (HL) poses significant challenges to healthy aging, as it is associated with adverse effects, including cognitive decline. One of the most common complaints among those with HL is difficulty understanding speech in noisy environments. Conventional hearing assessments are typically based on language-dependent measures of speech understanding, which inform treatment recommendations. However, these language-based approaches create obstacles for non-English speakers, limiting access to equitable care for individuals with limited English proficiency (LEP). Speech perception in noise is a complex process that relies on various auditory skills, including frequency, temporal, and spatial resolution. Tests are available to assess these key aspects of auditory processing. This study aims to evaluate whether these non-linguistic features can provide a more comprehensive characterization of HL. The primary objectives were to investigate whether non-linguistic auditory markers-specifically spatial and spectro-temporal resolution-correlate with hearing loss and speech perception outcomes in individuals with HL, across different language backgrounds.

Design: This cross-sectional study included 15 adult participants: 5 with normal hearing and 10 with hearing loss, evenly split between Spanish and English speakers. Speech perception was assessed in both languages using the Word Intelligibility by Noise (WIN) test. Spectro-temporal resolution was measured through the Spectral-temporally Modulated Ripple Test (SMRT) and the Random Gap Detection Test (RGDT), with all tests presented at sensation levels 15-30 dB above each participant's 2 kHz hearing threshold. Spatial resolution was evaluated by presenting broadband noise bursts (0.5 to 20 kHz) from 47 speakers positioned across different azimuths and elevations.

Results: No significant associations were found between gap detection ability and either hearing loss or speech perception in English- or Spanish-speaking participants. However, frequency resolution exhibited a clear trend: as hearing loss increased, frequency resolution decreased, necessitating a higher signal-to-noise ratio for effective speech understanding.For spatial resolution, a trend indicated that greater hearing loss correlated with increased difficulty in localizing sound sources, leading to larger errors in target identification. This association between poor spatial resolution and higher signal-to-noise ratios was most apparent in English-based assessments. Among Spanish speakers, although spatial resolution errors rose with hearing loss, this did not correspond with a notable decrease in speech understanding performance. This suggests a potential resilience in speech comprehension for Spanish speakers, even as spatial resolution declines.

Conclusions: These findings highlight the differential impact of hearing loss on non-linguistic auditory markers and suggest that linguistic background may influence the relationship between auditory processing abilities and speech perception. Non-linguistic markers may offer a more objective and language-independent approach to assessing HL, potentially enhancing the accuracy of hearing evaluations. Consistent with prior research, our results indicate that Spanish speakers outperform English speakers in speech-in-noise tasks, regardless of hearing loss severity, underscoring the need to consider linguistic background in auditory assessments. Using non-linguistic metrics may help identify auditory deficits that traditional language-based tools might overlook, fostering a more inclusive and culturally sensitive approach to hearing assessments and improving healthcare accessibility for diverse linguistic populations.

Category: Diagnostic Audiology / Otology

Poster #: 031

Impact of Tinnitus on Speech Perception in Quiet and Noise

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Objectives: Tinnitus is one of the most common auditory conditions, affecting around 15% of the population, and is frequently associated with hearing loss, aging, and head injuries such as concussions. Hearing challenges-especially difficulty with speech perception in noise-are a primary complaint among those with tinnitus. However, research on whether tinnitus worsens speech recognition, particularly in noise, is inconclusive. Some studies report significant deficits in tinnitus patients, while others find no notable difference in auditory abilities between tinnitus and non-tinnitus groups with similar hearing thresholds. This inconsistency may stem from small sample sizes and limited variability in hearing loss severity in prior research. Here, we address these limitations by analyzing speech perception performance in both quiet and noise across thousands of patients, with and without tinnitus, at our academic medical center.

Design: We identified over 100,000 audiograms from patients evaluated at our facility. Pure-tone audiometry was performed on all patients, with most completing monaural word-recognition testing in quiet using the NU-6 word lists. A subset of around 12,000 patients was assessed for monaural speech-in-noise performance using the QuickSIN test. Patients diagnosed with tinnitus were identified using the ICD code H.93, and those with concurrent diagnoses of Meniere's disease or vestibular schwannoma were excluded.

Results: Our preliminary results from the GLM indicate that tinnitus has minimal to no impact on speech recognition in quiet ($p=0.62$) but shows a potential trend toward affecting performance in noise ($p=0.09$) when controlling for hearing sensitivity and patient age.

Conclusions: Preliminary results from this ongoing study indicate that deficits in speech recognition are primarily driven by hearing loss and age rather than self-reported tinnitus. We plan to explore whether tinnitus impacts speech perception in quiet and noise when additional auditory pathologies, such as vestibular schwannoma or Meniere's disease, are present. This investigation offers essential insights for counseling patients with tinnitus and supports integrating speech-in-noise assessments into routine practice due to their sensitivity to common auditory pathologies.

Category: Diagnostic Audiology / Otology

Poster #: 032

Investigating Pure-tone Threshold Test-Retest Reliability in Individuals with Down Syndrome

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Objectives: Down syndrome occurs in approximately 1 in 700 newborns annually in the United States (de Graff, Buckley, & Skotko, 2024), and is associated with many co-occurring conditions across the lifespan (for review see, Bull et al., 2022 & Capone et al., 2017). It is the most common genetic cause of intellectual disability (Ilyas et al., 2020), with most individuals with Down syndrome having mild to moderate intellectual impairment (Stancliffe et al., 2012). Hearing loss is one of the most prevalent co-occurring conditions, observed in ~40-80% of individuals with Down syndrome of all ages (e.g., Kreicher et al., 2018; Malt et al., 2013). Although all types of hearing loss occur more frequently for individuals with Down syndrome than individuals who are neurotypical, fluctuating conductive hearing loss occurs often, and is particularly pervasive in childhood (e.g., De Schrijver et al., 2019; Nightengale et al., 2017). Current standards accept variability of up to 10-dB between successive pure-tone threshold measurements (ANSI S3.21 - 2004); however, supporting data are based on studies of participants without described intellectual impairment (e.g., Steinberg & Munson, 1936; Whitting & Hughson, 1940). The only study to our knowledge evaluating test-retest reliability in listeners who are neurodiverse describes similar variability between listeners with and without mild dementia (i.e., McClannahan et al., 2021). No previous studies have evaluated test-retest reliability for pure-tone threshold estimation for individuals with Down syndrome. The purpose of this study is to evaluate variability in pure-tone threshold measurements in a community-based sample of individuals with Down syndrome for consecutive audiograms obtained over a 3-year period and for successive measurements obtained in a single test session.

Design: Participants are children and adults with Down syndrome ≥5 years of age. Data are collected in our laboratory or in a mobile research vehicle. Sessions are guided by use of social stories and visual schedules, and include otoscopy, 226-Hz tympanometry, and behavioral audiometry for air-conducted, pulsed pure-tone stimuli using a 2-down, 1-up procedure with a 5-dB step size. Hearing thresholds are estimated at 4, 8, and 11.2 kHz; 1 kHz is also measured for listeners with no measurable threshold at 11.2 kHz. Participants who are neurotypical ≥15 years of age are included for comparison of data obtained in successive measurements during a single test session.

Results: Results for participants with Down syndrome show stronger associations for thresholds obtained within shorter timeframes. Successive measurements obtained in a single test session show the strongest association, with ≥95% of threshold differences ≤10 dB for both groups. Future data analyses include interclass correlations between sequential measurements, and consideration of middle ear status across sessions.

Conclusions: Variability in successive hearing threshold estimates within a single test session for listeners with Down syndrome is similar to listeners who are neurotypical. Differences in audiometric threshold observed between test sessions for individuals with Down syndrome >10 dB are likely attributed to fluctuating hearing sensitivity.

Category: Diagnostic Audiology / Otology

Poster #: 033

Survey of Speech-in-Noise Testing Practices

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Objectives: Speech-in-noise (SIN) testing allows clinicians to assess the ability to hear in background noise, which is a common difficulty in individuals with hearing loss. Additionally, audiometric testing in quiet is not a strong predictor of performance in background noise. Despite this, survey studies of audiologists suggest limited use of SIN testing. Some estimates suggest that only 13-35% of audiologists use SIN testing. However, a comprehensive characterization of SIN testing practices has not been conducted. The goal of the current study is to identify facilitators and barriers to SIN testing among U.S. audiologists. To our knowledge, this is the first survey study that focused exclusively on SIN testing practice patterns in U.S. audiologists.

Design: The study involved an anonymous online survey designed in Qualtrics. Eligible participants were licensed U.S. audiologists who performed audiometric testing at the time of the survey. The survey was available from October to December 2024 and was distributed through message boards, listservs, social media, e-mails, and word of mouth. The survey included questions about eligibility, demographics, patient populations seen, and SIN practice patterns and attitudes. Questions about SIN testing practice patterns included how often testing was performed, reasons for testing, barriers to testing that were encountered, and the tests that were most frequently used. Questions about SIN attitudes addressed the perceived clinical usefulness and confidence in selecting tests, performing tests, and interpreting results. Separate questions about SIN testing were asked for adult hearing evaluations, pediatric hearing evaluations, cochlear implant evaluations, and auditory processing disorder evaluations.

Results: Preliminary results were obtained from 104 respondents who perform adult hearing evaluations. The majority of respondents held an Au.D., and the workplace setting that was most represented was private practice. There was a median of 11 years of professional experience. A majority of respondents reported using SIN testing frequently, with a ranking of at least 8 on a scale of 0 (never) to 10 (always). The most common reason for conducting SIN testing was to validate the patient's report of SIN testing, while few reported using SIN testing to select and fit amplification or assess treatment outcomes. The most commonly reported barrier to conducting SIN testing was lack of time. The QuickSIN was the most frequently used test, with other tests reportedly used much less frequently.

Conclusions: Preliminary results suggest frequent use of SIN testing in this sample of U.S. audiologists. Although this could suggest an increase in SIN testing compared to previous studies, response bias must be considered. Participants reported that SIN testing was most often performed to assist in diagnosis and counseling rather than for treatment purposes. Our next steps include analyzing the responses from audiologists who evaluate other patient populations and examining associations between variables. The insights into facilitators and barriers gained from this study will inform clinical practice and identify potential ways to increase usage of and confidence in SIN testing.

Category: Diagnostic Audiology / Otology

Poster #: 034

Characterizing Patterns of Early Aging in Cochlear and Auditory Brainstem Function

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Objectives: Given the global pervasiveness and the complex pathophysiology of age-related hearing loss (ARHL), there is a need to detect signs of auditory decline as early in life as possible and pinpoint the site(s) and nature of lesion. Work in animal models and postmortem humans indicates that there are at least three primary subtypes of ARHL: sensory, metabolic, and neural. However, the gold standard diagnostic test in audiology (behavioral audiometry) cannot differentiate between these subtypes. More sophisticated approaches for diagnosing ARHL are needed. To this end, this work explores metrics of cochlear and neural function in tandem to examine signs of early age-related change in the auditory system. Specifically, we examine and compare the growth of distortion product otoacoustic emissions (DPOAEs) and Wave I of the auditory brainstem response (ABR). Our goals were to: 1) characterize early signs of age-related auditory decline and 2) explore the possibility of using these two tools in tandem to pinpoint site of lesion in ARHL.

Design: 31 individuals across two age groups participated in this study: 15 participants (3M) in the 18-29 year group (¬μ = 23.9 years), and 16 participants (8M) in the 30-49 year group (¬μ = 36.7 years). All participants had clinically normal audiometric thresholds (≤ 25 dB HL at octave and interoctave frequencies from 0.25-8 kHz), allowing the exploration of early signs of age-related changes. Additionally, all participants had unremarkable otoscopy and immittance results.DPOAE growth functions were measured at three f2 frequencies: 2, 4, and 8 kHz. The stimulus levels followed a Fixed L1 paradigm, such that L1 was fixed at 70 dB while L2 was swept nearly continuously in level from 0-70 dB FPL. DPOAE levels were estimated using a weighted least squares fitting (LSF) procedure. ABRs evoked by narrowband 2kHz and 4kHz iChirp stimuli were collected on the Intelligent Hearing Systems Duet SmartEP platform. Stimuli were presented to the test ear at a rate of 27.1/s, starting at 80 dB nHL and decreasing to 10 dB nHL in 10-dB steps. Responses were collected using an Fz-Tiptrode montage. Wave I amplitude was marked via visual inspection. All study procedures were approved by and conducted in accordance with the Northwestern University Institutional Review Board (STU00217879).

Results: On average, both DPOAE and ABR Wave I growth functions of the 30-49 year age group show shallower slopes as level increases relative to the 18-29 year group. However, the patterns of age-related decline differ between the two measures. Shallower DPOAE growth of the older age group emerges only at 8 kHz. In contrast, shallower ABR Wave I growth with age is more prominent and is apparent at lower frequencies (both 2 and 4 kHz), particularly at moderate to high stimulus levels.

Conclusions: Overall, results suggest the presence of subclinical age-related decline in early-aged ears, despite their relatively young age and clinically normal hearing thresholds. Additionally, the patterns of data indicate that this decline is frequency-dependent and suggests the dominance of inner hair cell/neural (rather than outer hair cell) pathology in earliest stages of auditory decline.

Category: Diagnostic Audiology / Otology

Poster #: 035

Self- and Informant-Reported Hearing Difficulties in Adults with Mild Dementia

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Objectives: Compared to cognitively healthy adults, people with dementia may experience greater functional consequences of hearing loss because of reduced cognitive resources. It may also be more difficult for these listeners to accurately self-report their hearing difficulties, presenting a dilemma when evaluating their communication abilities and needs. A supplement to self-report is obtaining information from family, friends, and caregivers. These informant reports are commonly used during the evaluation and treatment of dementia, but their utility in hearing health care has not been widely explored. The objective of this project was to examine hearing loss and hearing handicap in participant pairs (i.e., a participant and an informant partner), with participants identified as either cognitively healthy or experiencing mild dementia symptoms. We predicted that self- and informant-reported hearing handicap would be correlated, but that informant-reported hearing handicap would have a stronger relationship with hearing thresholds, particularly for adults with mild dementia, compared to self-report.

Design: In this cross-sectional design, we recruited 55 adults with normal cognitive function, based on Clinical Dementia Rating (CDR) of 0 or Montreal Cognitive Assessment scores of ≥ 24 and 32 adults with mild dementia symptoms, with CDR of 0.5 or 1. All participants provided written informed consent and the study was approved by the Washington University Institutional Review Board (IRB 202009161). Participants completed a comprehensive audiometric assessment and each person in the pair completed the Hearing Handicap Inventory for the Elderly and the 15-item Speech Spatial and Qualities of Hearing Scale.

Results: Preliminary analyses partially support our hypotheses, with significant correlations between self- and informant-reported hearing handicap for the cognitively healthy (HHIE: $r = .75$, $p<.001$, SSQ: $r = .37$, $p= .005$) and mild dementia (HHIE: $r = .42$, $p= .02$) groups. Self- and informant-reported hearing handicap scores were moderately and similarly correlated with the participant four-frequency pure tone average (.5, 1, 2, & 4 kHz) for each group. Additional findings will be discussed.

Conclusions: The results of this work indicate that self- and informant-reported hearing handicap scores in adults with normal cognitive function and mild dementia are significantly correlated as well as moderately correlated with audiometrically defined hearing loss. More investigation of the clinical utility of informant-based assessments in adults with dementia symptoms are needed. Future studies will help us in the development of procedures that better identify hearing difficulties in adults experiencing hearing loss and dementia, concurrently.

Category: Diagnostic Audiology / Otology

Poster #: 036

Impact of Middle Ear Dysfunction on Pediatric Hearing Aid Fittings

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Objectives: This presentation is part of the Outcomes of Children with Hearing Loss Consortium (OCHLCON), a longitudinal, multi-center collaboration following children with hearing loss from infancy to early adulthood, and the Finding Appropriate Solutions to Treat Reduced Audibility in Kids (FASTRAK) study, which was designed to develop clinical tools to support the identification and intervention of children with hearing loss. The current presentation includes both retrospective and prospective data.Our first objective was to examine the effects of middle ear dysfunction (and subsequent intervention) for children with hearing loss over time. We explored how audiometric thresholds and ear-canal acoustics changed before, during, and after intervention for otitis media (specifically PE tube placement), and how these changes impacted hearing aid fitting quality.Our second objective was to prospectively conduct assessments using FASTRAK audiometry, which uses a microphone to measure ear-canal acoustics and self-generated noise. We sought to determine the effects of PE tube intervention on audiometric thresholds. We hypothesized that thresholds below 1000 Hz will be elevated compared to traditional dB HL thresholds associated with increased impedance and a lower sound pressure level from larger ear-canal volumes.

Design: For Objective 1, we examined retrospective data collected on 85 children with bilateral hearing loss who participated in a longitudinal study. Participants were 6 months to 7 years at entry in the study. Participants completed pure-tone audiometry, tympanometry, and hearing aid verification.For Objective 2, we collected prospective data from children between the ages of 2 and 12 years who had at least one patent PE tube. The protocol included otoscopy, wideband tympanometry, measured wideband real ear to coupler difference (RECD), experimental FASTRAK audiogram, and clinical audiogram. Wideband tympanometry was used to confirm the presence of a functioning PE tube as well as to collect information on middle ear absorbance. The experimental audiogram was administered via computer-based software using an ER-10B+ probe that monitored noise levels and ear-canal acoustics.

Results: With our retrospective data, we found that audibility and the proximity to prescriptive targets were poorer than prior to tube placement. Hearing aid output was not consistently adjusted in children with otitis media and subsequent tube placement to account for changes in ear-canal acoustics.For the prospective FASTRAK portion of this study, data has been collected from 7 subjects to date, with data collection ongoing. Preliminary results indicate that thresholds at 250 Hz and 500 Hz are routinely outside the normal range in ears with PE tubes.

Conclusions: While middle ear dysfunction is common among children, there is little research on the effects of PE tubes on thresholds and hearing aid fitting. Documenting changes in children's thresholds helps to highlight the need for audiological monitoring and hearing aid adjustment for children with

hearing loss following PE tube placement. The prospective data demonstrates the effects of PE tubes on audiometric thresholds and ear-canal acoustics, specifically below 1.5 kHz. The goal of FASTRAK audiometry is to provide an alternative clinical tool to yield more specificity related to differences in ear-canal volume when testing populations that deviate from average values.

Category: Diagnostic Audiology / Otology

Poster #: 037

Differentiation of High Frequency Hearing Loss Etiology with Bone Conduction

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Objectives: It is becoming routine to measure air conduction (AC) auditory thresholds through 16kHz, as studies have demonstrated the importance of extended high frequency (EHF) hearing (>8kHz). Bone conduction (BC) thresholds, however, are not measured above 4kHz due to limitations of clinical bone transducers. Consequently, it is not possible to differentiate EHF conductive (CHL) from sensorineural (SNHL) hearing loss. The inability to differentiate high frequency hearing loss types is clinically relevant as CHL is frequently treatable with surgery. Our group has identified two bone transducers with improved high frequency output, one of which has not previously been clinically tested. Here we build on prior results, and discuss methods of testing with both bone transducers, including making measurements in pediatric patients, and patients with pathology to differentiate forms of high frequency hearing loss.

Design: Two bone transducers, Tascam¬Æ HP-F200 and Westra¬Æ KLH96, have been adapted to test EHF BC thresholds. Adult and pediatric patients with normal AC/BC hearing thresholds (<25dB 0.25-8kHz) or hearing loss (clinical history of noise exposure, prior middle ear surgery, or otitis media with effusion, >25dB 0.25-8kHz) underwent EHF testing. EHF AC testing from 8-16kHz occurred with Sennheiser/DD45 circumaural headphones, and EHF BC testing occurred with the novel transducers on the subjects' better hearing ear. Test-retest variability within BC devices was established and intrasubject force thresholds were compared across transducers. Methods for masking EHF BC thresholds were established and applied. With reference thresholds from subjects aged 18-25yrs, EHF air-bone-gaps are computed and compared between subjects with hearing loss. Feasibility of EHF AC/BC threshold measurements in children as young as 5 years of age was established.

Results: AC and BC threshold testing was feasible across frequencies in all patients. Measures of intra-device reliability were similar for all subjects (n=19), including pediatric subjects (aged 5-11). 93% of measures had test-retest differences ≤5dB and ≥99% of measures had differences ≤10dB. In adults, the average absolute inter-device difference across EHF was 5dB which was similar to absolute average test-retest differences across EHF, which was 3dB. In pediatric subjects, the absolute average inter-device difference overall was<10dB, and through 12.5kHz was ≤5dB. In pediatric subjects the inter-device difference increased with increasing frequency, particularly at 14 and16kHz. Subjects with hearing loss

were found to have EHF AC and BC thresholds consistent with either a pattern of SNHL or CHL. Subjects with a clinical history of noise exposure had minimal EHF ABGs, whereas subjects with prior middle ear surgery (stapedotomy) had persistent EHF ABGs ranging from 25-40dB. Pediatric patients with CHL from otitis media with effusion, confirmed with otoscopy and flat tympanograms at the time of testing, were found to have a flat ABG across frequencies, with an average 9-16kHz ABG of 33dB.

Conclusions: Two novel bone transducers have been used to reliably measure EHF BC thresholds in adult and pediatric patients, allowing differentiation of the type of hearing loss at high frequencies. Use of EHF transducers during routine audiometry can provide helpful clinical information to differentiate high frequency hearing loss types, with the knowledge that treatment will differ.

Category: Diagnostic Audiology / Otology

Poster #: 038

Traumatic Brain Injury and Longitudinal Changes in Tinnitus Severity

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Objectives: Many post-9/11 era active-duty Service members (ADSM) and Veterans have sustained a traumatic brain injury (TBI). Although TBI is commonly associated with tinnitus, the degree to which tinnitus severity differs between those with, versus without, TBI is unclear. Moreover, it is not well understood whether the type of TBI, specifically blast-related versus non-blast-related TBI, affects the severity of tinnitus differently. We examined these associations among post-9/11 ADSM and Veterans, both at baseline and over a five-year follow-up period, to estimate changes in TFI score over time and to determine if specific TBI characteristics were associated with patterns of tinnitus severity.

Design: The Noise Outcomes in Servicemembers Epidemiology Study was designed to examine the longitudinal effects of military and non-military exposures on auditory functioning in post-9/11 era ADSM and Veterans. Veterans were eligible to participate in the study if they were within 2.5 years of military separation. Study participants complete a comprehensive audiological evaluation and self-report questionnaires. This analysis focused on a subset of the NOISE Study cohort with chronic tinnitus (n=610) as determined by the Tinnitus Screener. Self-reported military TBI was assessed using a questionnaire modified from the Department of Veterans Affairs Comprehensive TBI Evaluation; TBI was defined using American College of Rehabilitation Medicine criteria, including potential causes (blast-related and non-blast-related TBI). Tinnitus severity was measured using the Tinnitus Functional Index (TFI). We used a linear mixed-effects model to analyze the TFI score over time, adjusting for demographic and military characteristics. Mean differences in TFI score and 95% confidence intervals (CIs) estimating associations between self-reported TBI and tinnitus severity are reported.

Results: Among participants with chronic tinnitus, 86% (524/610) were male, mean age was 36.4 years (standard deviation [SD]: 9.72 years), mean TFI score was 34.0 (SD: 20.9), and 29% (177/610) reported a history of TBI. Of those reporting a TBI, 36% (63/177) had a blast-related TBI and the other 64% (114/177) had a non-blast-related TBI. At baseline, those with blast-related TBI and non-blast-related TBI had significantly worse mean TFI scores compared to those without TBI history (mean TFI score difference = 13.52 (95% CI: 8.6, 18.5) and 5.9 (95% CI: 2.1, 9.8), respectively). Longitudinally, the average TFI score increased by 0.5 units (95% CI: 0.1, 0.9; p=0.02) every year for 5-years post baseline, indicating an annual increase in tinnitus severity ~1.63%. However, suspected TBI etiology (blast-related and non-blast-related) was not associated with average changes in TFI score over time (p-value = 0.4).

Conclusions: Findings revealed tinnitus was more problematic for ADSM and Veterans with TBI history compared to those without TBI history at baseline. Tinnitus severity persisted over five years and even showed a slight increase during this period, though the trend did not differ by TBI status. These results underscore the importance of inquiring about TBI history when evaluating patients with tinnitus. A tailored, interprofessional approach to tinnitus care may better address the complex needs of those with both tinnitus and a history of TBI.

Category: Diagnostic Audiology / Otology

Poster #: 039

Establishing Expanded Approaches for Monitoring Auditory Function in Humans

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Objectives: The value of assessing auditory function at extended high frequencies (EHF; >8kHz) for earliest detection of ototoxic damage and age-related changes in the cochlea is well established however not standard clinical practice. This is in part due to EHF measurement challenges, including ear canal acoustics and limited transducer bandwidths that influence distortion product otoacoustic emissions (DPOAEs) and hearing thresholds. Additionally, enhanced audiological approaches are needed to help identify physiological biomarkers of auditory dysfunction and earliest cochlear injury. While the reliability of hearing thresholds and DPOAEs obtained using standard clinical methods has been explored, the reliability has not been fully characterized in more precise laboratory studies focusing on EHFs combined with boothless explorations needed for clinical translation. Moreover, this will characterize and potentially reduce test-retest variability, promote more accessible (efficient and high throughput) evaluation of auditory function, and enhance our understanding of clinically-meaningful changes. This investigation explores technical barriers and establishes test-retest variability of an expanded, modified battery of serial audiological tests in healthy participants for potential adoption of the test battery to target auditory dysfunction and monitoring.

Design: In this study (NCT01629108) we characterize and compare test-retest variability of hearing thresholds (0.25-16kHz) using the standard modified Hughson-Westlake (manual) method to a tablet-based (automated method) boothless method using the Wireless Automated Hearing Test System (WAHTS). We also compare DPOAEs obtained with standard and EHF probes across two systems (Interacoustics and Intelligent Hearing Systems) to characterize serial measures. This pilot study includes nine healthy participants seen for either 2 visits, 3-months apart (part 1) or 3 visits, 2 weeks apart (part 2). Participants in part one (n=4; females; mean age=47 years; 22-70 years; 2 additional in progress) completed a comprehensive audiological test battery including conventional (manual method) audiometry (0.25-8kHz), middle ear measures, and standard DPOAEs. Participant in part two (n=1; male; 20 years; 2 additional enrolled) was evaluated using a modified, expanded audiological evaluation including part one tests, hearing thresholds (0.25-20kHz) obtained via manual and automated methods, and three DPOAE test paradigms. Variability within each measure was calculated across test sessions. Results from each test method and test time across methods were compared.

Results: Sessions 3 months apart show differences in hearing thresholds (n=4) ranging from 0-15 dB while sessions 2 weeks apart show ranges of 0-10 dB for manual methods and 0-15 dB for automated methods (n=1). Similar hearing threshold results were obtained between manual and automated methods with greater variability noted for EHFs. Room noise measures confirmed within acceptable limits for automated testing sessions. Preliminary DPOAE outcomes are similar across sessions and equipment, with increased variability above 4kHz. Proposed clinical monitoring parameters and navigation of technical barriers to EHF will be discussed.

Conclusions: Preliminary findings support establishment of test-retest variability of an expanded, modified battery of audiological tests to characterize auditory function at baseline, and through serial measurements for optimal clinical translation. Future monitoring strategies and clinical applications of serial measurements will be discussed.

Category: Diagnostic Audiology / Otology

Poster #: 040

Reliability of Novel Morphological Features of the Auditory Brainstem Response

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Objectives: This study aims to evaluate the test-retest reliability of novel morphological wave features of the auditory brainstem response (ABR) measured by a recently developed automated approach to analysis. Though the neurodiagnostic ABR has the potential to differentiate sensory and neural pathologies of the cochlea and brainstem, is not widely used in clinical settings in part due to time-consuming and subjective analyses relying on visual inspection of the response waveform. The automated analysis approach also provides measurements of new features, such as wave width and

curvature, which are not easily measured through visual inspection. This study is crucial in establishing the reliability and clinical use of these new features in identifying sensorineural pathologies.

Design: Fifty adults participated in the study. Participants had normal hearing function as measured via self-report, a pure-tone hearing screening (thresholds at octave frequencies 0.5-8 kHz were ≤ 20 dB HL), and tympanometry; and had no history of neurological disorders, hyperacusis, or tinnitus. ABRs were recorded to broadband clicks presented at 100 dB pe SPL. Each participant completed at least two ABR testing visits separated by at least one week. Thirty of the fifty participants completed four visits with at least one month separating two of the visits. The automated analysis approach was applied to each waveform extracting the following features: peak latency, peak amplitude, onset latency, wave width, area, and curvature.

Results: Two-way mixed effects models of intraclass correlation were used to determine the test-retest reliability of each ABR waveform feature across visits. The strength of reliability for each measure was categorized as excellent ($0.9 \leq r < 1.0$), good ($0.75 \leq r < 0.9$), moderate ($0.5 \leq r < 0.75$), or poor ($0 \leq r < 0.5$) based on the established intraclass correlation coefficients.

Conclusions: This study provides valuable insights into the test-retest reliability of novel ABR waveform features extracted by a recently developed automated approach to ABR waveform analysis. The findings will determine the sample size and whether repeated measures are needed for any future studies using these morphological features or automated analysis approach. The clinical use of these features can only be known if the observed changes are due to treatment or pathology rather than natural variability.

Category: Diagnostic Audiology / Otology

Poster #: 041

The Know Your Hearing Public Health Campaign

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Objectives: Many people know their vision or blood pressure and monitor data about their step count or sleep quality. These health and wellness metrics are widely used and understood. But what about hearing? Without a consistent metric to understand and talk about hearing, consumers depend on vague qualifiers to describe their hearing, leaving them unclear on whether or when to take action to protect or optimize their hearing.The Know Your Hearing public health campaign by the Johns Hopkins Bloomberg School of Public Health aims to create broad acceptance of the Hearing Number, or 4-frequency pure tone average (PTA4), as a common, widely-understood, and neutral metric for hearing. This presentation will describe the development and execution of the Know Your Hearing campaign.

Design: Campaign goals: Establishing the clinical and public health rationale and need for a consumer-facing hearing metric - through publication of a scientific editorial outlining the PTA4 as that hearing metric, December 2020.Developing consumer-facing materials - made available with the launch of the campaign website, August 2022. Establishing technical standards - collaborated with the Consumer Technology Association (CTA) to ensure that technologies providing the PTA4 to consumers are accurate, reliable, and labeled consistently, 2023.Developing an app from a trusted, evidence-based source to

provide consumers with their PTA4, adjacent to other commercial-based apps and tools - the Hearing Number app, created by the Johns Hopkins Bloomberg School of Public Health for iOS and Android, launching late 2024.Campaign impact and reach is expanded through partnerships. The Hearing Roundtable, an industry consortium of CTA members, meets quarterly to discuss adoption of hearing solutions, reducing stigma around hearing loss, and tracking and acting on hearing wellness. The Bloomberg School's external affairs team is a trusted partner for app launch.

Results: The CTA's standard, "The Four Frequency Pure Tone Average Testing Methodology and Hearing Wellness Reporting Metric for Consumer-Facing Hearing Solutions (ANSI/CTA-2118)," has been cited by Apple, Mimi, and Jacoti, and the PTA4 is directly presented to users with hearing tests from these companies. The Hearing Number app will be launched in January 2025 with a coordinated earned/owned media campaign.

Conclusions: A coordinated, multi year campaign to increase hearing awareness through a collaborative academic, industry, and advocacy consortium has the potential to drive foundational public awareness of hearing across the life course.

Category: Diagnostic Audiology / Otology

Poster #: 042

Effect of Stimulus and Pressure Sweep Rate on Tympanometry

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Objectives: Wideband Tympanometry (WBT) has been shown to have significant clinical utility in improving the clinical diagnosis of mechanical pathologies affecting the middle and inner ear. Despite its documented utility, clinical uptake of WBT has been limited. Reasons for this may include clinician training and/or comfort levels in interpreting WBT, lack of access to devices capable of WBT, or the additional time needed to add yet another diagnostic test to the audiologic battery. Recent work has shown that WBT has the potential to replace standard 226-Hz tympanometry, as opposed to being an additional test. In theory, WBT provides at least as much information as standard tympanometry, by calculating extracted tympanograms at multiple frequencies using a click stimulus, as well as providing the additional information that can be obtained through interpretation of other WBT outcomes like absorbance. However, equivalence between extracted WBT tympanograms and standard tympanograms has not yet been demonstrated. Only recently have the outcomes of extracted and standard tympanograms been examined. Statistically significant differences in peak admittance between the two measures have been identified; however, this difference was found to not be clinically significant. While this difference did not appear to impact clinical interpretation, further investigation as to the cause of these differences is warranted. There are several possible explanations to this difference in admittance including (but potentially not limited to): calibration method, stimulus differences, sampling rate, pressure sweet rate, etc. The purpose of this study was to examine the role of stimulus and pressure sweep rate in these differences.

Design: Sixty-one participants, age 8 months to 49 years (M=14 years) participated in this study. Four different pressure sweep rates (fast, medium, slow, and very slow) were used to record tympanograms with a click (WBT) stimulus and with a standard 226 Hz pure tone stimulus, for a total of 8 tympanograms for each run in each ear. The protocol was completed twice in each ear, with the probe removed and re-inserted prior to the second run. Tympanograms were recorded using custom MATLAB software.

Results: Preliminary analyses suggest that both stimulus type and pressure sweep rate result in statistically significant differences in tympanometric outcomes, including volume, peak admittance, pressure, and gradient. Whether these statistically significant differences are clinically significant, however, is not clear. Additional analyses are ongoing, included examining the clinical significance of these differences.

Conclusions: Tympanometry parameters, including pressure sweep rate and stimulus type, can cause statistically significant differences in tympanometry outcomes.

Category: Diagnostic Audiology / Otology

Poster #: 043

Predicting Hearing Aid Benefit with Machine Learning Using Auditory Profiles

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Objectives: Individuals with similar audiograms often show differing degrees of hearing aid benefit, suggesting that factors beyond hearing thresholds may influence rehabilitation outcomes. While suprathreshold auditory processing tests show promise in explaining these variations, their clinical application remains challenging due to the complexity and duration of auditory test batteries. This study aimed to develop a machine learning-based prediction model using a combination of auditory processing measures to identify patients likely to experience overall good or poor hearing aid benefits. We hypothesized that an optimal combination of these measures would be able to classify patients into different benefit groups, potentially providing additional information for individualized rehabilitation consultation and strategies.

Design: Thirty-three older adults (18 females, 15 males; age range = 61-89, mean = 73.4) with sensorineural hearing loss participated in this study. Each participant completed pure-tone audiometry and five suprathreshold tests using the iPad-based Psychoacoustic Assessment System (iPAAS): frequency discrimination, gap detection, amplitude modulation detection at 20 and 200 Hz, and binaural masking level difference. Participants were fitted with hearing aids set to omnidirectional and front-fixed

directional modes. Speech-in-noise performance was evaluated using QuickSIN in low and high reverberation, with target speech presented frontally and competing babble noise presented laterally or in surround. Benefits from directional microphones and aided spatial release from masking (SRM) were then calculated. Based on these aided benefits across listening conditions, participants were clustered into groups using hierarchical clustering. An ensemble machine learning approach combining K-Nearest Neighbors classification and Support Vector Machine algorithm was employed to find the most effective variable combination of predictors (selectively from the pool of all five iPAAS tests, PTA, MoCA, and age) and the optimized prediction model for group classification.

Results: Hierarchical clustering revealed two distinct groups based on the directional and SRM benefits: a good-benefit group and a poor-benefit group. Through comprehensive feature selection with the K-Nearest Neighbors algorithm, four measures were selected as the most effective predictors: frequency discrimination, Amp200, MoCA, and age (PTA and the other three iPAAS tests were factored out by this procedure). The final Support Vector Machine model, trained with these predictors and evaluated using leave-one-out cross-validation, yielded a classification accuracy of 91% in identifying participants' benefit groups. Among all iPAAS measures, frequency discrimination and Amp200 appeared to be better predictors.

Conclusions: This study shows that suprathreshold auditory processing measures, particularly frequency discrimination and fast envelope processing, can effectively help predict aided benefits beyond audiometric thresholds. The cross-validation evaluation of machine learning models suggests the potential clinical value of incorporating these measures into hearing aid consultation. These findings support the development of more comprehensive auditory profiling approaches that could guide expectations and potentially inform rehabilitation strategies. Further research with a larger sample size is needed to validate the prediction model and establish clinical use protocols.

ELECTROPHYSIOLOGIC RESPONSES

Category: Electrophysiologic Responses

Poster #: 044

Clinical Practice Patterns, Barriers, and Opportunities in Auditory Electrophysiology

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Objectives: Electrophysiology plays a vital role in audiology by providing objective measures of auditory system function, allowing audiologists to assess auditory processing at multiple levels of the auditory pathway. While electrophysiologic measures have the potential to improve diagnostic sensitivity, facilitate treatment recommendations, and monitor intervention outcomes, clinical implementation remains somewhat limited. Therefore, this study aimed to explore the perceptions and lived experiences of practicing audiologists concerning the use of electrophysiology techniques in clinical practice. Our

results provide valuable insights on the perceived benefits, challenges, and opportunities for growth that support broader clinical application of electrophysiology assessments in audiology.

Design: Using a phenomenological approach, we captured the unique and shared experiences of 12 clinical audiologists regarding auditory electrophysiology through semi-structured interviews. Our sample represented a wide variety of clinical settings and populations served. Participants were assigned to pairs for virtual interviews that lasted approximately 1 hour. Because we were interested in perspectives and experiences across the field as a whole, prior or current use of electrophysiologic techniques in clinical practice was not required to participate. Interview questions probed participants' experience and familiarity with electrophysiology measures, their perceived utility in clinical practice, educational and training backgrounds in these techniques, and challenges faced in providing electrophysiology-based services in their clinical practice. All interviews were recorded, transcribed, and analyzed using thematic analysis to identify recurring themes and meaningful patterns within the data.

Results: Three major themes emerged from the analysis: clinical advantages, implementation barriers, and strategies to overcome these barriers. Participants highlighted the utility of electrophysiology for differential diagnosis particularly in complex cases and as a "gold standard" when behavioral responses were unreliable or otherwise not obtainable. However, significant barriers including high equipment costs, time-intensive procedures, and limited knowledge and training restricted wider adoption. To address these challenges, participants emphasized the need for increased awareness of electrophysiologic applications through professional advocacy, expanded education and training opportunities for audiologists, and further research to substantiate clinical utility and support broader integration into standard practice.

Conclusions: This study offers a comprehensive view of the current perceptions and experiences of clinical audiologists regarding auditory electrophysiology techniques. While electrophysiology is recognized for its clinical advantages and potential to enhance diagnostic accuracy, barriers such as cost, time demands, and limited knowledge remain significant obstacles. Addressing these challenges through targeted advocacy, education, and research is essential to promote the integration of electrophysiology into standard audiologic care. By emphasizing the clinical utility and advancing professional understanding of these measures, the audiology field can better position itself to deliver high-quality, evidence-based care that ultimately benefits diverse patient populations.

Category: Electrophysiologic Responses

Poster #: 045

Cortical Evoked Potentials in Conductive and Mixed Hearing Losses

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Objectives: The P1 cortical auditory evoked potential (CAEP) response is a biomarker of auditory cortex maturation that has been measured extensively in children with sensorineural hearing loss to help determine their candidacy for hearing aids and/or cochlear implants or to provide information about

cortical maturation before and after hearing treatment. This information can provide clinical guidance on hearing interventions for children. Additionally, measuring cortical visual evoked potentials (CVEP) can provide further information regarding crossmodal reorganization of the brain due to hearing loss, which may have implications for performance outcomes. However, there is less research on cortical potentials in individuals with conductive and mixed losses, including those who are candidates for or utilizing osseointegrated hearing devices. The goal of this research is to examine cortical maturation and crossmodal reorganization in conductive or mixed hearing losses who may be osseointegrated device candidates.

Design: We present two case studies of adults with conductive/mixed hearing losses with congenital unilateral microtia/atresia. Case study #1 has a conductive unilateral hearing loss and has never pursued an osseointegrated device. Case study #2 has a mixed hearing loss in one ear and a high-frequency sensorineural hearing loss in the contralateral ear. Additionally, case study #2 pursued an osseointegrated device after our initial testing and we plan to bring this participant back to test with their device. Both participants underwent electroencephalography (EEG) testing, including cortical auditory evoked potentials (CAEP) in response to an auditory speech stimulus and cortical visual evoked potentials (CVEP) in response to a visual motion stimulus to investigate crossmodal reorganization. EEG was measured in a sound-proof booth using a high-density EEG cap (128 electrodes) and low-density single electrodes (5 electrodes).

Results: For both participants, CAEPs presented with normal latency and morphology for an adult. However, when analyzing source localization from the high-density CVEP, case study #1 had expected activations for a visual stimulus, while case study #2 showed evidence of auditory activation during the visual stimulus, indicative of crossmodal reorganization. After more than six months of consistent osseointegrated device use, we will investigate if this reorganization remains for case study #2.

Conclusions: Results from this research indicate various outcomes of cortical maturation and crossmodal reorganization in two cases of adults with congenital microtia/atresia. Next steps are to further test in more participants, including children with conductive and mixed losses. Information from this research may be important when considering treatment and early intervention for children with conductive and mixed hearing losses considering bone conduction devices.

Category: Electrophysiologic Responses

Poster #: 046

Simultaneous Recordings of Subcortical and Cortical Responses to Speech Stimuli

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Objectives: The main objective of this study was to assess two methods of simultaneous recording of subcortical and cortical auditory evoked potentials to speech stimuli. The following questions were addressed. (1) Can Frequency Following Responses and Late Latency Responses be recorded

simultaneously? (2) How does response amplitude differ among recording paradigms? We hypothesized that amplitudes in simultaneous recordings will not significantly differ from standard responses. (3) When using trains of stimuli, does the number of stimuli in the train affect amplitude? We hypothesized that increasing the number of stimuli will not change the response. (4) An additional primary question examined the effect of the length of the interstimulus interval on response amplitude. We hypothesized that decreasing the ISI will decrease the amplitude of the response.

Design: Twenty adult participants with normal hearing completed baseline testing, standard, and two simultaneous auditory evoked potential conditions. (1) A standard Late Latency Response, using a presentation rate of 0.781/s, comprised the reference comparison condition. (2) A multi-train stimulus paradigm recorded subcortical and cortical responses with stimulus trains involving 3 and 5 stimuli and presentation rates of 1.0-1.6/s. (3) A simultaneous method was completed at a stimulus rate of 3.91/s. The test stimuli were a synthetic /da/ spoken by a male speaker that were 94 or 170 ms in duration. Stimuli were presented binaurally at 75 dB SPL via shielded ER3 insert earphones. Presentation rates ranging from 0.78 to 3.91 stimuli per second were compared to assess changes in response amplitude as a function of stimulus rate. Response latency and amplitude were compared between each of the three paradigms for the subcortical and cortical measures. All conditions were counterbalanced across participants with each participant pre-assigned a specific order of electrophysiologic measures to avoid order effects.

Results: Responses were present for all test paradigms. The standard and multi-train Late Latency Response paradigms yielded all (P1-N1-P2) components. Response amplitude was lower in the simultaneous conditions, particularly for the simultaneous paradigm, than for the standard paradigm. The most significant reductions in response characteristics were observed for the simultaneous condition using the shorter duration 94 ms /da/ and the fastest stimulus rate of 3.91/s.

Conclusions: The results of this study support the ability to simultaneously record subcortical and cortical auditory evoked potentials to speech stimuli. The ability to characterize responses across the auditory neural pathway in a time-efficient manner provides a valuable strategy in individuals who cannot provide reliable behavioral responses. Obtaining information from subcortical and cortical components of the auditory neural pathway allows differentiation of various forms of neural disease. Finally, the use of speech stimuli and longer duration responses facilitate applications in verification of performance with assistive technology such as amplification and cochlear implants. [Supported by NIH NIDCD T35DC008763.]

Category: Electrophysiologic Responses

Poster #: 047

A Comparison of Auditory Brainstem Response for Chirp Stimuli Across Three Different Manufacturers

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Objectives: This study aims to compare Auditory Brainstem Response (ABR) metrics obtained using broadband (BB) and narrow-band (NB) chirp stimuli across different commercial manufacturers. With equipment manufacturers designing unique chirp stimuli that vary in timing, magnitude, and bandwidth, resulting in notable differences in ABR amplitude and latency, it is essential to understand these differences. Unlike previous studies that focus on BB chirps versus clicks or NB chirps versus tone-bursts, this study specifically examines commercially available chirp stimuli from Interacoustics Level Specific (LS) CE-Chirp, Vivosonic VF Chirp, and Intelligent Hearing Systems iChirp. The hypothesis is that differences in chirp design across manufacturers will yield distinct ABR response indices, particularly in Wave-V latency and amplitude, across various frequencies and intensities.

Design: This study recruited 16 normal-hearing adults from the local population. ABR measurements were obtained using a two-channel recording montage with chirp stimuli from each manufacturer. Electrode placement included a non-inverting electrode at the forehead hairline, inverting electrodes on each mastoid, and a ground electrode on the mid-forehead. Recordings were conducted while participants were relaxed or sleeping in a recliner.

Results: Significant differences were found in Wave-V latency and amplitude across manufacturers. For BB chirps, iChirp exhibited longer latencies than both LS CE-Chirp and VF Chirp. At 500 Hz NB chirp, both iChirp and VF Chirp showed longer latencies compared to LS CE-Chirp, while no latency differences were observed at 4000 Hz NB chirp. In terms of amplitude, LS CE-Chirp and iChirp consistently generated larger Wave-V amplitudes than VF Chirp.

Conclusions: The observed differences in ABR latency across manufacturers are primarily due to variations in zero-point shifts for signal averaging. Significant disparities in both latency and amplitude were found among the chirp stimuli produced by the three manufacturers, highlighting the importance of understanding inter-manufacturer variability in ABR responses. These findings emphasize the need for audiologists to make informed choices in ABR equipment selection. Additionally, this information offers clinicians valuable insights into the potential benefits of specific equipment for targeted diagnostic purposes.

Category: Electrophysiologic Responses

Poster #: 048

Cortical Activity Associated with Speech Auditory-motor Adaptation

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Objectives: Auditory-motor integration - or synchronization -is integral in playing instruments, dancing, and even speaking. One prominent example is speech auditory-motor adaptation, a phenomenon in which the central nervous system learns to adjust future speech movements in response to altered auditory feedback such as changes in pitch or formant frequencies. Although this phenomenon is fundamental to speech motor development and maintenance, little is known about its underlying neural

mechanisms. Here, this study aims to examine cortical activity changes during auditory-motor adaptation using functional near infrared spectroscopy imaging. We hypothesize that we will identify cortical activation associated with adaptation in a priori regions of interest implicated in auditory-motor integration.

Design: Ten normal-hearing participants completed an auditory-motor adaptation task in which they were prompted to read target words while listening to audio of their own voice in near real-time. In a sound booth, participants were instructed to say the word that appeared on the screen in front of them while wearing functional near infrared spectroscopy (fNIRS) cap. Three words with similar phonological properties were chosen for this experiment: "Talk," "Tech," and "Tuck." The words were randomized in each block of three trials. The total experiment included 120 trials (40 blocks of the three words). For the first 60 trials, the feedback the participants heard was unaltered and was treated as a baseline period. For the last 60 trials, the participants' first two formant frequencies (F1 and F2) of their voice were increased by 250 cents during which adaptation occurred. fNIRS was used concurrently to monitor changes in hemoglobin concentration in the inferior frontal gyrus, somatosensory association cortex (SAC), angular gyrus (AG), supramarginal gyrus (SG), and the primary & secondary auditory cortices. The SAC, AG, and SG were all chosen because of their implications in integration of auditory and somatosensory inputs, remapping sensorimotor information, and supporting complex linguistic processing.

Results: Preliminary results show that participants lowered F1 and F2 in their speech production in response to the increased formant frequencies, consistent with previous findings. Preliminary neuroimaging results show a small but significant increase in the hemodynamic responses for the altered compared to the unaltered live voice monitoring conditions in the SAC and AG.

Conclusions: Preliminary findings indicate that fNIRS could be a useful tool in examining neural mechanisms underlying speech auditory-motor adaptation. Our findings also demonstrate the overall proof-of-concept of using fNIRS to better understand neural responses associated with auditory-motor integration during speech production and learning.

Category: Electrophysiologic Responses

Poster #: 049

Auditory Brainstem Responses in Children Born Extremely and Very Preterm

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Objectives: Click-evoked auditory brainstem response (ABR) wave latencies are sensitive indicators of brainstem neural conduction time. Because ABR wave latencies decrease with age they are used as an indicator of subcortical auditory development. In preterm infants, ABR wave latencies are longer than those of infants born full-term for the same gestational age, suggesting that the development of the auditory system is delayed in preterm infants. Being born preterm also puts infants at a higher risk for

later diagnosis of language delays and autism. The over-arching goal of our research is to determine whether ABR latencies in children aged 5-6 years who were born preterm have relationships with language and academic outcomes. The objective of the current study was to examine if ABR wave latencies are (1) correlated with tympanometric peak pressure (TPP); (2) if ABR latencies from children born preterm are similar to those reported previously in literature; and (3) for autistic children, if ABR latencies were similar to nonautistic children in our sample.

Design: Of the 104 infants who completed the previous study at Syracuse University, 35 children returned at 5-6 years. Children completed cognitive testing and the Autism Diagnostic Observation Schedule (ADOS-2) supervised by licensed psychologists. Wideband acoustic immittance, otoacoustic emissions, ABR, tympanometry, and behavioral thresholds were measured. ABRs were evoked by 100 ¬µs clicks at 70 dB nHL with a rate of 27.7/s monaurally in both ears. Wave latencies I, III, and V were visually and independently picked by two observers. Pearson correlations were conducted to determine if there was a significant relationship between TPP and ABR wave latencies. Independent t-tests were conducted between mean Wave I, III, and V latencies compared to published ABR latencies.

Results: Of the 35 children that participated in the study, 13 met ADOS-2 criteria for autism. All participants had audiometric thresholds of 15 dB HL or better, yet some had negative tympanometric peak pressure. (1) Significant correlations were found between TPP and ABR for Waves I, III, and V, so data from children with TPP< -150 daPa were excluded from further analysis. (2) Wave I, III, and V latencies for children with clinically normal TPP and without autism (n=17) were significantly longer than those reported in the literature. (3) The wave latencies for the autistic children were similar to those from children without autism except for Wave III in the right ear.

Conclusions: Negative TPP affects ABR latencies even when behavioral thresholds are within normal limits. Longer ABR latencies in preterm children, compared to data in the literature, are suggestive of differences in the auditory brainstem; however, stimuli choices could have contributed to the outcomes. The longer mean Wave III latency for children with autism may reflect anatomical differences in the lower brainstem between children with and without autism. Future studies are needed to address possible interactions between prematurity and autism that affect ABR. [Funded by Syracuse University 'Cuse grant].

Category: Electrophysiologic Responses

Poster #: 050

Acoustic Change Complex Assessment of Binaural Frequency Modulation Sensitivity

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Objectives: The purpose of this study was to measure sensitivity to interaurally in-phase and out-of-phase frequency modulation (FM) using the acoustic change complex (ACC) as an objective test of

temporal fine-structure processing. The goal was to compare this measure to behavioral FM detection results in adults across a wide age range. The hypothesis was that the benefit to sensitivity of interaurally out-of-phase FM declines with age.

Design: Adults with normal/near-normal hearing were equally divided into three age groups of 21 participants: young, middle-aged, and older. FM detection thresholds were measured behaviorally by adjusting modulation depth for in-phase and out-of-phase FM for rates from 4-32 Hz. The carrier was nominally 500 Hz. The ACC was measured for a subset of these rates with a fixed modulation depth of 3 Hz. A continuous 500-Hz tone contained a 250-ms segment of FM every 2.5 sec. For each FM rate, and for both in-phase and out-of-phase modulation, about 200 response repetitions were averaged to extract the ACC. All 63 participants undertook both behavioral and ACC testing.

Results: The ACC was quantified using the inter-trial phase coherence (ITPC) metric. The ITPC was largest for low rates of out-of-phase modulation and declined into the noise floor with increasing rates. This pattern of rate dependence matched the behavioral results across all participants. Correlations between electrophysiological results and behavioral results were small, but significant, for rates of 8, 16, and 24 Hz. Older adults performed consistently more poorly than young adults for out-of-phase FM.

Conclusions: The results of both behavioral and electrophysiological measures support the hypothesis of age-related degradations in temporal fine-structure processing. The general similarities in data pattern for the ACC and behavioral FM sensitivity for both in-phase and out-of-phase FM as a function of modulation rate support the use of the ACC as a proxy measure of frequency discrimination capacity.

Category: Electrophysiologic Responses

Poster #: 051

Examining EEG Correlates of Tinnitus in Mild to Moderate Hearing Loss

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Objectives: This study aimed to identify EEG (electroencephalogram) differences associated with tinnitus in individuals with mild to moderate hearing loss. Specifically, we examined the P300 event-related potential. The P300 is an event-related potential (ERP) that reflects cognitive processes such as attention. The N2 component of the P300 ERP is linked to early cognitive control processes such as response inhibition and cognitive control. Previous research suggests that auditory P300 responses may be smaller in amplitude and delayed in individuals with tinnitus, with these alterations correlating with tinnitus severity. In individuals with hearing loss, auditory P300 responses have also shown reductions in amplitude and increases in latency. Therefore, further research is warranted to examine differences between the impacts of hearing loss and hearing loss and tinnitus on the P300 ERP. Additionally, visual event-related P300 measures have been less studied in these populations, with mixed results on whether visual P300 measures demonstrate differences as a function of tinnitus. Therefore, our goal is to

understand neurocognitive changes in hearing loss and tinnitus by examining individuals with and without tinnitus with mild to moderate hearing loss.

Design: A retrospective cross-sectional study was conducted with older adults with mild to moderate hearing loss. Data collection is ongoing with currently 9 participants reporting tinnitus and 6 reporting no tinnitus. EEG recordings were collected with a 128-channel high-density electrode cap. Auditory stimuli consisted of a frequent tone at 500 Hz and a rare tone at 1000 Hz. Visual stimuli included a frequent "O" and a rare "X". Difference waves were calculated by subtracting frequent from rare waveforms.

Results: Preliminary results show visual P300 amplitudes were significantly reduced in participants with tinnitus compared to those without, in a mid-parietal region of interest. Furthermore, in a mid-central region of interest, auditory N2 component amplitudes from the P300 were larger in individuals with tinnitus, in both the rare and difference waveforms.

Conclusions: In this small dataset we observed individuals with tinnitus and mild to moderate hearing loss exhibited distinct EEG differences, notably reduced visual P300 and enhanced auditory N2 amplitudes. Similar to our findings, increased N2 amplitudes have previously been noted in individuals with tinnitus. It may be that these larger N2 amplitudes reflect heightened auditory attention; however, further research is needed. The differences in our findings of smaller visual P300 amplitudes compared to previous research showing no differences in visual P300 results may be related to the examination of different tinnitus populations, i.e. those with and without hearing loss. These preliminary findings highlight the potential of EEG measures to serve as objective measures for tinnitus.

Category: Electrophysiologic Responses

Poster #: 052

Effects of Outer Hair Cell Loss on Suprathreshold Coding

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Objectives: Threshold audiometry and restoration of speech audibility through amplification are the cornerstones of current audiological practice. Yet, patients with sensorineural hearing loss (SNHL) often struggle to understand audible speech, especially in noisy environments. This research aims to investigate the impact of outer hair cell (OHC) loss on the processing of audible sounds, particularly in relation to envelope coding and speech perception in noise. We hypothesize that greater degrees of OHC loss will lead to broader tuning curves and reduced speech perception scores in noise, indicating a degradation in auditory coding. We also aim to predict individual differences in hearing outcomes in noisy environments across the continuum of normal and disordered hearing.

Design: Individuals across the continuum of normal hearing and hearing loss were recruited through flyers posted in public sites around the Pittsburgh community, word of mouth, and through "Pitt+Me", an institutional research participant registry which allows for both general web postings and personalized mailings based on the preferences set by potential participants. Otoacoustic-emission measurements (OAEs) were used as an index of OHC integrity. To measure suprathreshold sound coding, we used both electrocochleography (EEG)-based envelope-following responses (EFRs), psychophysical tuning curves, and speech-in-noise scores. Data collection is ongoing with a target N=100. Preliminary results from ~70 participants are reported.

Results: Preliminary data suggests that when there is slight OHC loss associated with slight audiometric threshold elevation and reduced DPOAEs, we see larger EFRs consistent with enhanced envelope coding with broadened tuning. However, with greater degrees of OHC injury, peripheral coding is substantially altered with psychophysical tuning curves not only exhibiting broader "tips", but hypersensitive "tails" and significantly reduced tip-to-tail ratios. In both cases, OHC injury is associated with poorer speech-in-noise scores.

Conclusions: Our results are consistent with animal studies of altered auditory nerve responses in SNHL showing both broadened tuning curve "tips" and distorted tonotopic coding owing to hypersensitive tuning-curve "tails". These findings help explain why OHC injury not only reduces hearing sensitivity, but also impacts suprathreshold speech perception in noise. Future work may seek to characterize these neural coding alterations in more detail, particularly for speech sounds in realistic backgrounds. In the long run, this line of research could guide targeted interventions to improve speech perception in individuals with varying degrees of hearing loss.

Category: Electrophysiologic Responses

Poster #: 053

Can Transcranial Magnetic Stimulation Alter Auditory Cortical Excitability?

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Objectives: Feedback neural networks from the auditory cortex to the ear play a crucial role in sound perception, yet the mechanisms underlying this cortical control remain poorly understood. Transcranial Magnetic Stimulation (TMS) offers a non-invasive means to alter the excitability of cortical neurons as a means to study the downstream effects at the periphery. While TMS has shown promise in modulating motor cortex activity, its application to the auditory cortex is still emerging. Clinically, TMS has been used for tinnitus treatment; however, no objective method currently exists to verify its specific effects on the auditory cortex. The present study aims to bridge this gap by exploring whether TMS can induce measurable changes in auditory cortical excitability and peripheral auditory function. We hypothesised that TMS would produce significant changes in cortical excitability and peripheral measures, as measured by electroencephalography (EEG) and otoacoustic emissions (OAEs), respectively. Our null hypothesis posited that sham TMS and TMS would produce similar changes in ear and brain activity.

Design: The study employed a within-subjects design with 13 normal-hearing adults (9 females, aged 18-35) across three conditions: baseline, post-sham, and post-TMS. Baseline EEG and OAE measures were first recorded prior to applying TMS or sham-TMS. Sham-TMS, a control condition involving a TMS coil that produces click sounds without an electromagnetic field, was then applied for 40 seconds, followed by EEG and OAE measurements. In the final condition, theta burst rTMS (50Hz in 5Hz bursts, totalling 300 pulses over 40 seconds) was delivered to both auditory cortices. EEG assessed cortical excitability via N1P2 amplitude and P2 latency, while OAEs measured peripheral auditory function and the function of the brainstem efferents, the medial olivocochlear reflex (MOCR). Participants engaged in an auditory oddball detection task during all conditions to ensure consistent attention to auditory stimuli.

Results: The analysis revealed no significant effects of TMS or sham-TMS on cortical excitability measures (N1P2 amplitude: $F[1,34] = 0.14$, $p = 0.7$; P2 latency: $F[1,34] = 0.04$, $p = 0.8$), indicating that TMS did not alter cortical responses as measured by EEG. However, there was a significant main effect of condition on MOCR magnitude ($F[1,34] = 9.4$, $p = 0.004$), suggesting that TMS influenced peripheral auditory function. Post-hoc tests showed that TMS significantly reduced MOCR magnitude relative to baseline [$t(11) = -3.4$, $p = 0.012$], while the sham condition produced no significant effect [$t(11) = -1$, $p = 0.7$].

Conclusions: We conclude that, under the tested parameters, TMS can effectively modulate peripheral auditory function, as demonstrated by significant changes in the OAEs and MOCR. However, the lack of measurable effects on cortical excitability suggests that the current TMS parameters require further optimization to achieve more pronounced changes both peripherally and at the cortical level. Notably, there is a need for a more sensitive neural marker to detect TMS-induced changes in cortical excitability. Clinically, this research underscores TMS's potential as a non-invasive method for influencing auditory processing, which may ultimately contribute to developing treatments for auditory disorders associated with neural correlates, such as tinnitus.

HEARING LOSS / REHABILITATION

Category: Hearing Loss / Rehabilitation

Poster #: 054

Diet Quality and Hearing Loss in Older Adults

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Objectives: Hearing loss is common among older adults. Many factors contribute to age-related hearing loss, with dietary contributions receiving increasing attention. In studies exploring the relationship between diet quality and hearing loss, dietary patterns quantified with indices such as the Healthy Eating Index (HEI) and the Mediterranean Diet Score (MDS) have shown that poorer diet quality is associated with increased odds of hearing loss. The frequency ranges where diet predicts risk of hearing loss vary with the dietary indices used. In this study, we explored the relationship between diet quality and hearing loss in several frequency ranges, using both the HEI and the MDS indices to quantify diet. We hypothesize that poor diet quality, as quantified by the HEI and MDS, will be associated with greater odds of hearing loss but that the frequency ranges where this relationship is shown will differ for the two dietary indices, as has been shown previously. We will extend these previous findings by exploring the dietary components of each index that are associated with increased odds of hearing loss, which may give insights into mechanisms driving the differences.

Design: This cross-sectional study uses data from the National Health and Nutrition Examination Survey (NHANES) cycles 2015-2016 and 2017-2020. We included adults aged ≥ 50 years (n=1250). Hearing sensitivity was evaluated using pure tone averages at different frequencies: low frequencies (0.5, 1, and 2 kHz), speech frequencies (0.5, 1, 2, and 4 kHz), and high frequencies (3, 4, 6, and 8 kHz). Hearing loss was defined as a pure-tone average greater than 25 dB HL. Diet quality was assessed using both the HEI and MDS. A higher HEI is associated with better diet quality according to the Dietary Guidelines for Americans, 2020-2025. A higher MDS is associated with better adherence to a Mediterranean-style diet.

Results: We used two multinominal logistic regression models to analyze the relationship between diet quality (HEI or MDS score) and hearing loss. In model 1, the covariates of age, sex, and total energy intake were included. Model 2 included all covariates from model 1 and additionally adjusted for cardiovascular disease (CVD), smoking, body mass index (BMI), and noise exposure. MDS or HEI score were significantly related to odds of hearing loss, with frequency ranges showing this relationship differing between the two approaches to quantifying diet, as predicted. Covariates showing significant relationships with odds of hearing loss also varied between the models and approaches to quantifying diet. Dietary components most strongly associated with the differences for each model and index will be discussed.

Conclusions: Dietary quality (as quantified by the HEI or MDS indices) is related to odds of hearing loss in older adults. Following dietary guidelines and adhering to a higher quality diet may reduce the risk of developing hearing loss at older ages and may be a modifiable lifestyle factor to reduce the burden of hearing loss associated with aging. Recognizing habits that preserve hearing ability is crucial for general health, given the link between hearing loss and cognitive decline.

Category: Hearing Loss / Rehabilitation

Poster #: 055

Physiological Responses as Markers of Everyday Listening Effort and Fatigue

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Objectives: Individuals with hearing impairment report experiencing higher levels of listening effort and fatigue during daily life than age-matched individuals with normal hearing. Since findings from the laboratory have been shown to be poor predictors of real-life listening experiences there is a need for measures that can be used to evaluate listening effort and fatigue in daily life. Physiological responses, such as heart rate, electrodermal activity, and skin temperature, are markers of stress and arousal and can be measured unobtrusively outside laboratory settings. The present study aims to investigate the suitability of heart rate, electrodermal activity and skin temperature as markers of self-reported listening effort and fatigue during daily life.

Design: Sixty-seven hearing aid users (mean = 72 years. SD = 10.45) participated in a four-week field trial, during which physiological responses were continuously recorded via Empatica Embrace Plus wristbands. Sound pressure level (SPL) and signal-to-noise ratio (SNR) were recorded every 20 seconds via the participants' own hearing aids. Self-reported ecological momentary assessments (EMAs) were provided by the participants via an app throughout the day. The physiological responses, SPL, and SNR were averaged in a 5-minute window prior to each EMA report.

Results: The early results of the current study will be presented. Random forest models are used to analyze how well heart rate, electrodermal activity and skin temperature predict self-reported listening effort and fatigue. Specifically, the variable importance and accuracy of the models will be reported.

Conclusions: The present study is the first to combine longitudinal objective data - that is, physiological responses and ambient acoustics, with self-reported momentary assessments obtained during the hearing aid users' daily life for investigating daily-life listening effort and fatigue. The outcomes of this study are ultimately expected to contribute to ecologically valid methods of assessing the effects of hearing aid signal processing on well-being.

Category: Hearing Loss / Rehabilitation

Poster #: 056

Feasibility of a Hearing Program in Primary Care for Underserved Older Adults

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Objectives: Age-related hearing loss has a substantial negative impact on communication and biopsychosocial health. Despite its high prevalence, hearing loss is under-recognized and often undertreated, especially within marginalized communities. We hypothesize that offering hearing screenings and a point-of-care counseling program in an older underserved population will be more accessible and acceptable than the traditional pathway for audiology care.

Design: We are conducting a randomized clinical trial in which we screen older adults for hearing loss in primary care. Eligible and consenting participants are then randomized to either (1) a referral to audiology (usual care) or (2) a point-of-care counseling session on alternative hearing rehabilitation individualized to patients' preferences. To date, we have approached 519 patients before their primary care visits in a geriatric clinic in a city hospital and screened of these 198 patients. This component of the program is a quality improvement initiative using a self-report survey tool (HHI) and a tablet-based screener (Shoebox). Eligibility criteria included those aged ≥60 years, proficiency in English or Spanish, not using hearing aids or cochlear implants, and have the capacity to consent to research. Of the eligible participants who screened positive for hearing loss (118/198 or 60%), 58 consenting participants were randomized and completed questionnaires, including a demographic form, the Dejong Loneliness Questionnaire, and the Patient Health Questionnaire 9 (PHQ-9). The demographic form collects data related to prior hearing care experiences, use of a smartphone, and socioeconomic characteristics. Subjects in the intervention arm are counseled on communication strategies, smartphone tools (if applicable), and given a demonstration with a Personal Sound Amplifier with the option to take them home. After one week, all subjects receive a follow-up call to confirm understanding from the audiology referral or counseling, address questions, troubleshoot equipment, and reinforce strategies. At 3 months, a final follow-up will assess actions taken and re-administer the HHI-S to evaluate the intervention's impact on hearing and communication. We are also conducting semi-structured interviews for pre-implementation with stakeholders and participants.

Results: The median age of participants in our trial was 79. More than 40% have at least moderate hearing loss. Only 3% of positive screens had been fitted for hearing aids. We found a significant disconnect between self-report and measured hearing: only about 13% self-reported difficulty of those with measured hearing loss. Our follow-up rate at 3 months was 70%. Ninety percent of study participants identified as non-White and had an annual income of<$20,000. We have met pre-specified feasibility targets for screening and enrollment. Preliminary results support the acceptability of a patient-centered communication counseling program in primary care serving underserved older adults.Interviews with clinic staff and patients indicate acceptability of our current approach and have led to refining our study protocol.

Conclusions: Our program offers a novel approach for hearing loss identification and at the same point of care, equips patients with tailored rehabilitation strategies that strive for high acceptability. We will also provide evidence on the extent to which current care pathways are serving the needs of this vulnerable population. Preliminary results suggest that a patient-centered communication counseling program in a primary care setting serving underserved older adults is feasible and acceptable to persons who might otherwise not access hearing rehabilitation. Future trials will measure the impact of such a program on patient health and quality of life.

Category: Hearing Loss / Rehabilitation

Poster #: 057

What Do We Know About Audiology Clients With Normal Audiograms?

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Objectives: One of the challenges facing audiologists is managing clients who attend audiology appointments who report hearing difficulties but have normal audiograms and for whom options for hearing amplification devices are limited. The objective of this study was to compare the demographic and hearing-related factors of those attending an audiology appointment with normal audiograms, to those with hearing loss.

Design: The hearing ability of clients of a large network of audiology clinics were classified as normal if thresholds in both ears were<=20 dB HL , and non-normal for all other cases. The following variables were examined: Age at first appointment, sex, best ear three-frequency average thresholds, AB word scores, QuickSin scores, tinnitus (reporting, bothersome, awareness), aspects of psychosocial health, 0 to 10 scales for self-reported hearing ability, and effect of hearing loss on quality of life, impact on work, and motivation to do something about their hearing loss.

Results: Data from 4,449 normal and 38,632 non-normal adults were included. Although there were approximately equal numbers of males and females, significantly fewer males had normal hearing. For the normals, tinnitus was of greater significance, AB word scores were almost all normal , but 17.3% had mild or greater difficulty with the QuickSIN test (versus 68%.5% for non-normals). Their median scores for motivation to do something about their hearing was only a point lower than non-normals. More than 10% of those with normal audiograms reported frustration and being worried about their hearing.

Conclusions: About 10% of clients attending had normal thresholds, with many reporting significant impacts on their daily life. Tinnitus may be a more important driver for them than other clients. Clinicians should make themselves aware of the difficulties faced by clients who have normal audiograms, and consider options such as fitting hearing aids, recommend use of assistive listening devices, and counselling.

Category: Hearing Loss / Rehabilitation

Poster #: 058

A Clinical Study of Neuromodulation and Sound Therapy for Tinnitus

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Objectives: Tinnitus management is gaining attention by the public because effective treatments for tinnitus have emerged in recent years. For example, the Lenire bimodal neuromodulation device from Neuromod delivers sound stimulation through wireless headphones and electrical stimulation to the surface of the tongue to reduce the effects of bothersome tinnitus. The device activates both auditory and somatosensory pathways and has shown significant improvements in reducing tinnitus severity in adult patients. Lenire is relatively new to audiologists in the US, and most research on Lenire is based on clinical trials that demonstrate its efficacy in adult research participants. To investigate the clinical effectiveness of these tinnitus treatments, we compared Lenire to sound therapy using a clinical population of 24 adults with tinnitus. We also provided individual counseling using Tinnitus Activities Treatment (TAT) to all 24 patients. TAT offers counseling and strategies for the four areas impacted by tinnitus: thoughts and emotions, concentration, sleep, and hearing and communication. TAT also uses a collaborative approach to set patient-specific goals for therapy and incorporates picture-based counseling in the management of tinnitus.

Design: Patients received tinnitus counseling using TAT over multiple sessions, approximately three to five individual tinnitus consultations, over a three-to-six-month period. Each patient also used neuromodulation (n=12) or sound therapy (n=12) in combination with tinnitus counseling. Patients in the neuromodulation group used the Neuromod Lenire device as prescribed for at least 3 months. Patients in the sound therapy group used a combination of wearable tinnitus devices, smartphone Apps for tinnitus, or stand-alone sound generators as appropriate during treatment. We administered the Tinnitus Primary Functions Questionnaire (TPFQ) that includes 12 items and assesses the impact of tinnitus on daily activities (i.e., concentration, thoughts and emotions, hearing and communication, and sleep). We also administered the Client Oriented Scale of Improvement for Tinnitus (COSIT) to determine the specific problems related to tinnitus. We evaluated tinnitus treatment effectiveness by comparing pre- and post-treatment responses on the TPFQ and COSIT, and used paired t tests to compare differences.

Results: Reactions to tinnitus significantly improved for both groups after tinnitus treatment. TPFQ total scores improved by 24 points, which was statistically significant for both groups. Additionally, 67-83% of individual patients reported a clinically significant reduction in their tinnitus. The best improvements were reported for problems related to concentration and sleep. Results from the COSIT suggested slight differences in the problems reported by patients who seek sound therapy compared to those using neuromodulation. COSIT change scores were better or much better for 60-80% of patients, indicating a good result from tinnitus treatment.

Conclusions: Our clinical study concluded that sound therapy and neuromodulation combined with tinnitus counseling are effective in managing bothersome tinnitus. We anticipate gathering data from more tinnitus patients to investigate differences between neuromodulation and sound therapy.

Category: Hearing Loss / Rehabilitation

Poster #: 059

Impact of Central Penetration Effectiveness on Antiretroviral Ototoxicity in Humans

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Objectives: To investigate the relationship between the central penetration effectiveness (CPE) of antiretroviral therapies (ARTs) used in prophylactic intervention and management of HIV patients and the ototoxic effects these populations experience. This review seeks to understand how the CNS Penetration-Effectiveness (CPE) score of antiretroviral therapies (ARTs) relates to the ototoxic effects patients experience by examining previous literature. In doing so, we aim to fill in the gaps in understanding the relationship between varying CPE scores assigned to ARTs and the ototoxic effects patients experience. Rationale: In 2023, nearly 40 million people were living with HIV. Of those, 77% were on Antiretroviral medications for the treatment and prevention of HIV. The CDC and other health organizations around the globe have a goal of ending the HIV epidemic by 2030. Yet both preclinical and clinical models have shown the ototoxic effects of these medications on auditory tests like extended high-frequency audiometry, otoacoustic emissions, speech in noise testing, and more (DeBacker et al. 2021, Fasunla et al 2019). There is literature that shows that ARTs permeating through the blood-brain barrier can have ototoxic effects for patients. However, there is no previous literature that states whether the penetration of these ARTs through the cerebral spinal fluid (CSF) plays a role in the auditory outcomes of patients. Using the Central Penetration-Effectiveness (CPE) score, a scoring system created to measure how effective ARTs are at penetrating the blood-brain barrier (Letendre et al. 2008), we hope to better understand the relationship between penetration scores and auditory outcomes. Using the CPE score criteria to classify the effects these therapies have on the auditory system will allow physicians to incorporate these findings into the treatment recommendations for their patients.

Design: The search was conducted using controlled vocabulary (e.g., MeSH or Emtree) in the following databases: PubMed, Embase, and Web of Science. Inclusion criteria included all study designs that used human subjects with exposure to ARTs and had hearing or balance-related measures, and articles were excluded if they met any of the following conditions: study designs that included non-human subjects, no mention of ART exposure, pharmacokinetic studies that do not measure a hearing-related outcome, or opinion studies about deafness and HIV/AIDS. A total of 2059 relevant articles were identified. 935 duplicates were identified and removed. The remaining 1,124 articles underwent abstract screening where each was reviewed by two evaluators for inclusion. Screened articles will undergo full-text screening and the final cohort of included articles will undergo data extraction to identify relevant variables including auditory outcome measures, population features, and treatment factors.

Results: Although the full-text review is still underway, many common themes in the literature have become apparent. Roughly ,Öî of the studies are on adults compared to children, ,Öî of studies are from outside the US, and all the studies report varying auditory outcomes from many test measures including peripheral and central tests and cognitive screeners, including audiometry, auditory brain stem responses, otoacoustic emissions, latency responses, speech test, and the Montreal Cognitive Assessment.

Conclusions: This information shows us that the result of this study could have a global impact and help physicians and researchers better understand how ARTs affect certain populations as well as what test methods offer consistent results in monitoring. Ultimately leading to future monitoring protocols and well-informed recommendations.

Category: Hearing Loss / Rehabilitation

Poster #: 060

Lancet Commission on Hearing Loss: Novel Tools to Measure Stigma

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Objectives: The Lancet Commission on Hearing Loss is a multinational effort that aims to reduce the global burden of disability associated with being d/Deaf or hard of hearing (d/DHH). Commissioners recognized stigma as a significant barrier to living well with hearing loss and seeking hearing healthcare. The Commission convened a Measures, Models, and Reduction of Stigma Subgroup tasked with advancing our understanding of d/DHH stigma and identifying actions to address it. Drawing on research and expertise from other stigmatized health conditions, the subgroup identified a lack of tools to measure the different types of stigma faced by diverse groups of d/DHH people. This presentation describes the development and preliminary validation of novel scales designed by the Subgroup to measure different types of stigma among diverse populations of d/DHH people and those close to them.

Design: We used an exploratory sequential design, through a multistep process: initial survey development, modified Delphi process, cognitive interviewing, and pretesting. Finally, psychometric validation took place across the United States (high-income country) and in the Eastern and Greater Accra Regions of Ghana (low-middle income country).

Results: A set of stigma measurement scales was developed for four distinct populations: individuals who are d/DHH, care partners of adults who are d/DHH, parents of children who are d/DHH, and health care providers. For use among those with lived experience of being d/DHH, we created scales for experienced, perceived, internalized, and hearing device-related stigma. Scales for care partners included observed and perceived stigma toward d/DHH people and their own internalized, experienced, and perceived stigma because of their association with a person who is d/DHH. Scales for parents included parental observation of stigma their child experiences, parental perceptions of stigma toward their child, parental secondary experienced, perceived, and internalized stigma. Healthcare provider scales included provider-perceived stigma, provider-enacted stigma, secondhand patient-experienced stigma, and secondhand patient-perceived stigma. We developed scales to measure perceived hearing device-related stigma among care partners, parents, and healthcare providers. We also developed a series of ageism scales: experienced ageism, care partners' observed ageism, health care providers' observed ageism, and the general population's observed ageism.

Conclusions: The suite of stigma measurement scales developed by the Subgroup, now published in a special supplement of Ear and Hearing, fill a critical gap in d/DHH stigma measurement. Continued research using these measurement tools will allow for the ongoing monitoring of d/DHH stigma and its impact. Over time, the data collected can be used to track changes in societal attitudes toward hearing loss, measure the effectiveness of stigma reduction interventions, and further refine interventions. By leveraging these scales in both clinical settings and broader public health initiatives, the next steps can significantly reduce stigma, improve patient experiences, and lead to better overall outcomes in hearing healthcare.

Category: Hearing Loss / Rehabilitation

Poster #: 061

Characterizing Sleep Outcomes in School-Age Children with Hearing Loss

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Objectives: Growing research suggests that children with hearing loss show increased listening-related effort and fatigue relative to age-matched peers with normal hearing. However, the influence of hearing loss on sleep-related fatigue in children is relatively understudied. The goal of this work was to characterize sleep outcomes in school-age children with hearing loss who experience listening fatigue using subjective (e.g., questionnaires) and objective (e.g., actigraphy) measures of sleep and fatigue. We predict that children with hearing loss will report higher levels of both listening and sleep-related fatigue relative to children with normal hearing, which will relate to disrupted sleep.

Design: The study recruited children with hearing loss (n = 5) and children with normal hearing (n = 7) between the ages of 6-12 years from an outpatient clinic, with a planned sample size of 25 participants per group. All participants completed an in-person visit followed by a 7-day tracking period at home. During the in-person visit, participants and caregivers completed standardized questionnaires of fatigue, listening effort, and sleep. Participants were fit with an actigraph sleep-wake tracking watch and provided instructions to wear the watch during a 7-day tracking period at home and complete an at-home sleep log. Participants mailed back equipment and sleep logs at the end of the tracking period.

Results: With respect to subjective measures, preliminary results suggest that children with hearing loss showed higher levels of fatigue across domains (cognitive, physical, and sleep fatigue) relative to children with normal hearing. Children with hearing loss also reported higher listening-related fatigue and greater self-reported sleep dysfunction relative to children with normal hearing. Preliminary actigraphy measures suggest children with hearing loss showed fewer recorded sleep hours relative to normal hearing children.

Conclusions: Preliminary findings suggest that children with hearing loss show greater sleep disruptions relative to normal hearing children. Questionnaire measures of fatigue and listening effort replicate previous findings demonstrating increased listening effort and fatigue among school-age children with hearing loss. This ongoing work suggests that hearing loss and listening-related fatigue may have downstream effects on sleep patterns in children leading to sleep disruptions.

Category: Hearing Loss / Rehabilitation

Poster #: 062

The Role of Resilience and Hearing Difficulties on Psychological Distress

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Objectives: Although hearing loss can have a substantial impact on mental health, relatively little research has focused on factors that predict mental health outcomes among adults with hearing loss. This study examined the effects of demographic identity, self-perceived hearing difficulty and resiliency on psychological distress in adults with hearing loss. In this survey-based study of adults with hearing loss, we addressed the following research questions: 1. What are the associations between demographic identity, self-perceived hearing difficulty, resiliency, and psychological distress? 2. To what extent do demographic identity, self-perceived hearing difficulty, and resiliency predict psychological distress? We hypothesized that adults with lower resilience and higher self-perceived hearing difficulty would have higher psychological distress.

Design: This study utilized an exploratory cross sectional-survey design. Participants included 118 adults with hearing loss (73 women, 44 men, 1 gender unknown). The mean age was 66.9 years (SD = 17.1). Participants were recruited through the University of Tennessee Health Science Center's Audiology Clinic. Participants answered demographic questions and three scales: the Abbreviated Profile of Hearing Aid Benefit (APHAB) measured self-perceived hearing difficulty, the Kessler 6 (K6) measured psychological distress, and the Brief Resilience Scale (BRS) measured resilience. Bivariate analyses and multiple regressions were conducted to examine the relationships between demographic variables (gender, age, and income), resilience, and self-perceived hearing difficulty on psychological distress.

Results: The regression results indicated that gender was not associated with K6 (psychological distress) whereas both age and income were significantly negatively associated with K6 (p's = .038 and .049). As age and income increased, psychological distress decreased. The APHAB Global Score was significantly positively associated with K6 ($p = .024$), indicating that higher communication difficulty is associated with higher psychological distress. BRS (resilience) was significantly negatively associated with K6 ($p < .001$), indicating that higher resiliency is associated with lower psychological distress. When age, income, APHAB Global Score, and resilience were included together in a multiple regression predicting psychological distress, older age, better communication ability, and higher resilience significantly predicted lower psychological distress.

Conclusions: There are three main findings from this study that provide helpful insights into the relationship between hearing loss and mental health. The first finding is that age and income are protective factors for psychological distress. Although this pattern is well documented in the general literature, there are conflicting findings in audiological literature. The second finding demonstrates that higher communication abilities predict lower levels of psychological distress. To our knowledge, this is the first study that examines the relationship between the APHAB and K6 and shows a promising way to predict psychological distress in this population. Finally, this study demonstrates insight into the resilience of adults with hearing loss and the impact of resilience on psychological distress. As resilience increases, psychological distress decreases. This underscores the importance of strengthening resilience to help navigate psychological well-being for adults with hearing loss. Broadly, the findings suggest that both audiologic and mental health interventions may directly contribute to well-being in adults with hearing loss.

Category: Hearing Loss / Rehabilitation

Poster #: 063

Favorite Activities Among Older Adults with Hearing and Vision Loss

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Objectives: Activity participation plays a crucial role in the health, well-being, and quality of life of older adults. Hearing and vision loss are highly prevalent in this population and may impact activity participation and preferences. In this study, we (1) describe the preferred activities of older adults with hearing, vision, and dual sensory loss and (2) investigate the association between hearing, vision, and dual sensory loss and physical vs. non-physical activity participation. We hypothesized that participants with hearing, vision, or dual sensory loss will be less likely to report a physical activity as their favorite activity.

Design: This study utilizes data from Round 12 of the National Health and Aging Trends Study (NHATS), a US nationally representative sample of Medicare beneficiaries aged 65 and older (n=6,327) collected in 2022. Hearing loss was assessed through pure-tone audiometry and vision loss was measured through standardized tests for distance/near acuity and contrast sensitivity. The pure-tone average (PTA), in decibels hearing level (dB HL) was measured at 0.5, 1, 2, and 4 kHz. Hearing loss is defined as PTA thresholds >25 dBHL in the better hearing-ear (combining mild [26-40 dBHL], moderate [41-60 dBHL], and severe or greater [>60 dBHL] categories), while normal hearing is ≤25 dBHL.Vision loss was defined by the presence of distance, near (logarithm of the minimum angle of resolution >0.30), or contrast sensitivity loss (log contrast sensitivity<1.55). Dual sensory loss was defined as having both hearing loss

and vision loss. The ranking of favorite activities was based on responses to the survey question "What is your favorite activity?" Open-ended responses were then categorized into physical and non-physical activities. Multivariable logistic regression models were used to examine the association between sensory losses and odds of preferring physical or non-physical activities. Covariates include age, gender, race/ethnicity, education, marital status, house type, self-reported health conditions, financial strain, BMI, depressive symptoms, and count of chronic conditions.

Results: Among 5,437 participants (57.1% female, 65.6% White, 57.7% with ≥college education), 23.2% had no sensory loss, 39.3% had hearing loss only, 8.5% had vision loss only, and 29.1% had dual sensory loss. The most commonly reported favorite activity overall was walking or jogging. In the fully adjusted model, dual sensory loss was associated with lower odds of reporting a physical activity as their favorite activity compared to no sensory loss (OR=0.77, 95% CI: 0.64-0.92). Compared to those without sensory loss, individuals with hearing loss only (OR=0.92, 95% CI: 0.79-1.08) and vision loss only (OR=0.93, 95% CI: 0.74-1.17) had lower but non-significant odds of reporting physical activities as favorites.

Conclusions: Our findings suggest that dual sensory loss was associated with lower odds of reporting physical activities as favorite activities. Lack of sensory accessibility to many physical activities is a substantial barrier to maintaining an active lifestyle for older adults with sensory loss. Future research should focus on exploring strategies for improving access to physical activity in this population.

Category: Hearing Loss / Rehabilitation

Poster #: 064

Developing the WHO Package of Ear and Hearing Care Interventions

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Objectives: Persistent inequities in access to ear and hearing care (EHC) are most pronounced in low- and middle-income countries and other resource-limited settings. To overcome these inequities, EHC services must be integrated across different levels and sites of care. To support countries in decision-making regarding which EHC interventions to include in their national health services, the World Health Organization (WHO) aims to provide guidance on the most relevant conditions to address at different levels of care and the resources required to address them. To this end, WHO will develop a package of evidence-based EHC interventions to assist countries in making decisions regarding which interventions to prioritize, how to budget for these interventions, and how they can be integrated into national health services packages and policies. This presentation will describe the methodology that guides the development of that package, titled the Package of Ear and Hearing Care Interventions (PEHCI), led by the WHO.

Design: This development of the PEHCI is comprised of four phases. The first is to select priority EHC conditions to be included, through literature reviews and consultation with experts. The second is to identify evidence-based EHC interventions, by review of high-quality clinical practice guidelines and systematic reviews, to be included in the PEHCI. The third is expert agreement on interventions and their service delivery platforms, and to create descriptions for resource requirements for each intervention. The fourth is peer review. The project will be led by the WHO Ear and Hearing Care Programme and will be supported by relevant stakeholders throughout the development process, including experts in research and practice related to EHC, and individuals with hearing loss.

Results: This presentation will provide an overview of the methodology for developing the PEHCI. It will also include an initial list of conditions and example interventions that are proposed to be included in the PEHCI.

Conclusions: The PEHCI aims to provide countries and other end-users with information related to evidence-based EHC, which can be used to prioritize interventions, and plan for the resource requirements and costs to facilitate the implementation of the interventions into national health services packages and policies. The PEHCI can serve as an important resource towards strengthening EHC within health systems, ultimately allowing more people to benefit from EHC interventions.

Category: Hearing Loss / Rehabilitation

Poster #: 065

Sex- and Race-Specific Prevalence and Incidence of Hearing Loss

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Objectives: Hearing loss is an important public health problem, yet the current understanding of the natural history of hearing loss, including sex and race differences, is limited. This study reports the prevalence and incidence of hearing loss and associated factors across the adult lifespan, and differences by sex and race.

Design: Participants were adults from the Medical University of South Carolina Longitudinal Cohort Study of Age-related Hearing Loss, an ongoing (1988-current) community-based cohort study based in Charleston, SC. Hearing loss is defined as a worse-ear pure-tone average (0.5-4.0 kHz) >25 dB HL. Prevalence and incidence (per 1000 person years [PY]) of hearing loss are reported for the entire sample and by sex (male/female) and race (White/Black). Demographic factors measured at participants' baseline examination included age, sex, race, and socioeconomic position, defined by education and occupation. Hearing- and health-related factors, also measured at baseline, were self-reported, and included history of noise exposure, diabetes, cardiovascular conditions, smoking, obesity, and number of

comorbid conditions. We built age- and multivariable-adjusted logistic regression (cross-sectional) and Cox proportional hazards (longitudinal) models to determine associations of these factors with hearing loss.

Results: Prevalence analyses included 1,787 participants (mean age 61.3 [SD 16.4] years; 56.7% female; 18.0% Black). The prevalence of hearing loss was 46.2% and was highest among White males (60.4%) and White females (42.1%), and lower for Black males (32.8%) and Black females (27.9%). Prevalence increased with age for all sex and race groups. In a multivariable logistic regression model, older age, male sex, lower socioeconomic position and noise exposure were associated with higher odds, and Black race was associated with lower odds of hearing loss. Incidence analyses included 754 participants without hearing loss at the baseline examination (mean baseline age 56.7 [SD 16.2] years; 67.6% female; 22.9% Black participants; mean follow-up time: 5.0 [SD 5.9] years). The incidence of hearing loss was 44.8 per 1000 PY and was similar for White (44.9 per 1000 PY) and Black (46.5 per 1000 PY) participants, and non-significantly higher in males (51.3 per 1000 PY) than females (41.8 per 1000 PY). In separate age-adjusted models, older age, male sex, noise exposure, and more smoking pack years were associated with higher risk of incident hearing loss; only older age remained significant in a multivariable Cox proportional hazards model. Some factors associated with prevalent or incident hearing loss differed in separate models across sex and race groups. For example, in cross-sectional age-adjusted logistic regression models, noise exposure was associated with hearing loss among White, but not Black, males, despite similar prevalence of noise exposure among those two groups.

Conclusions: The prevalence and incidence of hearing loss are high among older adults, and there are sex and race differences in hearing loss prevalence, incidence, and associated factors. Prevention and management of hearing loss could be improved through the development and implementation of tailored interventions across populations.

Category: Hearing Loss / Rehabilitation

Poster #: 066

Barriers and Facilitators of Implementing a Self-efficacy-based Auditory Rehabilitation Protocol

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Objectives: Auditory rehabilitation (AR) is gearing towards a more individualized patient-centered approach where the rehabilitation is customized to each individual's hearing loss and their personal characteristics. One of the personal characteristics that has shown to impact aspects of AR success is hearing aid self-efficacy (HASE) which refers to an individuals' belief in their ability to manage hearing aids (HA) effectively. Researchers have developed questionnaires to evaluate HASE in four different domains. They have also developed techniques based on the sources of information for self-efficacy (mastery experience, vicarious experience, social persuasion, and physiological and emotional states) to improve HASE while providing AR. Although there is some research to suggest the positive impacts of high HASE on greater HA success, not many clinicians are actively considering their patients' HASE while

planning individualized AR. The purpose of this study was to identify the common barriers and facilitators of implementing a self-efficacy-based auditory rehabilitation (SEBAR) protocol.

Design: The interpretive phenomenological (IP) qualitative approach was used for data collection and analysis. Twelve participants (6 audiologists who provide adult AR services and 6 new hearing aid users) aged 27 to 81 years completed semi-structured interviews with the researchers. The interview questions were designed around the Capability Opportunity Motivation - Behavior (COM-B) model of health behavior change and were about participants' perceptions on the barriers and facilitators of using the SEBAR protocol. Results of the qualitative thematic analysis highlighted the primary themes shared among the participants. These themes were used to describe the determinants that would facilitate the implementation of the SEBAR protocol.

Results: Eight different themes emerged that were shared among multiple participants and were around the COM-B model. The audiologist group shared that having more knowledge about the resources, making them available on multiple platforms and making them digitally accessible, incorporating the SEBAR protocol in standard audiology practice and making it a billable service category would motivate them to implement it. Additionally, they believed that having intrinsic motivation to improve AR and being flexible to change the clinical protocol as needed are also crucial. The only theme that was shared across both the audiologist and HA user groups was that dedicating more clinical time by the audiologist would facilitate the protocol's implementation.

Conclusions: This study identified that providing appropriate resources on the SEBAR protocol and evidence on its success in standard clinical practice would create opportunities for audiologists to gain the competency, confidence, and motivation to implement it. The COM-B model and its behavioral change wheel were used to discuss attainable next steps in research and clinical practice to facilitate the implementation of the SEBAR. For example, to make this protocol more intuitive and user-friendly, an app can be created that would provide guided steps to infuse and implement it in clinical practice. This will not only make the protocol more accessible within the existing clinical practice, but also will help alleviate the time constraints many clinicians have. Future research should focus on further improving the SEBAR protocol and validating its implementation within different AR services.

Category: Hearing Loss / Rehabilitation

Poster #: 067

Benefits of a Spanish-Language Hearing Loss Self-Management Program: AUDISOL RCT

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Objectives: To assess the benefits of a Spanish-language hearing loss program among adult patients. Specifically, we sought to investigate changes in hearing health care knowledge and self-efficacy for

managing hearing loss following delivery of culturally- and linguistically-appropriate self-management program, AUDISOL – La Programa de Audiología y Soluciones Auditivas/Audiology and Hearing Solutions Program.

Design: Individuals were considered for inclusion if they met the following criteria: Hispanic/Latino/a/x-identifying; aged 50 years or older; self-reported preference of speaking in Spanish; mild hearing loss (Pure-tone threshold > 20dB in one or both ears at any measured frequency between 500-4000Hz) or self-reported hearing difficulties (Hearing Handicap Inventory Screening [HHI-S] score of > 8). Participants were randomized into: (1) An experimental group that received a culturally- and linguistically-appropriate, Spanish-language hearing loss self-management program (AUDISOL); or (2) An active control group that received printed Spanish-language handouts from the American Speech-Language-Hearing Association (ASHA) Audiology patient education series. The Partners in Health Scale-Audiology version (PIH-A) assessed hearing-loss specific self-management, and the Self-Efficacy to Manage Chronic Disease Scale (SEMCD) assessed generic condition self-management. Psychometrically validated Spanish versions of the HHI-S, PIH-A, and SEMCD were used throughout the study. The PIH-A and SEMCD-S were administered pre-post-intervention. In a preliminary analysis, paired-sample t-tests were used to assess the effect of group assignment on PIH-A and SEMCD-S change scores from pre- to post-intervention. Bonferroni corrections were used to adjust p scores for multiple comparisons.

Results: Results are based on n=36 participants who completed both pre- and post-intervention outcomes. Participants randomized to both AUDISOL (n=18) and the ASHA Audiology Patient Series handouts (n=18) demonstrated positive and clinically-meaningful improvements in hearing-loss specific self-management as measured by the PIH-A (Cohen's d effect sizes = .49, p = .03 and .61, p = .01, for the AUDISOL and ASHA groups, respectively). No significant effects were seen in either group for the SEMCD-S.

Conclusions: To our knowledge, these data are some of the first that demonstrate the benefits of a culturally- and linguistically-tailored hearing loss self-management program designed for culturally Hispanic Spanish speakers using a rigorous randomized controlled trial design. Participants randomized to the experimental group receiving the AUDISOL program and to the control group receiving ASHA handouts showed significant improvements in self-management, highlighting the importance of accessible, language-specific resources in audiological care. These findings underscore the potential of targeted interventions to address hearing health disparities that are evident in the U.S.

Category: Hearing Loss / Rehabilitation

Poster #: 068

Socioeconomic and Geographic Barriers to Hearing Healthcare: The Patient's Perspective

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Objectives: Despite the widespread prevalence of hearing loss, many individuals encounter substantial barriers to accessing hearing healthcare and using technology. These challenges include financial limitations, navigating complex healthcare systems, and the stigma associated with hearing loss. By focusing on the patient's perspective, this study seeks to uncover the key obstacles to hearing healthcare in both the USA and UK, with a particular focus on the influence of socioeconomic status and geographic location.

Design: A total of 273 participant responses were collected anonymously using an online Microsoft Forms survey. Participants aged 18+ with experience seeking hearing care were primarily recruited through social media sites 'Facebook' and 'X', via advertisements posted in hearing loss support groups and hearing technology experience groups. Demographic characteristics (location, gender, age, and education level) were gathered. A thematic analysis of open-ended questions such as "what are the challenges/limitations to your hearing technology?", "what would you like to see from your hearing healthcare provider?", and "which factors influence your decision to seek hearing services?" was conducted. Responses were coded and overarching themes identified as per Braun & Clarke's thematic analysis process.

Results: A total of 67% participants resided in the UK, and 33 % participants resided in various states across the USA. Additionally, 75% of participants were women, and the modal age category was 40-49 years. The most common issues were cost of technology and limited services available in rural areas, discouraging participants from seeking hearing technology. Those in more remote areas reported difficulty getting an appointment with a hearing specialist locally, especially if they required a cochlear implant. Moreover, participants reported that there were issues making appointments over the phone, as they would often struggle to hear and respond accordingly. As well as barriers to seeking care, factors such as hearing technology breaking, lack of support after appointments, and limited information from the healthcare provider, were all highlighted as issues once technology had been obtained.

Conclusions: Issues were identified throughout the hearing healthcare pathway - both when the patients seek care and after they have received technology. Participants most commonly reported challenges related to the cost of technology and the limited availability of services in rural areas, followed by communication difficulties with healthcare providers and not knowing where to seek information. Post-care challenges were also noted, including the maintenance of devices, insufficient social support, and a need for more guidance from hearing providers.There is a need for lower cost hearing technologies and an increase in hearing services in rural areas. Additionally, there should be more educational resources for the public to raise awareness of hearing loss and the rehabilitation options available. By exploring barriers to accessing care, disparities can be identified and addressed, encouraging timely interventions and promoting the utilization of hearing technology. Ultimately, this research enriches the exploration of socioeconomic and geographic inequities in hearing healthcare, by directly involving patients and emphasizing the importance of developing inclusive hearing environments.

Category: Hearing Loss / Rehabilitation

Poster #: 069

Hearing Difficulty, Health Literacy, and Health Among US Adults

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Objectives: Adults with hearing loss experience poorer health outcomes than their hearing counterparts. As hearing loss becomes more prevalent in the U.S., research examining how to reduce health disparities among this population is needed. This study aimed to estimate the associations between hearing loss and each of poor physical and mental health, evaluate health literacy as a mediator of these relationships, and estimate the proportion of cases of poor physical and mental health that are attributable to having inadequate health literacy among adults with hearing loss.

Design: The 2016 Behavioral Risk Factor Surveillance System survey included cross-sectional data on self-reported hearing difficulty, health literacy, and number of days of poor physical and mental health in the past 30 days in a subpopulation of adults aged 18 and over among 17 U.S. states and territories (N=104,792). Number of days of poor physical and poor mental health was split into 5 categories (0, 1-10, 11-20, 21-30, and all 30 days). Age-stratified weighted complex survey logistic regression models estimated the total and direct effects of hearing difficulty on each of poor physical and mental health, and the indirect effects mediated by health literacy. Outcomes for poor physical and mental health were modeled separately as 1+ days versus 0 days, 11+ days versus ≤10 days, 21+ days versus ≤20 days, and all 30 days versus<30 days. Models were adjusted for age, sex/gender, race/ethnicity, education, income, marital status, and health insurance coverage. Population attributable fractions (PAFs) estimated proportions of cases of poor physical and mental health attributable to having inadequate health literacy among adults with hearing difficulty.

Results: Compared to those without hearing difficulties, those with hearing difficulties had higher prevalence of inadequate health literacy (70.3% vs 56.2%), 30 days of poor physical health (16% vs 6.4%), and 30 days of poor mental health (10.7% vs 5.3%). Odds ratios for the total effect of hearing difficulty ranged from 1.679 (95% CI: 1.443, 1.915) to 1.870 (95% CI: 1.657, 2.084) for poor physical health and 1.681 (95% CI: 1.514, 1.848) to 2.203 (95% CI: 1.812, 2.593) for poor mental health. The indirect effect of hearing difficulty mediated through health literacy explained between 3.8% to 6.6% of the total effect for poor physical health and 1.8% to 3.5% for poor mental health. When stratified by age, the total effect generally declined as age increased while the indirect effect stayed relatively consistent across age groups. PAFs indicate that over 218,000 cases of poor physical health lasting 30 days and over 115,000 cases of poor mental health lasting 30 days were attributable to having inadequate health literacy.

Conclusions: These results show that those with hearing difficulties experience significantly poorer physical health, poorer mental health, and lower health literacy. Health literacy was determined to be a significant mediator between hearing loss and both poor physical and mental health. Findings suggest that improving health literacy among this population would reduce the number of days of poor physical and mental health in the past month experienced by adults with hearing loss in the U.S.

Category: Hearing Loss / Rehabilitation

Poster #: 070

Cochlear Synaptopathy: Assaying Damage and Recovery after Noise Exposure

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Objectives: Overexposure to sound degrades hearing, with underlying cellular injury ranging from trivial toextensive. Among the most vulnerable elements are synapses between sensory hair cells and auditoryneurons that carry sound information toward the brain. Not all synapses/fibers are equally susceptible todamage. As response properties vary across fiber spontaneous rate (SR) subtypes, clarifyingconsequences of loss is key to understanding perceptual effects of deafferentation after noise. Here, weconsider functional measures that may predict the extent and frequency location of synapse loss, thenature of the fibers/synapses affected and their patterns of recovery in gerbil models, where we haveaccess to both.

Design: We produced models of noise-induced cochlear synaptopathy in gerbil and studied cochlearpathophysiologic and histopathologic consequences from 24 hr to 36 wk post exposure (n=135) bycomparison with age-matched controls (n=42). Two exposures produced synapse loss without hair cellloss or permanent dysfunction to isolate functional sequelae of neural damage. Two exposures yieldedsynapse + hair cell loss/injury, to model the mixed neural and sensory involvements likely common inhumans. We recorded distortion product emissions (DPOAE) and round-window-accessed auditorynerve compound action potential (CAP) and post-stimulus time response (PSTR) growth functions forfrequencies spanning 1-45 kHz. Offline, thresholds and suprathreshold amplitudes were extracted andneural response waveforms were analyzed to provide clues to fiber subtype injury and recovery. Spontaneous round window neural ‘‘noise’’ also was recorded. In immunostained organ of Cortiwholemounts, we quantified hair cells and synapses and correlated the noise-induced histopathologywith pathophysiologic outcomes.

Results: All exposures were synaptopathic, and except for the highest-level exposure, synapse loss magnitudewas similar, though the pattern of damage was unique to each exposure level. What differed among themodels was the degree of functional loss, the rate and extent of recovery, and whether recovery persistedor instead yielded late declines in function compared to age-matched controls. A single 2-hour octave-band noise exposure at 100 or 103 dB yielded threshold shifts and amplitude reductions (DPOAE, CAP)that recovered, without hair cell loss. High-SR-dominated CAP and PSTR peak responses andspontaneous neural noise all recovered, exceeding control values at some post-exposure times. PSTRplateaus, reflecting contributions of neurons from all subgroups, recovered but never exceeded controls.In the same ears, synapse loss was persistent, even at 36 wk. With increased noise level, synaptopathywas accompanied by permanent threshold shifts, persistent amplitude declines and OHC loss. After 112 dB exposure, these were restricted to the highest frequencies/cochlear regions evaluated. Following 115dB exposure, large threshold shifts and amplitude declines remained at 36 wk. OHC loss was largest inthe extreme base. For both higher-level exposures, spontaneous neural noise declined significantly, withincomplete post-noise recovery.

Conclusions: For a range of noise exposure levels, we observed persistent synaptopathy with recovery, even over-recovery, of sound-evoked neural responses and augmented spontaneous neural activity,

perhapssignifying a compensatory mechanism. The extent to which this is relevant to post-noise structure andfunction in humans is unknown, but critical for optimal clinical management. Parallel studies in humansare underway.

Category: Hearing Loss / Rehabilitation

Poster #: 071

The MVP Database: Audiologic Profile, Tinnitus Prevalence and Associated Characteristics

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Objectives: As part of their experience in combat and training, US Veterans are often exposed to harmful noise during their military service. In addition to hearing loss, tinnitus is one of the most reported sequelae associated with overexposure to noise. This study documents the prevalence of tinnitus and its associated characteristics in the largest cohort of Veterans described to date.

Design: Data from 267,000 Veteran participants within the Million Veterans Program (MVP) database were extracted for analysis. Only those with a complete set of audiometric data were included. In addition to surveying tinnitus prevalence, the audiometric profile of this large cohort was examined, along with demographic data, medical history, and military service characteristics. Data were compared to another cohort of 45,000 patients with normal hearing or presbycusis seen at the Massachusetts Eye & Ear.

Results: 94% of veterans were males, 86% presented with hearing loss and 47% reported tinnitus. The prevalence of tinnitus was greater among Veterans with hearing loss, whether male or female, when compared to Veterans with normal hearing; however, males reported tinnitus more often than females irrespective of their hearing status (among males, 44% with normal hearing vs. 49% with hearing loss reported tinnitus; among females, 35% with normal hearing vs. 40% with hearing loss reported tinnitus).When compared to a cohort of age-matched patients with age-related hearing loss (AHRL) (i.e., idiopathic), Veterans presented greater degrees of hearing loss across test frequencies, particularly at 4 kHz (> 15 dB in MVP subjects). No difference in word recognition scores in quiet as a function of hearing loss / presentation level was seen between Veterans with or without tinnitus. Tinnitus prevalence was greater in Veterans with hearing loss irrespective of race or ethnicity; however, a lower prevalence of tinnitus among African American was noted (37%) when compared to other groups (Caucasian: 48%, Asian: 54%, Others: 53%).The Merchant Marine was the branch with the fewest reports of tinnitus (30% and 36%, respectively); the Marine Corps reported the greatest prevalence at 50%. Tinnitus prevalence increased by ~39% when Veterans reported traumatic brain injury and/or a concussion, by 27% when reporting anxiety and/or depression, by ~14 % when reporting sleep disorders and by ~13 % when reporting alcohol consumption. Smoking was not associated with a change in tinnitus prevalence.

Conclusions: The tinnitus prevalence among Veterans is dramatically larger when compared to estimates obtained in the US population (47% vs. 11%). Unsurprisingly, tinnitus in Veterans comes with greater hearing loss, particularly at 4 kHz, the pattern of noise-induced hearing loss. Further investigations are needed to better understand the racial differences in tinnitus prevalence. Supported by NIH-NIDCD Grant P50 DC015857 and VA Merit I01RX004293

Category: Hearing Loss / Rehabilitation

Poster #: 072

Listening Effort and Hearing Handicap, Cognition, and Social Interaction

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Objectives: Listening effort is "the deliberate allocation of mental resources to overcome obstacles in goal pursuit when carrying out a [listening] task." Growing evidence suggests that older adults with hearing loss (OHL) experience greater listening effort than older normal hearing (ONH) counterparts. Emerging work has linked listening effort to self-perceived hearing handicap. Additionally, theories suggest that listening effort involves cognition and psychosocial factors, such as social interaction/support. While increasing evidence has documented hearing handicaps and cognitive changes in OHL, studies on social interaction factors, especially social isolation and loneliness in OHL, are understudied. Furthermore, despite theoretical postulations, few have examined how self-reported listening effort is linked to hearing handicap, cognition, and social interaction in older adults with mild hearing loss. Objectives: This preliminary study examined whether self-reported listening effort is related to measures of hearing handicap, cognition, and social interaction. We hypothesized that greater self-reported listening effort would be associated with 1) worse performance on cognitive tests, 2) greater self-reported hearing handicap, and 3) lower self-reported social interactions, specifically, higher social isolation and loneliness.

Design: This cross-sectional, correlational study included 20 older adults, 10 OHL with mild loss, and 10 ONH adults. Participants were ≥ 55 years old, English speakers, with normal/corrected vision. Those with congenital hearing loss, psychological and/or neurological disorders, diagnosis of dementia, and history of alcohol/drug abuse or dependence were excluded. Participants rated their listening effort on a 7-item Effort Assessment Scale, which ranged from 0 to 10, with higher rating indicating more effort. Hearing handicap measures included the Hearing Handicap Inventory for Adults - Screening (HHIA-S) and the Social and Emotional Consequences of Hearing Impairment (SEI-HI) scales; cognitive tests included verbal measures of working memory (Forward and backward span tests) and verbal fluency (phonemic and category fluency tests); and social interaction measures included the Lubben Social Network and the UCLA Loneliness Scales. Analyses: Bivariate correlations were used to address the research question. Correlations were done with all participants included, as well as within the OHL and ONH groups.

Results: We found positive correlations between listening effort and total scores on HHIA-S ($r = .704$, $p<.001$) and SEI-HI ($r = .635$, $p =.002$). A similar finding was also observed in the OHL group between listening effort and HHIA-S ($r = .665$, $p =.025$). Additionally, we found a trending negative correlation

between listening effort and the longest span recalled on the forward digit span task ($r = -.626$, $p = .053$), and on task performance accuracy ($r = -.615$, $p = .059$) in OHL group. No significant correlations were found between listening effort and social interaction measures.

Conclusions: These preliminary findings suggest that higher self-perceived listening effort is linked to higher perception of hearing handicap, and to worse working memory performance in older adults with even mild hearing loss. This work highlights the importance of considering cognitive skills, self-perceptions of listening effort, and hearing handicap while providing hearing care to the geriatric population. However, validation of our results with a bigger sample size is necessary.

Category: Hearing Loss / Rehabilitation

Poster #: 073

Exploring Person-Centered Care Practices Among Audiologist Nationwide: Pilot Survey Insights

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Objectives: We aimed to explore audiologists' implementation of person-centered care (PCC) across the United States (US) via a survey rooted in The Eight Picker Principles of PCC and answer our research question: How are licensed audiologists clinically implementing PCC to better serve their adult patient populations?

Design: We designed a cross-sectional survey study and collected self-reported data from licensed audiologists regarding their implementation of person-centered care and demographic information. We recruited participants via direct email invitations to audiology service providers; social media; professional, virtual message boards; our lab website; and word-of-mouth. We administered the survey via Qualtrics and collected pilot data from 44 audiologists to date.

Results: Descriptive statistics will serve as the foundation of our results-highlighting key demographic characteristics of audiologists and the prevalence of different person-centered care (PCC) practices. However, we also plan to explore preliminary associations between demographic factors of audiologists and their approaches to implementing person-centered care. By examining variables such as age, experience, and educational background, we seek to identify patterns that may influence how audiologists incorporate PCC to better serve their adult patient populations.

Conclusions: Our study provides insight into the current state of audiologists' implementation of PCC with adult patients across the US. The survey findings will also contribute to existing research on Person-Centered Care and establish a basis for formulating PCC education and interventions aimed at addressing the possible challenges and obstacles with its integration into audiological practice. Maximizing PCC implementation can lead to patient benefit through improved hearing aid outcomes, greater adherence to treatments, and increased trust in their audiologists.

Category: Hearing Loss / Rehabilitation

Poster #: 074

Hearing Loss, Living Arrangements and Dementia Among U.S. Older Adults

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Objectives: Hearing loss is a modifiable risk factor for dementia. Living arrangement, reflecting levels of social support, is critical for cognitive health and well-being among older adults. Individuals with hearing loss in different living arrangements may encounter unique communication challenges, stressors, or resilience factors. This study aimed to assess living arrangement's role in moderating the relationship between hearing loss and dementia.

Design: We conducted a cross-sectional analysis of community-dwelling adults aged 65 and older in the U.S. from the nationally representative 2022 National Health and Aging Trends Study (NHATS) (n=4,766). Using a tablet-based auditory assessment, we defined hearing loss as a better-ear pure tone average >25 dB. We classified participants' living arrangements into 3 categories: living with a spouse/partner (reference group), living with others only, and living alone. Dementia was defined as possible/probable dementia using the NHATS dementia algorithm (reported dementia diagnosis, AD8, and neurocognitive test results). We used survey-weighted Poisson regressions to assess differences in prevalence of dementia by hearing and living arrangement status, and to evaluate potential interactions between hearing loss and each living arrangement category.

Results: The prevalence of hearing loss was 56.1%, living with a spouse/partner 60.2%, living with others without a spouse/partner 13.5%, living alone 26.4%, and dementia 13.4%. The association between hearing loss and dementia varied by living arrangement. Compared to those without hearing loss and living with a spouse/partner (reference group), the prevalence ratio for dementia among those with hearing loss and living with a spouse/partner is 2.54 (95% CI: 1.69, 3.83), and 3.65 (95% CI: 2.27, 5.86) among those with hearing loss and living with others only, and 2.56 (95% CI: 1.69, 3.89) for those with hearing loss and living alone. We observed a super-additive interaction between hearing loss and living with others (Synergy Index = 1.2 , 95% CI: -0.4, 2.9), suggesting greater vulnerability to hearing loss among individuals living with others. In contrast, we found a negative interaction between hearing loss and living alone (Synergy Index=0.6, 95% CI: -0.7, 1.9), indicating a lower susceptibility to harmful impact of hearing loss in this group. However, neither interaction was statistically significant.

Conclusions: The association between hearing loss and dementia is more pronounced among community-dwelling older adults who live with others, compared to those living with a spouse/partner or living alone. Further research using longitudinal data is needed to explore the heterogeneous effects of hearing loss by living arrangements for causal implications.

Category: Hearing Loss / Rehabilitation

Poster #: 075

Familism and Hearing Loss in Older Latino Adults

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Objectives: Hearing aid use is lower among US Latino adults with hearing loss compared to other racial/ethnic groups. Familism is one of the most frequently examined Latino cultural values, yet its relationship with hearing loss and hearing aid use remains unexplored. Familism refers to the deep connection and commitment individuals feel towards their families. When familism levels are high, individuals often receive strong support from their family members, which may help buffer the subjective experience of hearing loss. Conversely, low familism may exacerbate the subjective experience of hearing loss due to a lack of social support, lower prioritization of family needs, and fewer collective coping mechanisms. Given the important role of familism in Latino culture, the objective of this study was to test the hypothesis that the strength of association between objective hearing loss and subjective hearing disability differ according to levels of familism.

Design: Data collection for this study took place at adult day centers in San Diego County. Inclusion criteria were: ages 60 or older and the ability to provide informed consent. Participants completed a demographic survey and the Hearing Handicap Inventory for the Elderly (HHIE). Pure-tone air-conduction audiometry was carried out using a portable tablet-based audiometer and calibrated headphones, and a four-frequency pure-tone average (PTA) was calculated. Participants completed the Sabogal Familism Scale, 14 items on a five-point Likert scale (5 = very much in agreement, 1 = very much in disagreement). Two items corresponding to the family support sub-scale were used in this analysis. Items were averaged to create an overall mean score with higher scores indicating stronger familism. A series of linear regression models were conducted to examine the effects of PTA and familism on HHIE scores.

Results: A total of 102 individuals participated (average age 76 years, SD=9). The right ear pure-tone average was 31.7 dB HL (SD = 17.6) indicating a slight/mild hearing loss, and the mean HHIE was 13.71 (SD = 13.9) corresponding with a mild to moderate hearing handicap. The mean familism score (family support sub-scale) was 4.28 (SD = 0.96). Results of linear regression indicated that PTA was significantly associated with HHIE ($p = .007$), but familism was not a significant predictor of HHIE.

Conclusions: These findings suggest that familism, as measured by the Sabogal perceived support from family members subscale, does not appear to play a central role in the relationship between severity of hearing loss and hearing-related disability in this sample of older Latino adults. Despite these findings, cultural values, including the importance of family, likely shape Latino adults' experiences of hearing loss

and response to disability. There is a need for further research to identify the influence of cultural values on hearing health outcomes which can guide tailored interventions.

HEARING TECHNOLOGY / AMPLIFICATION

Category: Hearing Technology / Amplification

Poster #: 076

Hearing Aid DIY: Predictors of Successful Self-Fitting for Commercially Available OTC Hearing Aids

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Objectives: The US Food and Drug Administration approved over-the-counter (OTC) hearing aids (HAs) for consumers in October, 2022. OTC HAs are expected to be more accessible and affordable than traditional prescription HAs. An underlying assumption of OTC HAs is that consumers can set up and manage the devices themselves. However, some older adults may struggle with the self-fitting process, particularly if they do not have experience with technology or with traditional HAs. This study investigates the abilities of older adults to independently and effectively self-fit a pair of commercially-available OTC HAs. Specifically, the objectives of this cross-sectional study are to (1) investigate the characteristics that are associated with older adults' ability to assemble and manage OTC HAs, and (2) understand the thoughts, opinions, and experiences of older adults on using OTC HAs.

Design: Participants include 80 adults ages 55 and older with perceived mild to moderate hearing loss. Participants carried out an OTC HA management task under observation, in which they were asked to carry out steps such as pairing the OTC HAs to a smartphone, changing the HA batteries, and cleaning the devices. Trained observers scored the participants' performance in terms of accuracy and independence on a 4-point Likert scale from 0 to 3 (3 being performed on their own with no difficulty, and 0 being unable to complete). The points for each of the steps were averaged to create a grand mean. A higher mean score indicated a more successful self-fitting. Univariate and multivariate linear regression models were used to identify participant characteristics that predicted OTC HA skills among the following potential variables: age, sex, technology familiarity, cognition, locus of control, education, income, race, ethnicity, PTA, and HHIE. Participants also completed a brief exit interview during which they were asked to share their thoughts and opinions on OTC HAs, and experiences with the OTC HA management task. Interviews were recorded, transcribed verbatim, and coded and analyzed using an iterative deductive and inductive thematic analysis approach.

Results: Eighty participants in San Diego, California completed the study (mean age = 71 years, SD = 7; 46% female). Twenty-seven participants (34%) were previous HA users. Results of regression analyses

indicated that females and individuals with better cognitive abilities had better OTC HA management skills ($p < 0.05$). Semi-structured interviews revealed six themes, including: (1) perceived benefits and drawbacks of OTC HAs; (2) user challenges; (3) support needs and social factors; (4) awareness, knowledge, and learning about OTC HAs; (5) aesthetic and functional considerations; and (6) self-perception and motivation to use HAs.

Conclusions: Individuals with greater cognitive impairment and males, compared to females, encountered more challenges in independently setting up and using OTC HAs. These factors will be explored in more detail, as well as the specific steps in the self-fitting process that proved most difficult. Given that the interviews revealed participants' misperceptions about OTC HAs and frustration during the self-fitting process, this highlights a need for clearer user guides and targeted education and outreach efforts to enhance health literacy and support consumers in their use of OTC HAs.

Category: Hearing Technology / Amplification

Poster #: 077

The Telehealth Intervention for the ACHIEVE Hearing Intervention Follow-Up Study

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ACHIEVE Collaborative Study, Other, ACHIEVE Collaborative Study, ,

Objectives: The Aging & Cognitive Health Evaluation in Elders (ACHIEVE) was a randomized control trial of hearing intervention against a health education control on 3-year cognitive trajectories (n=977) at four sites in the United States (Jackson, MS, Forsyth County, NC, Minneapolis, MN, Washington County, MD). The ACHIEVE Hearing Intervention Follow-Up (HIFU) study [Clinicaltrials.gov NCT05070429; NIH funded R01DC019408] is a nested trial that randomized participants who had received 3-years of conventional in-person hearing care to either a telehealth model (experimental) or continuation of

conventional care (control) with a primary aim to compare one-year post-randomization daily hours of hearing aid use between groups and secondary aim to compare patient-centered hearing and communication outcomes between groups. Here, we will describe the development and implementation of the evidence-based, person-centered telehealth hearing health care (HHC) intervention used in ACHIEVE-HIFU Study.

Design: The ACHIEVE-HIFU Study is a randomized trial that seeks to determine whether a telehealth HHC model, compared to clinic-based HHC, improves hearing aid use and other communication outcomes among older adult experienced hearing aid users. From 2021-2022, as participants in the hearing intervention group (fixed sample, n=490) completed the pre-specified three years of follow-up in the main ACHIEVE trial, the investigators recruited the existing hearing aid users and randomized the participants 1:1 to receive continued conventional clinic-based delivery of HHC versus a model that incorporates telehealth. Participants are still being followed for two years post-randomization for observational analyses, with data collection follow-up visits occurring every six months. We will describe the development of the telehealth intervention, generic technology platform utilized, and implementation of the telehealth hearing healthcare (HHC) delivery in the study.

Results: Of the 490 eligible ACHIEVE participants, 339 were enrolled in ACHIEVE-HIFU. Intervention compliance, measured by visit completion, was greater than 90% across all intervention and study visits for both conventional and telehealth groups. The conventional HHC and telehealth HHC were designed around patient-established listening goals using the Client Oriented Scale of Improvement (COSI). Participants randomized to the conventional in-clinic HHC were only seen in person. Participants randomized to the telehealth HHC received synchronous and asynchronous telehealth support supplementing any in-person visits. The telehealth HHC support was provided through the GrandPad™ (GrandPad, Minnetonka, MN) which is a tablet specifically designed for use by older adults that comes with integrated cellular internet connectivity, on-demand support, and customized applications. The Grandpad allowed for routine troubleshooting of communication challenges, hearing aid technical issues, and reinforcement of self-management support strategies.

Conclusions: Standardized yet personalized intervention protocols for older adults are critical for protocol compliance and intervention benefit. We will share lessons learned from designing and implementing patient-centered interventions with and without telehealth support. These details are critical for interpretation and contextualization of results from the ACHIEVE Hearing Intervention Follow Up study.

Category: Hearing Technology / Amplification

Poster #: 078

Measuring Listening Effort in New Hearing-Aid Users Using Physical Exertion

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Objectives: Hearing-impaired individuals often report that listening in challenging situations is effortful even when speech is intelligible. Thus, there is clinical value in assessing listening effort in addition to speech understanding to better capture hearing aid benefit. Prior evidence indicates that, under challenging auditory conditions, listeners will readily exert physical effort to secure easier listening conditions, suggesting its potential as an objective index of listening effort. This paradigm uniquely captures the involvement of motivation in effortful listening, as theorized in the Framework for Understanding Effortful Listening (FUEL). Previous research in a sample of young adults with normal hearing revealed the efficacy of this outcome measure in capturing fluctuations in listening effort using changes physical exertion as a proxy. The objective of this study was to determine whether these findings extend to older adults with hearing loss, with and without amplification. As untreated hearing loss often encumbers the ability to maintain attention in difficult listening environments, self-reported boredom, mind-wandering, and effortful listening were measured before and after hearing aid use.

Design: Participants were nine adults (3m, 6f) between the ages of 43 and 74 (m=63.1±10.6) years with mild to moderately-severe hearing loss, all of whom were first-time hearing aid users (i.e., had never owned hearing aids). In the behavioral task of listening effort, participants could improve the signal-to-noise ratio (SNR) of a subsequently presented sentence by exerting physical effort using the space bar on a keyboard, with more space bar presses leading to greater SNR improvement. A progressive-ratio schedule was used, requiring the participants to incrementally increase the number of space bar presses to achieve the most favorable SNR in each successive trial within a block. Sentences were either high or low in context; starting SNR was either of hard or medium difficulty. Participants completed the task with and without hearing aids in separate study visits. Participants completed the self-report measures (Mind-Wandering: Spontaneous Scale, Short Boredom Proneness Scale, and a 4-item measure of subjective listening effort) twice: once just prior to being fit with hearing aids, and again after six months of full-time hearing aid use.

Results: Participants pressed the space bar more frequently in the more challenging listening conditions (low sentence context, hard SNR, unaided) indicating that they applied more physical exertion to ease listening effort in these conditions. Self-reported listening effort was reduced following six months of consistent hearing aid use, while no changes in mind-wandering or boredom were observed.

Conclusions: Consistent with previous findings in younger adults with normal hearing, results in older adults with hearing loss revealed greater physical exertion (i.e., more space bar presses) in more effortful listening conditions. Further, the present findings confirm the sensitivity of this paradigm to differences in listening difficulty related to background noise and contextual cues and demonstrate that this sensitivity extends to use of amplification. While further work is needed to directly compare the present approach with pre-existing measures of listening effort, the results of this study provide further support for the efficacy of measuring physical exertion as an index of listening effort.

Category: Hearing Technology / Amplification

Poster #: 079

The Values That Guide Hearing Health Decisions

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Objectives: A concept central to patient-centered care is that services should reflect a patient's values. Values guide important decisions, where people are more likely to engage with products and services that reflect their values. Our hypothesis is that misaligned values in hearing healthcare underlie disparities in the access and use of hearing health care. This study aimed to identify and categorize the values of adults with self-reported hearing difficulties who live in urban and rural communities. It is part of a broader effort to address barriers to hearing aid use by ensuring that products and services reflect the values of underserved populations.

Design: Adults with self-reported hearing difficulty (N=45), aged 31 to 94 years, were recruited from urban and rural communities targeting a representative sample of the racial and ethnic demographics of each region. Hearing ability was quantified using National Health and Nutrition Examination Survey question AUQ054 for overall perceived ability, the Revised Hearing Handicap Inventory (RHHI) for perceived hearing handicap, and Spatial Release from Masking (SRM) for objective hearing ability. SRM was tested with Portable Automated Rapid Testing using methods consistent with normative data in young adults with normal hearing. Semi-structured interviews were used to elicit values statements in the domain of hearing healthcare. Thematic analysis was used to code values in participant statements and to identify recurring themes related to facilitators, barriers, and unmet needs.

Results: Participants included both hearing aid users (42%) and non-users (58%). Hearing aid users reported a higher perceived hearing handicap on the RHHI, with a mean score of 23.26, compared to 13.31 for non-users. SRM showed no difference between users and non-users, with all but three participants in the impaired range relative to normative data; no data were obtained for 12 participants due to equipment limitations accommodating more significant losses. Interview data revealed an array of values in three categories: healthcare, social, and material. Healthcare values were access, aided hearing ability, health, hearing ability, and provider. Social values were community, knowledge, respect, socioemotional, and support. Material values were aesthetics, comfort, consumer attitudes, finance, maintenance, and technology.

Conclusions: Hearing healthcare decisions are rooted in diverse, intersecting values. Within each coded value, perceptions about hearing and hearing healthcare differed among urban and rural participants and among those with and without hearing aids, indicating specific areas to target to reduce disparities. This work builds on our previous evaluation of values in best-practice and enacted audiology toward the goal of identifying the values of stakeholders in hearing healthcare. We plan to use Value Sensitive Design to ensure products and services reflect the values of patients and other stakeholders, reducing barriers in underserved populations and facilitating patient-centered care.

Category: Hearing Technology / Amplification

Poster #: 080

Hearing Aid Noise Reduction: Exploring Outcomes Using ACT, HINT, and EMA

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Objectives: Listening in background noise remains a major complaint among hearing aid users, despite increased flexibility in how hearing aid directionality and noise reduction (DIR + NR) settings can be adjusted by audiologists. It is not clear what variables should be used to make decisions about DIR + NR settings. The audiogram alone provides very little information about suprathreshold abilities that are important to understanding speech in noise. Recently, the Audible Contrast Threshold (ACT) test has been suggested as a tool to improve the first fit of hearing aids in terms of DIR + NR settings. We measure the ACT and the Hearing in Noise Test (HINT) and relate these measures to hearing aid user preferences using ecological momentary assessments (EMAs) to link performance and preference at different DIR + NR settings among US Veterans.

Design: More than fifty participants, fit with hearing aids in the VA Portland Healthcare System audiology clinics, have been enrolled in this study. They completed multiple four-week field trials which pit pairs of DIR+NR settings against each other (e.g., strong vs. moderate DIR+NR). The participants' preferences for different settings were measured using laboratory questionnaires and EMAs in every-day situations. Subjective preferences were compared with the ACT test, a clinical spectro-temporal modulation detection test, and the HINT, a measure of sentence recognition in spatially separated running speech and noise. Variables such as listening environment and relative fitting occlusion were taken into account to understand participant preference and performance.

Results: Results will be presented from all tests, with demonstration of variance across users in comparison with other datasets. In general, HINT performance improved with more aggressive DIR +NR settings; however, overall EMA data demonstrated little evidence of listener preferences for any DIR + NR setting. Further comparisons will be made across noise management settings to determine how differences in speech recognition benefit in noise align with spectro-temporal modulation processing abilities and participant preferences.

Conclusions: The lack of strong participant preferences in these data may be an indication that clinicians should prioritize performance based on suprathreshold tests, such as the ACT or HINT, more than preference information. It is noteworthy that these data are specific to US veterans, a population whose auditory abilities may not be adequately represented by traditional audiological methods. By investigating the alignment between the ACT test, HINT, and participant preference, we seek to provide a foundation for a more comprehensive and individualized approach towards hearing aid customization in audiology. This research is funded through the Portland VA Research Foundation by a grant from the William Demant Foundation.

Category: Hearing Technology / Amplification

Poster #: 081

Investigation of Amplification Cloud Data and Relationship with Fine-Tuning Requests

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Objectives: This exploratory investigation aims to understand whether hearing aid users show different user-initiated behavior, primarily volume control adjustments, based on their time in different environments and whether they requested fitting adjustments during an approximately seven-week field study. Hearing aid and user-initiated behavior was captured from the hearing aid cloud data at 15-minute intervals, which included ambient sound levels, environmental classification, program and volume control usage, and daily wear time. Hearing aid users were grouped by whether the individual voiced fine-tuning requests to the researcher during the fitting and subsequent follow-up appointments. The primary objective was to assess whether those with fine-tuning requests show different user-initiated behavior than those without fine-tuning requests and whether the user-initiated behavior changes after fine-tuning adjustments.

Design: Fifty-seven adults (mean age, 57 years; 35.1% female) with, on average, a mild sloping to severe sensorineural hearing loss were fitted with receiver-in-canal, in-the-ear , in-the-canal, or completely-in-the-canal hearing aids. Participants wore the hearing aids for an average of seven weeks, and had four study sessions, each approximately 2-3 weeks apart. At each session, fine-tuning requests were documented and addressed by a licensed audiologist. Fitting notes were compiled and analyzed to group similar requests. From the 57 participants, a group of participants (n=12) with fine-tuning requests necessitating an increase or decrease in gain, and a control group of participants (n=7) without fine-tuning requests was identified. Additionally, cloud data captured from the hearing aids was analyzed for each field evaluation period between study sessions to assess user-initiated behavior and its relationship with listening environments. For the group requesting fine-tuning adjustments, user-initiated behavior was assessed before and after fine-tuning adjustments.

Results: The fine-tuning and control groups had similar hearing loss and unaided QuickSIN scores. Over seven weeks, the control group had a mean daily number of volume adjustments (NVA) of 1.63 (SD = 2.30), with specific values of 1.66 (SD = 2.86), 1.80 (SD = 2.38), and 1.43 (SD = 2.06) for the first to third field trials, respectively. The fine-tuning group had a mean NVA of 1.56 (SD = 2.35), with values of 1.68 (SD = 2.82), 1.74 (SD = 2.66), and 1.27 (SD = 1.56) for the same trials. These differences were not statistically significant. Descriptive data suggested that the fine-tuning group spent more time in Quiet, Speech-only, and speech-in-noise environments on average compared to the control group. A linear regression model showed that the listening environment trended towards predicting daily NVA.

Conclusions: The findings indicate that (1) for individuals with loudness issues, audiologist adjustments improved loudness perception, resulting in a lower NVA by the end of the field trial; (2) those without adjustments might benefit from volume controls and specialized settings (e.g., memory, edge mode) to meet their listening needs while acclimatizing to the research hearing aids. This study marks the first

attempt to utilize cloud data for analyzing patient complaints and the effects of adjustments. Further research with a larger sample, longer trial period, and additional measures (e.g., personality) is needed to validate these results.

Category: Hearing Technology / Amplification

Poster #: 082

Assessing the Influence of Apple AirPods with Live Listen feature on Speech Comprehension and Recall in Noise Levels Simulating Noisy Healthcare Settings

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Objectives: This study investigates the integration of the Live Listen feature with noise cancellation capabilities of AirPods Pro (2nd generation) to assess their potential as a cost-effective and accessible Assistive Listening Device (ALD) in acoustically challenging healthcare settings. It aims to evaluate the efficacy of this technology in enhancing speech comprehension and memory retention among patients, particularly those with varying degrees of Speech-to-Noise Ratio (SNR) loss.

Design: A prospective, within-subjects design was utilized, involving participants aged 60 and above with normal to mild/moderate hearing loss. Participants underwent pre-test assessments, including pure tone audiometry, digit span tests, and QuickSIN tests. They were then exposed to controlled noise conditions mimicking a noisy healthcare environment with and without the Live Listen feature activated. Speech comprehension and memory retention were measured and analyzed using paired t-tests and regression analysis.

Results: The study found significant improvements in both speech comprehension and memory retention when the Live Listen feature was used. Specifically, comprehension scores increased from an average of 20.47 without Live Listen to 23.53 with Live Listen, and memory retention scores improved from 10.89 to 14.74. Furthermore, regression analysis revealed a positive correlation between the degree of SNR loss and the benefits gained from using the Live Listen feature, suggesting greater enhancements for individuals with higher levels of SNR loss.

Conclusions: These findings indicate that AirPods Pro with Live Listen can serve as an effective ALD in noisy healthcare environments, potentially improving patient outcomes by enhancing communication. This study underscores the value of integrating accessible consumer technology into healthcare practices to address communication barriers, especially for the aging population and those with hearing impairments. Further research is needed to explore the implementation and broader applicability of such technologies in healthcare settings.

Category: Hearing Technology / Amplification

Poster #: 083

Effectiveness of Hearing Devices: Systematic Review and Meta-Analysis of RCTs

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Objectives: This systematic review and meta-analysis examines the effectiveness of hearing devices in adults with mild-to-severe hearing loss, addressing three key questions: 1) What is the extent of outcome improvement for adults with mild-to-severe hearing loss using hearing devices? 2) Which measures are commonly used across outcome domains in randomized controlled trials (RCTs) of hearing devices? 3) What adverse effects are associated with hearing device use?

Design: The review is registered with PROSPERO (CRD42024598710). RCTs comparing hearing devices and associated outcomes were sourced from PubMed, CINAHL, and Embase. Studies were selected based on a pre-defined PICOST framework, including adults with mild-to-severe hearing loss fitted with either bilateral or unilateral acoustic hearing devices. Comparators included both passive and active controls with various outcome measures. Covidence software supported screening, data extraction, and quality assessment. Risk of bias was evaluated using Cochrane's RoB2 tool, and evidence levels were rated via OCEBM. A narrative synthesis was conducted, followed by a meta-analysis to calculate effect sizes.

Results: A total of 6,672 citations were screened, resulting in 17 RCTs (2,513 participants) included in the analysis-comprising five efficacy and 12 effectiveness trials. Most studies (53%) originated in the US, with contributions from Korea (11%), and one each from the UK, China, Denmark, Thailand, and South Africa. Study focuses varied, covering tinnitus (n=2), service-delivery (n=3), hearing aid (HA) features (n=2), and additional training (n=1). Participants aged 18 to 85, with sample sizes from 26 to 380 and attrition rates of 0% to 30.9%. Hearing devices assessed included body-worn (n=3), monoaural (n=2), binaural (n=10), and unspecified (n=2). Comparators were diverse, including personal sound amplification systems (n=4), assistive listening devices (n=1), digital HAs (n=13), digital-trimmer HAs (n=1), HAs with sound generators (n=1), and extended-wear HAs (n=1). Sample size estimations were provided in 53% of the studies. Timelines for outcomes spanned from 2-4 weeks (n=3), 6 weeks (n=4), 2 months (n=5), 3-6 months (n=7), to 12 months (n=3), with two studies not reporting timelines. Outcome types included self-reported (n=17), behavioral (n=9), objective (n=2), qualitative (n=2), and cognitive (n=3), addressing hearing, mental health, device satisfaction, social network, communicative function, emotions, and quality of life. Primary outcomes, reported in 41% of studies, included functional-gain, word-discrimination tasks, QuickSIN, HHIE, APHAB, PHAB, and TFI, though primary endpoints were rarely specified. Efficacy trials (n=4) showed significant treatment effects, while effectiveness trials indicated greater benefits from conventional HAs (n=4), HA preference (n=1), and mixed results (n=6). Reported adverse effects were minimal, with one case of middle-ear infection, and no study-related adverse events reported in two studies. Meta-analysis results will be presented, providing comprehensive insights into treatment outcomes and device impact across populations.

Conclusions: This review shows that conventional HAs significantly improve user benefits and satisfaction, with users showing a clear preference for them over alternative devices. To enhance consistency and comparability across studies, there is a pressing need for researchers to adopt

standardized guidelines. Controlled studies remain limited within the field, underscoring the need to promote RCTs to strengthen the evidence base for both existing and emerging interventions.

Category: Hearing Technology / Amplification

Poster #: 084

Using Consonant Confusion to Predict Hearing-Aid Benefit

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Objectives: Consonant identification relies on audibility of acoustic consonant features, therefore, performance on a consonant identification task contains information that may be useful for predicting hearing loss. We are developing a consonant-confusion test (CCT) designed to maximize sensitivity to hearing loss. The percent-correct score on this CCT is highly correlated with pure-tone average (PTA) defined as the average of audiometric thresholds at three frequencies (PTA3). When PTA is defined as an optimized weighted average of thresholds at ten audiometric frequencies (PTAcc), its correlation with CCT performance improves. Individual predictions of PTAcc, using logistic regression methods and CCT results, may be a useful metric for assessment of hearing-aid benefit (HAB). A prediction of HAB based on audiogram and unaided CCT results could have clinical value for hearing-aid recommendations.

Design: 83 adults with a range of hearing from normal to moderate sensorineural hearing loss participated and were assigned to hearing loss categories based on audiometric three-frequency PTA3 (1, 2, 4 kHz). The CCT includes 10 vowel-consonant-vowel tokens spoken by a female talker, recorded twice, and mixed with speech-shaped background noise. Each token was repeated five times in a test (100 tokens total; 5 minutes) and the test was completed twice unaided. Participants in the mild and moderate hearing loss categories repeated the CCT once with a hearing-aid fit in the lab and with a personal hearing-aid if they had one. Consonant loss, defined as the difference between the predicted PTAcc and the Audibility function, is used to identify individuals with greater-than-expected loss. HAB is defined as the difference between predicted PTAcc in aided and unaided conditions.

Results: Compared to the standard definition of PTA which gives equal weight to 1, 2, and 4 kHz, a speech-based definition of PTA based on a weighted average of thresholds at 10 frequencies gives most weight to 0.25, 3, and 8 kHz and improves the correlation with CCT percent-correct score. Four participants had consonant loss greater than 10 dB. On average, the HAB of the lab aid was about the same as the personal aid. HAB prediction based on the audiogram and unaided CCT lacked functional precision.

Conclusions: The frequency weighting for PTAcc is a type of band-importance function that improves correlation with CCT score compared to the standard definition. The CCT has potential clinical utility, including quantification of greater-than-expected consonant loss and prediction of HAB. Consonant loss greater than 10 dB may indicate cochlear neural degeneration or cognitive impairment. On average, HAB is about the same for lab-fit aids compared to personal aids. HAB greater than 5 dB supports a

recommendation for hearing-aid use. Prediction of HAB has the potential to improve hearing-aid signal processing methods, but further research is required to develop predictions with usable accuracy.

Category: Hearing Technology / Amplification

Poster #: 085

Strength of Real-Life Preference Judgments for Advanced Hearing Aid Settings

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Objectives: User preferences for advanced hearing aid settings, such as directionality and noise reduction (DIR+NR), exhibit a large variability that is difficult to attribute to audiological or user-specific factors. The absence of clinical best practices for these features leads clinicians to adjust settings based on patient preferences, potentially compromising optimal audiological outcomes. This study examined individual preferences for DIR+NR in diverse acoustic environments, focusing on two primary questions: the sensitivity of users to changes in DIR+NR settings compared to minor brightness and soft gain adjustments, and the factors influencing individual DIR+NR preferences across various acoustic contexts.

Design: The study involved 111 bilateral hearing-aid users from centers in Germany and Japan, all with mild to severe hearing loss and at least 3 months of hearing aid experience. Participants were fit with premium receiver-in-the-ear hearing aids using standard clinical procedures. In each of six field periods (4-6 weeks each), two listening programs were provided, differing in DIR+NR strength or in high-frequency gain (brightness) and soft-sound gain (B+SG). Participants completed self-initiated field report questionnaires on program preferences in daily-life situations and reported their overall preference at

each period's end. Their overall preferences determined settings in the following period and program differences decreased over time. Clinical measures included audiograms, Audible Contrast Threshold (ACT), speech recognition thresholds (SRTs) in noise, and real-ear measurements.

Results: Self-initiated field preference ratings were more pronounced with greater contrasts in DIR+NR strength between programs. As this contrast diminished, preference ratings became less definitive and the number of participants unable to indicate a clear preference increased significantly. Preferences for B+SG settings were notably more pronounced than for DIR+NR settings. Overall DIR+NR preferences at the trial's end varied widely, with very few extreme choices. Strong DIR+NR settings were often chosen for their noticeable reduction in background noise, while weak DIR+NR settings were preferred for enhanced sound quality and loudness. Participants generally preferred DIR+NR settings with adaptive processing but showed greater sensitivity to omnidirectional + NR off or full directional + NR max settings. Several participants preferred weaker DIR+NR settings than those optimizing their speech-in-noise performance. No correlation was found between DIR+NR preferences and audiological factors.

Conclusions: Real-life preferences for adaptive DIR+NR settings were very weak, while reactions to minor gain changes were pronounced. Allowing users to self-select DIR+NR settings may thus not be optimal, as they may not consciously perceive differences or not choose settings that provide them with optimal benefit. However, most users are likely to readily accept most adaptive DIR+NR settings if counseled. Therefore, the findings suggest that clinicians should not refrain from guiding users towards adaptive DIR+NR settings that optimize speech-in-noise benefit. In contrast, clinicians should be mindful of individual preferences when fine-tuning brightness and soft gain, even minimally.

PEDIATRIC AUDIOLOGY / OTOLOGY

Category: Pediatric Audiology / Otology

Poster #: 086

Band Importance Functions in Noise and Two-Talker Maskers Children with Typical Hearing

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Objectives: Band importance functions quantify the relative contribution of spectral bands to the overall perception of speech. The Speech Intelligibility Index uses band importance functions along with audibility to produce a model for predicting speech recognition accuracy. Current methods of estimating band importance rely on manipulating audibility in frequency bands to determine the effect of such manipulations on speech perception accuracy. However, recent research suggest that band importance functions can be estimated in adults under complex listening conditions in which unmanipulated target speech is presented in noise. This method of estimating band importance has not yet been validated in children. Though pediatric frequency band importance functions are typically similar to functions in adults, typical hearing children tend to show greater individual variability in comparison to typical hearing adults. This study aimed to compare frequency band importance function estimation methods in

children with typical hearing both with manipulated and full bandwidth stimuli in the presence of noise and two-talker maskers. Our hypothesis was that children would show similar effects of method and listening condition as previously found in adults.

Design: Forty-two children aged 6-12 years-old with typical hearing acuity participated in this study. All participants had behavioral air conduction thresholds ≤ 15 dB HL across the frequencies 250-8000 Hz in at least one ear. Participants' individual relative frequency band importance was assessed using Bamford-Kowal-Bench sentences presented monaurally at 65 dB SPL under headphones. Band importance functions were estimated via the spectral subtractive method as well as two conditions with full bandwidth stimuli in either speech shaped noise or a two-talker-masker. Condition order and presentation ear were randomized across participants and band importance was estimated in each condition.

Results: Preliminary analyses revealed band importance functions estimated using filtered stimuli similar to those demonstrated in previous literature. Specifically, importance was highest in the octave-wide band centered around 2,000 Hz, with decreasing importance at higher and lower frequency bands. Band importance functions obtained using full bandwidth stimuli in speech shaped had increased relative importance in bands centered around 2,000 Hz and 4,000 Hz, with decreasing relative importance moving away from these bands. Frequency band importance functions estimated using the full bandwidth method in a two talker masker had higher importance in the lower frequency bands (250 - 500 Hz) as well as between 2,000 and 4,000 Hz.

Conclusions: Band importance functions measured using the filtered method were similar to those shown in previous studies. In contrast, high frequency cues became more important in the presence of noise and low frequency cues became more important in the presence of a multi-talker masker, which is consistent with previous findings in adults. Our results demonstrate that band importance functions can be estimated via analysis of target-masker interactions and that band importance changes across listening conditions in children.

Category: Pediatric Audiology / Otology

Poster #: 087

Pre-Implant Vocalizations Predict Post-Implant Language Development in Deaf Children

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Objectives: To determine whether automated, at-home measurements of children's speech and child-caregiver interactions predict spoken language development after cochlear implantation (CI).

Design: Prospective, cohort study. 15 participants with severe to profound SNHL and no other neurocognitive impairments who were candidates for CI were included in the study. Data were collected

via wearable audio recorders that measured children's vocalizations and caregiver-child vocal interactions (conversational turns) in the home prior to CI. Number of spoken words and conversational turns were standardized based on age-normed controls, where the average standard score is 100 and standard deviation is 15. Each participant completed 2-4 days of ~15 hour recording sessions pre-implantation. Data was extracted from 643 total hours of recordings. Post-implantation standardized language assessments, including the Preschool Language Scales-5th (PLS-5) edition, were administered at an average of 15 months post-CI. The standard score metrics described above were also used for the PLS-5.

Results: 9/15 (60%) participants were female. 9/15 (60%) of participants belonged to racial/ethnic minority groups, and 4/15 (26.7%) spoke a language other than English at home. 7/15 (46%) had maternal education less than a Bachelor's degree. 10/15 (67%) had some exposure to American Sign Language by parent report. Average age at CI was 11 months. Pre-implantation recordings were conducted on average 2.8 months prior to CI. Pre-implantation, standard scores for quantity of child vocalizations and conversational turns ranged from 78.8-137.2 and79.2-126.2, respectively, demonstrating behaviors comparable to typically hearing babies.On univariate regression, conversational turn standard scores (B: 0.48, 95% confidence interval: 0.14 to 0.83, p=0.01) and child vocalization standard scores (B: 0.49, 95% confidence interval: 0.07 to 0.91, p=0.02) were positively associated with post-implantation PLS-5 total language scores. On multivariable analysis controlling for CI use (hours per day), age of implantation, time from implantation to PLS-5 testing, child gender, and maternal education, these associations remained intact. For every standard deviation increase in caregiver-child interaction standard score, there was a 7.60 increase in total language score (95% confidence interval: 4.72 to 10.39, R2=0.84, p<0.001) and 11.71 in auditory comprehension standard score (95% confidence interval: 8.60 to 14.81, R2=0.82, p<0.001). For every standard deviation increase in child vocalization standard scores, there was a 5.6 point increase in total language score (95% confidence interval: 2.38 to 8.84, R2=0.82, p=0.001). There were no significant associations with the expressive language scores.

Conclusions: Previous studies have shown that the quantity and quality of child vocal interactions with caregivers in typically hearing children predicts future speech and language success. Whether these factors have a similar impact on children before and after cochlear implantation is unknown. In this study, we found that children with severe-profound SNHL produce speech-like vocalizations and engage in vocal conversational turn-taking even before CI, and that the quantity of these vocal behaviors pre-CI strongly predicts language outcomes after CI. These associations persist even after controlling for multiple demographic and clinical factors, with large effect sizes. These findings suggest that automated speech processing tools may predict language outcomes in children who are deaf and undergoing CI.

Category: Pediatric Audiology / Otology

Poster #: 088

Prevalence, Impact and Mitigation of Spontaneously Collapsed Ear Canals in Newborns

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Objectives: Sound-conduction dysfunction in newborns has been associated with increased fail rates in hearing screening. Spontaneous collapse (SC) of immature ear-canal walls has received less attention as an underlying cause of conductive dysfunction. While pinna stretching or ear-canal tip insertion presumably un-collapses (UC) ear canals, validated methods to verify SC and evaluate their impact on ear canal measurements have not been described. Wideband absorbance (WBA) is a measure of sound conduction that is also sensitive to narrowing or collapse of the ear canal. Objectives were to (1) characterize WBA in the presences of collapsed ear canals, (2) describe the prevalence of SC in newborns as a function of age and body size, and (3) determine their impact on TEOAE screening outcomes. A secondary objective is to demonstrate a pressurization procedure to mitigate SC and maintain valid WBA measurements.

Design: 297 newborns,< 48 hours old, underwent repeated sequence of WBA and TEOAE screening measurements (285 ears pass, 134 fail). In a subset of normal UC ear canals, a procedure to characterize WBA in collapsed ear canals was conducted as follows; (a) obtaining normal baseline WBA in ambient conditions, (b) presenting negative pressure to induce collapse of the canal, (c) measuring WBA following release of pressure without removal of ear probe, while the canal remained collapsed, and (d) verifying recovery of normal WBA following tip reinsertion. Next, using WBA characteristics, SC were identified to quantify their prevalence. Mann-Whitney statistics were used to analyze differences in age and birthweight by status of ear-canal collapse, while chi-squared tests were used to analyze the association between SC rates and TEOAE pass/fail outcomes. A pressurization/pressure-release procedure was tested in subset of ears with SC to evaluate its impact on WBA and TEOAE pass/fail outcomes.

Results: Procedures to collapse normal ear canals resulted in absorbance values< 0 at frequencies ≈ 4kHz, and an emergence of a single reduced and broad peak in the low mid-frequencies in comparison to the normal low- and mid-frequency maxima. There were no differences between SC and UC in terms of birthweight. Younger newborns tended to have greater proportions of SC than older infants, although age differences were marginal. There was a significant association between SC rates and TEOAEs outcomes, where rates were 29.2% among ears that failed the screening, and no SC among ears that passed. Also, the results demonstrated the viability of using positive pressure and release methods in restoring normal WBA and a TEOAE-pass outcome.

Conclusions: This work described methods for identification of SC using WBA measurements. The prevalence of SCs and their association with TEOAE fails indicates their impact on newborn screening tests has been understated. Where birthweight did not differ between SC and UC, newborns with SC tend to be younger than without (UC). Finally, pending further evaluation, preliminary outcome supports the use of careful sequence of positive pressure and release to mitigate impact of SC.

Category: Pediatric Audiology / Otology

Poster #: 089

Family Environment Influences DHH Children's Language Through Parents' Language

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Objectives: Emerging research suggests that specific dimensions of family environment contribute to deaf and hard-of-hearing (DHH) children's spoken language. Because of the known influence of parental language on children's language development, the current study investigated the potential mediating role of parental language on the relation between an important dimension of family environment - the family's emphasis on intellectual and cultural pursuits - and DHH children's receptive language one year later.

Design: Fifty-three DHH children (Mean age = 6.6 years; range = 3-8 years; 28 cochlear implant users; 25 hearing aid users) and their primary caregivers completed two in-home visits separated by 1 year. Families primarily used spoken English and children passed a nonverbal IQ screening. Parents completed a demographic questionnaire and the Family Environment Scale-4 - a standardized parental questionnaire that assesses the family environment. Only the Intellectual/Cultural Orientation subscale was used in this study. Child receptive language was evaluated at both visits (T1 and T2), but only scores from the second (T2) were used in the analyses. Language was measured using the Peabody Picture Vocabulary Test-4 and subscales of the Clinical Evaluation of Language Fundamentals-5/P-2 and the Comprehensive Assessment of Spoken Language-2. Parent language was quantified by mean length of utterance and number of different words/minute from T1 transcripts of 15-minute parent-child play interactions. Composite scores for child and parent language were used in the analyses.

Results: T1 Intellectual/Cultural Orientation was positively correlated with T1 parent language, r = .355, p = .010, and T2 child language, r = .437, p = .001. Regression analyses indicated that variability in T1 parent language and T2 child language were significantly accounted for by T1 Intellectual/Cultural Orientation, β = 0.355, R2 = .126, F(1, 51) = 7.204, p = .010 and β = 0.437, R2 = .191, F(1, 52) = 12.036, p = .001, respectively. Mediation analyses using a bootstrap confidence interval with caregiver education included as a covariate were then performed. These analyses revealed a marginally significant relation between T1 Intellectual/Cultural Orientation and T1 parent language, $\beta 1$ = 0.249, p = .0527, reflecting that for a 1-SD increase in Intellectual/Cultural Orientation, there was a .2-SD increase in parent language. Additionally, T1 parent language was significantly related to T2 child language, $\beta 2$ = 0.546, p = .0001, reflecting that for a 1-SD increase in parent language, there was a .5-SD increase in child language. Finally, Intellectual/Cultural Orientation was indirectly associated with child language ($\beta 1 \; x \; \beta 2$, point estimate: 0.136, 95% confidence interval [.011, .257]; independent of this, there was no evidence of a direct effect of Intellectual/Cultural Orientation on child language (p = .0565). In other words, parent language mediated the relation between T1 Intellectual/Cultural Orientation and T2 child language.

Conclusions: Preliminary results suggest that families that place a greater emphasis on intellectually-, socially-, politically-, and culturally-centered pursuits may foster communication environments with greater amounts of syntactic complexity and lexical diversity, supporting the development of receptive language among DHH children. These findings have important clinical implications for family-based counseling and intervention practices.

Category: Pediatric Audiology / Otology

Poster #: 090

Comparing Eye-Tracking and Verbal Fluency in Children with Hearing Loss

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Objectives: Lexical access is the ability to retrieve word forms from the mental lexicon. Listeners must initiate lexical access to map auditory input onto stored lexical representations and therefore recognize speech, and speakers need fast lexical access to fluently combine words into meaningful utterances. Verbal fluency tasks are a well-established way to assess lexical-semantic network organization, including lexical access. These tasks give 60 seconds to name as many words as possible that begin with a specific letter (e.g., "f;" phonemic task) or to name as many words as possible within a specific semantic category (e.g., "animals;" semantic task). Naming many words indicates good lexical access, and effective use of phonemically or semantically similar clusters within a task indicates good lexical-semantic network organization.Eye-tracking in the Visual World Paradigm (VWP) also assesses lexical access. In this task, the speed at which the listener looks at a target image while hearing the corresponding image label is used as an index of lexical access. School-age children with hearing aids (HAs) and cochlear implants (CIs) are slower to look at the target in VWP tasks relative to children with normal hearing (NH). However, the extent to which this delayed lexical access is due to degraded in-the-moment auditory access vs. differences in long-term lexical-semantic network organization is unclear. The objective of this study was to characterize the relationship between lexical access speed in a VWP eye-tracking task and performance on verbal fluency tasks among children with and without hearing loss.

Design: Participants included 22 children with HAs, 19 children with CIs, and 25 children with NH, ages 9-12. All participants completed a VWP eye-tracking task, phonemic and semantic verbal fluency tasks, and a standardized measure of receptive vocabulary.Lexical access in the eye-tracking task was measured using a "target timing" variable, which indexes the speed with which the child looked at the target image instead of competing images. Verbal fluency performance was analyzed to determine the total number of words named, the size of clusters produced, the number of switches used, and the time to the first word in the phonemic and semantic tasks.

Results: Target timing was significantly correlated with the total number of words named ($r=.36$, $p=.003$) and the number of switches ($r=.34$, $p=.005$) in the semantic verbal fluency task, and with the number of switches ($r=.34$, $p=.005$) and the time to the first word ($r=-.26$, $p=.03$) in the phonemic task. Target timing was not correlated with other measures of verbal fluency performance. In a multiple regression, total words named in the semantic verbal fluency task, receptive vocabulary, and hearing status all uniquely predicted variance in target timing ($R2=.47$, $p<.001$).

Conclusions: Although eye-tracking and verbal fluency tasks are both posited to measure lexical access, only some variables from these tasks were correlated. Results suggest that the delayed lexical access shown by children with hearing loss in the VWP are in part due to poorer ability to retrieve words from their mental lexicon, rather than simply being due to poor in-the-moment auditory access.

Category: Pediatric Audiology / Otology

Poster #: 091

Developing the Caregiver Childhood Hearing Awareness Inventory: English and Spanish

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Objectives: The early detection and intervention of hearing loss in children is important to auditory, academic, and quality of life outcomes. Even when a newborn passes a hearing screening shortly after birth, it is possible they have a mild hearing loss or will develop hearing loss in the future. Although families with newborns are counseled that their baby has passed a hearing screening, Caregivers should be aware of this risk and be prepared to seek hearing healthcare if they develop concerns about the child's hearing. This study aims to develop an inventory questionnaire on hearing health that can be used to evaluate disparities in caregiver awareness of hearing healthcare.

Design: A questionnaire that could be given to caregivers of infants is being developed in six main stages: literature review, an expert focus group, drafting the items, revision based on qualitative feedback, translation to Spanish and additional feedback. Literature review revealed previous questionnaires with comparable topics, but differed in population and scope of questions. The literature review informed a moderator's guide for the expert focus group to evaluate what information as what population should be the target of the current project. The focus group consisted of four audiologists and hearing researchers. Drafting the questionnaire utilized information and feedback from both the literature review and focus group responses. Additionally, readability indices and additional qualitative feedback were implemented to evaluate item validity. Changes to phrasing, word choice, and other aspects of the items were edited to address the feedback and readability metrics. For the Spanish version, the questionnaire was first translated to Spanish then evaluated using back translation and feedback from Spanish speakers

Results: The development resulted in a questionnaire-style inventory titled the Caregiver Childhood Hearing Awareness Inventory (CCHAI). It consists of a demographics section along with items divided into three sections: hearing health, speech and language milestones, and access to care. The items are primarily designed as a statement on the topic with the response being a Likert scale ranging from completely agree to completely disagree. Items in the access to care section are formatted primarily with multiple choice questions, yes/no, and limited open response questions that assess experience receiving information about hearing and the participants preparedness and access to hearing care. The questionnaire is implemented in RedCap with branching logic and text-to-speech features.

Conclusions: In summary, this project, the development of the Caregiver Childhood Hearing Awareness Inventory, established the basis for a tool that can be used to assess caregiver or parent awareness of the signs of hearing difficulties, information on hearing monitoring and the appropriate avenues to access hearing healthcare. Next, the questionnaire will be completed by caregivers of young infants (~4-6 months old) whose preferred language is either English or Spanish. Questionnaire responses will be analyzed to evaluate the effects of maternal education, socioeconomic status, and preferred language on parents' understanding of hearing health in infants. Ultimately, collecting data using this tool may identify

disparities in medical home education on hearing and guide improvements in counselling by the medical home.[NIH-NIDCD T35 DC008763]

Category: Pediatric Audiology / Otology

Poster #: 092

Using a Cause-and-Effect Response for Behavioral Hearing Evaluation of Children

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Objectives: To understand how auditory development unfolds during early childhood, it is critical to develop reliable behavioral methods for measuring hearing in toddlers and preschoolers. Recent work with an observer-based psychoacoustic procedure - the Play Observer-Based, Two-Interval (PlayO2I) method - has been shown to be feasible for 2- to 7-year-old children who are typically developing. In the PlayO2I method, an experimenter (called an "observer") initiates a trial and determines which of the two observation intervals the signal was presented in based on the child's behavior. The child is trained to perform a play-based motor response when they hear the signal. The purpose of this study is to examine how many trials are required for training based on the response task (i.e., cause-and-effect versus drop-and-release). Our hypothesis was that fewer trials would be required to learn the cause-and-effect response task because it is a developmentally easier task than a drop-and-release task.

Design: Two groups of children were enrolled: children with typical development (18 - 36 months) and children with developmental differences (18 - 71 months). Children completed an otoacoustic emissions screening. Each child was evaluated with three developmental instruments: Mullen Scales of Early Learning, Vineland-3 Adaptive Behavior Scales, and the Ages and Stages Questionnaire. Experimental data were collected with the PlayO2I method. The signal was a 500-ms, 1000-Hz warble tone at 50 dB SPL under headphones. All children were trained to perform two response types: cause-and-effect (i.e., push a button that provides visual and auditory feedback) or drop-and-release (i.e., drop a block in a bucket). Children completed two phases of training for each response type. Children were counterbalanced in their testing order, and children were re-tested in their first condition to further examine training effects.

Results: To date, we have collected data from 6 children with typical development and 3 children with developmental differences. Preliminary results are consistent with our hypothesis that the cause-and-effect response task is more likely to be learned by children, and in fewer trials, than the drop-and-release task. Learning the cause-and-effect response task first may reduce the length of training required to learn the drop-and-release task.

Conclusions: We will discuss number of trials required to learn the response tasks based on child age and developmental profile. We will discuss patterns in the data that highlight training effects based on testing

order. We will also discuss considerations around completing training under headphones or in the soundfield.

Category: Pediatric Audiology / Otology

Poster #: 093

Predictors of Vocal Emotion Recognition in Children with Hearing Aids

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Objectives: Perception and identification of vocal emotion is a key element of social communication and is essential to the development of meaningful relationships. Current clinical audiology speech perception measures evaluate what is said, but do not assess the listener's perception of how a message is conveyed. As a result, although children with hearing loss often perform well on speech recognition tests, it may not adequately capture real-world communication difficulties related to the ability to understand emotions of a speech signal. Vocal emotion recognition has typically been examined in children with cochlear implants due to the nature of the degraded auditory signal; however, recent work has shown that children who are hard of hearing show variability in emotion perception tasks. Greater attention to these abilities is necessary to improve hearing and communication outcomes for children who are hard of hearing. Our study evaluated several hypotheses: 1) We predict a positive relationship between age and emotion recognition accuracy, indicating improvement in performance with development; 2) Children with better unaided and aided hearing, as measured by the speech intelligibility index (SII), will perform better, indicating that performance is variable across children with hearing aids; 3) Greater expressive vocabulary and short-term memory will be associated with better emotion perception performance.

Design: School-age children (5-14 years old) who are hard of hearing with thresholds ranging from mild to profound bilaterally participated in the study. Air conduction thresholds were obtained using ER-3A insert headphones. All children were fitted with hearing aids bilaterally and hearing aid verification was completed to collect both unaided and aided SII. Expressive vocabulary was measured by the Weschsler Abbreviated Scale of Intelligence-Vocabulary (WASI) and short-term memory was measured by the Corsi Blocks Task. In the main experiment, each child participated in a five alternative-forced choice emotion recognition task. The stimuli were recordings by a native female speaker of North American English and consisted of 12 sentences read in 5 different emotions (Happy, Scared, Neutral, Sad and Angry). Participants selected the emotion that they heard by clicking a button on a touch screen monitor.

Results: Preliminary results showed a positive association between age and emotion recognition abilities, indicating that children with hearing aids were better at recognizing emotions as they develop. Moreover, emotion recognition abilities were associated with better short-term memory and greater expressive vocabulary, but there was no relationship with auditory access as measured by the SII. However, overall accuracy and relationship with these predictors varied by each emotion.

Conclusions: Preliminary results suggest that emotion perception abilities improve throughout development. Children who demonstrated higher expressive vocabulary and working memory tended to show better emotion recognition performance. Hearing aids appear to provide enough access to sound to enable children to compensate for difficulties with emotion recognition. The current study has implications for improved understanding of the underlying mechanisms of vocal emotion recognition in children with and without hearing loss.

Category: Pediatric Audiology / Otology

Poster #: 094

Treatment after School Hearing Screening: Trial Data from Rural Alaska

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Objectives: Untreated childhood hearing loss has well known negative effects on speech and language development, academic performance, and future employment opportunities. The majority of childhood hearing loss is from preventable ear infections, with rural and underserved populations disproportionately affected. It is vital to identify and manage children at risk for hearing loss early. While school screening programs can be pivotal in identifying children, many children then face barriers in accessing treatment. Management for preventable infection-related hearing loss can range from medical treatment, such as antibiotics and drops, to surgical treatment, such as tympanostomy tubes, or rehabilitative treatment, such as hearing aids. Access to treatment is difficult even in high-resource settings and affordable alternatives are needed if there is to be a public health initiative to address childhood hearing loss for all. However, little is known about the most common treatment pathways for management of childhood hearing loss in rural underserved communities, and evidence is needed to drive future innovation and development in accessible hearing loss treatment.

Design: This analysis evaluated common treatment pathways of school-aged children enrolled in two cluster randomized trials in rural Alaska (2017-2020) who did not pass their school hearing screening (n= 861) and who had at least one ear/hearing-related encounter within nine months of their date of screening (n=404). Relevant International Classification of Diseases, 10th revision (ICD-10) codes were recorded through chart review for each encounter and categorized into the following groups: external ear, middle ear, hearing loss, encounter for exam with normal findings, and encounter for exam with abnormal findings. Treatment recommendations were categorized into medical, surgical, medical + surgical, hearing aids, further testing, continued observation, or no recommendations. Descriptive analysis included primary treatment recommendation at the first visit following date of screening, as well as treatment recommendations at each subsequent visit.

Results: Of the 404 children seen for an ear/hearing-related encounter following a referred school hearing screening, 24% (n=97) needed medical care, 6.4% (n=26) were recommended surgery, 2.0% (n=8) needed both medical and surgical care, 2.5% (n=10) were recommended a hearing aid, 57.4% (n= 232) required further testing, and 5.9% (n = 24) did not have treatment recommended based on their

first visit. When considering treatment recommended after the first visit, 38.5% (n=10) of those initially recommended only surgery sought additional medical treatment, and 11.3% (n=11) of those recommended for only medical treatment were eventually referred for surgery. Of those children initially recommended for further testing, 24.6% (n=57) and 12.5% (n=29) were recommended for medical or surgical treatment, respectively.

Conclusions: Addressing preventable childhood hearing loss in rural and underserved regions requires early identification and accessible treatment. While implementation of hearing screening programs promotes early identification, knowledge of common treatment pathways is critical to developing accessible treatment solutions. Findings from this analysis of treatment pathways following hearing screening in Alaskan schools underscore the importance of accessible diagnostic testing within rural communities, as well as the need to identify affordable medical treatments and surgical innovations to make essential surgeries, such as tympanostomy tubes, more accessible.

PHYSIOLOGY

Category: Physiology

Poster #: 095

Can SFOAEs be Measured Without Suppressors or Other Conditions?

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Objectives: Stimulus frequency otoacoustic emissions (SFOAEs) are emitted at the same frequency as the probe tones that evoke them, but are often buried in noise, making separation challenging. To aid separation, additional stimulus conditions have been added to leverage cochlear nonlinearities, like two-tone suppression or compression, but these increase measurement time - sometimes by double or triple the amount of time. Although similar SFOAE paradigms exist, there's no consensus on whether SFOAEs can be directly obtained from probe tone recordings alone. Spectral smoothing, an analysis method which uses cochlear latency to estimate SFOAE magnitudes, eliminates the need for extra conditions, but is slow with finely spaced measurements. However, coupling continuous frequency sweeping with latency-based analysis significantly reduces measurement time by estimating SFOAEs directly from the probe response itself. Still, reliable separation may be limited in cochlear regions with short latencies or low SFOAE magnitudes. This preliminary study aimed to evaluate the reliability of continuously swept frequency probe tone-evoked SFOAEs compared to a similar suppressor-tone paradigm.

Design: Nine young adults, ages 18 to 29, participated in the study with normal tympanometry, no history of middle ear pathology or surgery, and pure-tone thresholds below 20 dB HL between 0.25 and 8 kHz. SFOAE data were collected from the right ear of each participant using swept frequency probe tones (1) with suppressor tones and (2) without a suppressor tone. SFOAEs were measured with a continuous frequency-swept tone (2 sec/octave, 8 sec/sweep) over 96 sweeps from 0.5 to 2.5kHz at 35 dB SPL using OAEToolBox (OTB). Suppressor tones were presented with the probe tone and were 50 Hz above that of the probe tone along with the probe tone in each odd-numbered trial with a frequency 50 Hz above the

probe's frequency. SFOAEs without suppression were estimated from the probe-alone trials (48 sweeps) and on the residual between probe-alone and suppressor-probe conditions using a least-squares fit (LSF). Pearson product correlation coefficients were computed between paradigms in overlapping 1/3 octave bands for SFOAE level, noise floor and SNR.

Results: Significant correlations for SFOAE level (p=7.53e-7) and SNR (p=0.029) were found when comparing the two paradigms. Correlation coefficients were generally >0.85 below 4000 Hz, but some local frequency regions had poor correlation coefficients (e.g.<0.5). In areas of poorer correlation coefficients there were still related shifts in fine structure and had similar local peak magnitudes.

Conclusions: This study demonstrates SFOAE measurements are obtainable directly from a continuously swept frequency probe tone without additional stimulus conditions, challenging traditional methods and assumptions in SFOAE measurement. Strong SFOAE magnitude correlations between the paradigms suggest that a simplified, faster measurement technique may be feasible, such as a screening test if the focus is on local SFOAE magnitude peaks.

Category: Physiology

Poster #: 096

Cochlear Synaptopathy and Central Gain with Aging and Noise Exposure

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Objectives: Adults of all ages experience a wide variety of potentially damaging recreational and occupational acoustic exposures. These noise exposures may cause a loss of cochlear afferent synapses that remain "hidden" from audiometric assessments. Aging results in a progressive loss of cochlear synapses, while early noise exposures exacerbate cochlear synapse loss. However, the vulnerability to cochlear synapse loss, and subsequent effects on the central auditory pathway at later ages are still unclear. In this study, we investigate the interactions between aging and acoustic overexposures, focusing on cochlear deafferentation and subsequent central gain in a mouse model (CBA/CaJ). By systematically varying age of noise exposure and time of testing, we aim to investigate vulnerabilities to noise-induced cochlear synapse loss and central gain as a function of age.

Design: Mice (N = 54) were exposed to a single synaptopathic noise exposure at various time points across their lifespan. Testing occurred two weeks post. Results were compared to unexposed age-matched litter-mate controls. Electrophysiological assessment of cochlear synapse loss and central gain

were made using EEG-based envelope following responses (EFRs). Histological assessment of cochlear synapse loss was made using immunostaining of glutamatergic ribbon synapses in the inner hair cells.

Results: The age at noise exposure affected both the degree of synapse loss, as well as the subsequent central gain changes. Early noise exposure resulted in cochlear synapse loss and increased central gain compared to age-matched controls. However, noise exposure at later middle-ages resulted in lesser central gain, despite cochlear synapse loss. Histological analysis confirmed cochlear synaptopathy observed using EFRs.

Conclusions: Our results suggest that age at noise exposure can have a dramatic effect on the compensatory ability of the auditory system when faced with decreased peripheral inputs. These unique profiles of cochlear synapse loss and central gain likely have differing effects on speech perception in noisy conditions. Clinically, these results suggest that an individual's age when exposed to noise should be considered in determining potential damage to the auditory system and effects. The electrophysiology measures used here could potentially lead to objective clinical biomarkers for cochlear synapse loss and central gain assessments in the clinic.

SPEECH PERCEPTION

Category: Speech Perception

Poster #: 097

Using Synthetic Speech Stimuli and Automatic Speech Recognition to Assess Masked Sentence Recognition in Human Listeners

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Objectives: Speech recognition testing is a core component of the audiological test battery. It helps clinicians understand a person's functional hearing ability beyond audibility alone. For open-set speech recognition testing, current clinical practice requires a human examiner to score listener responses. Reliance on human examiners can present accessibility challenges - particularly for examiners who are hard of hearing or listening in their second language - as it demands both auditory acuity and familiarity with the test language. Further, developing test materials for clinical assessments is a time-consuming process, limiting the number and diversity of materials that are available. Utilizing artificial intelligence (AI) could significantly accelerate test construction, allowing for more variety and a larger volume of speech stimuli tailored to various needs. Recent advances in AI, especially the introduction of Large Language Models (LLM) have greatly improved the speed, accuracy, and human-likeness of both the generation of synthesized speech as well as automatic speech recognition (ASR) algorithms. In this experiment, we utilize AI-powered models to synthesize speech and to perform post-testing reliability scoring for an open-set sentence recognition task.

Design: The experiment consisted of two parts: speech recognition testing and perceptual judgments. Participants were 30 young adults, all native speakers of American English. In the speech recognition task, participants listened to 200 sentences spoken by five human and five synthetic female talkers (20 sentences per talker). Each sentence, containing four scorable keywords, was presented with a spectrally shaped noise masker at -6 dB SNR, and participants were instructed to repeat what they heard. Sentence recognition scores were calculated for each talker. Live scoring, offline scoring, and ASR were used to calculate sentence recognition scores, eliminating potential tester bias and increasing scoring consistency. In the perceptual judgment task, participants rated sentences, identifying whether each was produced by a human or synthetic talker using a 5-point Likert scale; 50 sentences were presented in quiet and 50 sentences were presented in noise (+5 dB SNR).

Results: Performance differed by talker, with a trend for better performance with synthetic talkers. Mean scores were 32-73% correct for human voices and 58-76% for synthetic voices, but the rank order of individual differences was similar across both human and synthetic voices. There was also variability across talkers in the perceptual judgment scores. Participants were above chance at discriminating synthetic from human talkers, particularly in quiet, but one synthetic voice was consistently rated as human-sounding, particularly when it was presented in noise. There was no clear association between recognition and perceptual judgment scores. Agreement between human raters and ASR scoring was comparable to the consistency between human raters.

Conclusions: Results of this study support the idea that modern algorithms for speech synthesis and ASR scoring are accurate enough to warrant further study of their possible use in speech testing. Speech synthesis could support the rapid production of novel or individualized testing materials. ASR-based scoring could reduce bias, improve reliability, and allow a broader population of audiologists to provide speech testing (e.g., those with hearing loss).

Category: Speech Perception

Poster #: 098

Age-Related Changes in Speech-in-Noise Performance Under Varying Spectro-temporal Demands

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Objectives: This study investigates how aging affects performance in speech-in-noise tasks under varying spectro-temporal demands. Age related declines in the auditory system can cause challenges listening in

complex environments for individuals with both putative normal hearing and hearing loss. Specifically, we tested the hypothesis that age-related deficits would be evident under maximal energetic masking.

Design: All measurements in the study were performed using a web-based platform for psychoacoustics. 200 participants between the ages of 18-73 were recruited through Prolific. All participants were screened for putative normal-hearing status using a recently validated online hearing screener. The participants had to report no cognitive decline or dementia and normal or corrected vision. Participants were instructed to use headphones when doing the tasks and were allowed to adjust the volume to a comfortable listening level. A headphone-use check task was used to screen for compliance. Speech-in-noise scores were used using the Modified Rhyme Tests (MRT), a monosyllabic word-based test that that emphasizes bottom-up sensory processing while minimizing top-down effects such as working memory or stream segregation. The target MRT words were presented in three different conditions with varying spectro-temporal demands: - (1) MRT words amidst four-talker babble, (2) MRT words in babble with time compression and reverberation imposed on the mixture, and (3) MRT words with a steady (unmodulated) inharmonic tone complex as the maskers to maximize energetic masking. Participants responded by choosing the target word from a list of six choices that were all monosyllabic (CVC) words that differed only in the first or the last consonant.

Results: Aging was significantly correlated with performance in inharmonic tone complexes. However, we found no statistically significant effect of age on the participants' performance in the words in babble condition or the time compression and reverberation-imposed condition.

Conclusions: On average, older adults needed a more favorable signal to noise ratio to perform well in all the three listening conditions. Performance when using Inharmonic tone complexes as the masker resulted in a significantly worse performance with age, with thresholds decreasing by 0.76 dB per decade of adult life ($p=0.0039$). Based on these results, inharmonic tone complex maskers may be more sensitive to detecting cochlear deafferentation. The lack of age-effects on the other two conditions were surprising, but results may have been confounded by the use of a speech in babble-based hearing screener for normal audiometric function. Future studies will explore the role of cochlear deafferentation assessed using electrophysiological measures to explore the mechanisms underlying age-related deficits in energetic masking performance. Energetic masking with inharmonic tone complex maskers could also be a useful tool in the diagnostic evaluation of hearing difficulties in the clinic in subjects with normal audiograms.

Category: Speech Perception

Poster #: 099

Can Training in the Presence of Noise Maximize Auditory Learning?

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Objectives: Auditory learning is affected by a myriad of factors, such as session duration, stimulus complexity, background noise, and training schedule. While linguistic complexity has been found to influence auditory learning, the effect of non-linguistic complexity, particularly background noise, on

auditory learning is underspecified. The current study is aimed at examining the impact of embedding speech within speech-shaped noise at different signal-to-noise ratios (SNRs), on auditory learning. Using a combined behavioral and electrophysiological approach, we hypothesize a differential effect of the degree of auditory complexity (denoted by the SNR level) on auditory learning.

Design: The current study uses a between-group design with 48 participants, randomly assigned to one of the three groups (i.e., in quiet, 0 dB SNR, or +10 dB SNR). All groups receive a 5-day pseudoword-picture association training with Hindi voiceless dental and retroflex sounds. Outcome dependent measures include comparison of (1) learning curves of the learned stimuli across the five sessions; (2) Pre vs. post AX discrimination scores on the quiet dental-retroflex contrasts; and (3) Pre vs. post auditory P300 amplitude and latency data for the quiet dental-retroflex contrasts.

Results: From our preliminary behavioral data (N=17), we found that the groups trained with +10 dB SNR (n=6) and +0 dB SNR (n=6) exhibited enhanced generalization to discrimination of novel dental-retroflex contrasts as compared to the group trained in quiet (n=5). Currently, in order to understand the neural impact of learning across the different SNRs, a subset of subjects is undergoing P300 testing (with the dental-retroflex contrast stimuli) before and after the training. Following the preliminary behavioral results, we predict a more robust increase in P300 amplitude and a decrease in P300 latency for the groups trained in the presence of noise (i.e., +10 dB SNR and 0 dB SNR) as compared to the group trained in quiet.

Conclusions: Overall, the current study reveals a differential effect of SNR on auditory learning. More specifically, the preliminary results suggest that training in the presence of noise may be more beneficial than training in quiet (i.e., no noise). These findings exhibit promise toward the development of novel auditory training paradigms that may prove useful in maximizing auditory learning within a short period of time, to benefit both patients and clinicians alike.

Category: Speech Perception

Poster #: 100

Using Physical Exertion as a Real-Time Index of Listening Effort

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Objectives: Understanding speech in noisy environments is challenging. Measuring the corresponding increases in listening effort is important for assessing the effectiveness of interventions that address hearing impairments. We previously found that participants will exert physical effort (repeated button-pressing) to secure easier listening conditions (less background noise) in a subsequent speech-identification task, suggesting that physical exertion may be useful in providing a novel index of listening effort. Levels of exertion matched task demands across differences in sentence predictability and initial background noise, suggesting that key-pressing allowed participants to avoid the need to exert listening-related cognitive effort. Whereas we previously measured physical exertion before each trial, here we ask whether button-pressing behaviour can also provide a real-time index of changes in listening effort.

Design: Spoken-narrative stories were presented with gradually-increasing levels of background noise. Participants (N = 215) could reduce the noise, if desired, by pressing a spacebar. A progressive-ratio schedule, however, meant that an increasing number of key-presses were needed to obtain easier listening conditions during each of six successive portions of a given narrative. Different ranges of signal-to-noise ratios (SNR) also meant that the peak noise level was higher for 'wide-range' participants than 'narrow-range' participants (hardest SNR: -10 dB vs. -4 dB). But-with sufficient key-pressing-the noise could be reduced much more for those 'wide-range' participants than the 'narrow-range' participants (easiest SNR: 14 dB vs 8 dB). The temporal order of the narratives was also manipulated, presenting the story either in its intact form (coherent story), or as a scrambled version (incoherent story). Following the end of each story, thought probes assessed subjective effort, boredom, attention, and engagement. Narrative comprehension was tested using multiple-choice tests.

Results: Participants' key-presses increased significantly as the progressive-ratio required more physical exertion to obtain easier listening conditions; an effect that was significantly larger for wide-range participants than for narrow-range participants. However, there was no difference for either group in the pattern of key-presses between the scrambled-incoherent and the intact-coherent stories, although self-reports after each narrative revealed that the scrambled stories elicited greater subjective effort and boredom, and less attention and engagement, than the intact stories. Finally, multiple-choice test performance likewise revealed better memory for intact stories than scrambled stories for the narrow-range participants.

Conclusions: Our findings provide converging support that the effort-related costs of understanding speech in noise are readily exchanged for increases in physical effort. Importantly, these results demonstrate that the use of physical-exertion can provide a useful real-time index of fluctuations in these effort-related costs. Our novel index of listening effort therefore seems promising for inclusion in an audiologic outcome battery, given that it is efficient, easily administered, and requires no specialized equipment. Nevertheless, future work should investigate the non-significant difference between intact and scrambled narrative key-pressing. For instance, scrambling the sentences within a clip, in addition to the order of clips, may serve as a harder 'scrambled' manipulation and lead to increased key-pressing. Future work can also examine this novel index alongside other existing, physiological measures of listening effort.

Category: Speech Perception

Poster #: 101

Listening Effort and Listening Stress in Virtual Reality-Enabled Naturalistic Listening

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Objectives: Head and body movements significantly influence real-world hearing outcomes but are often overlooked in clinical evaluations of hearing aids. This oversight is partly due to the invasive and obtrusive nature of traditional objective outcome measures (e.g., desk-mounted pupillometry, EEG, fNIRS), which require participants to remain still while listening. This study introduces a novel experimental approach that incorporates natural human behavior during listening by using Virtual Reality (VR) in an anechoic chamber equipped with a spherical 64-channel loudspeaker array and an ecologically valid listening task. We hypothesized that objective outcomes derived from non-obtrusive heart rate recordings would be as sensitive to task difficulty and hearing-aid technology as traditional pupillometry.

Design: Participants (N = 25) freely moved their head and body to complete two listening tasks with a natural transition between them. First, they located a target talker among 15 source locations, then comprehended a 33-second speech from the target location. Task difficulty was manipulated by introducing either two or four interfering talkers at various spatial locations, and steady-state noise was presented at a constant level from the rear. Continuous heart rate was recorded using an Empatica E4 wristband, and listening stress was calculated as the relative change in beats-per-minute based on the number of interfering talkers. Additionally, sustained listening effort was measured from continuous pupil dilation recorded with head-mounted cameras in the VR headset. Head and gaze direction were tracked throughout the experiment. Participants used two different hearing aid models, both featuring noise management systems based on Deep Neural Networks. However, only one model utilized head movement information from an embedded accelerometer to adjust noise management in response to detected acoustic complexity.

Results: Speech comprehension performance decreased, and both sustained listening effort and listening stress increased in the four interfering-talkers condition compared to the two interfering-talkers condition. Comparing the two hearing aid models, speech comprehension was similar, but sustained listening effort and listening stress were significantly higher for the model that did not incorporate head movement information in its noise management. Notably, listening stress was initially higher for both models in the four interfering-talker condition, but after approximately 15 seconds of speech comprehension, listening stress with the model that included head movements was no longer affected by the number of interfering talkers.

Conclusions: VR combined with non-invasive objective outcome measures is a viable method for evaluating hearing aids under naturalistic conditions. Listening stress, quantified by relative heart rate, was sensitive to both task difficulty and hearing-aid technology, aligning with sustained listening effort.

Category: Speech Perception

Poster #: 102

Speech Recognition and Listening Effort at the Simulated Cocktail Party

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Objectives: Struggling to understand speech in noisy environments is a common problem for individuals with hearing loss, and some individuals with normal hearing. For these individuals, speech understanding often comes at the cost of increased effort. Poor speech understanding and increased listening effort in noisy situations can be detrimental to overall quality of life. Clinicians often offer positioning recommendations (e.g., sitting in a corner or at a booth) to patients as a potential solution for increasing understanding and reducing effort. To provide empirical support for these recommendations, we need to design experiments with realism in mind. To achieve this goal, spatial cues and listener positions (i.e., where the listener is in relation to noise sources) were simulated to better approximate real-world listening environments. In our study, participants completed a speech recognition task and provided ratings of perceived effort in three positions in a simulated cocktail party. Based on existing evidence, we predicted that speech recognition performance would be highest and perceived effort would be lowest in the position affording the most robust spatial cues.

Design: Young adults (aged 18-30) with normal hearing were tested in three listener positions at a simulated cocktail party. The three positions represented realistic seating/standing options at a cocktail party: the center, perimeter, and corner of the room. The center position was designed to yield poor spatial cues - background talkers were spaced at various distances to the front, back, left, and right of the listener. On the other hand, the corner position was designed to yield the most robust spatial cues (background talkers in front of and to the left of the listener only). There were six background talkers in each position. Each masker had different, simulated spatial cues depending on the position. In each position, target intensity level was adaptively adjusted to estimate individual psychometric performance functions. Next, listeners were tested at four fixed target intensity levels: the 50% and 80% correct thresholds on their psychometric function, and at 70 and 65 dB SPL, representing average and soft target speech levels. At each fixed level, participants provided subjective ratings of perceived effort throughout testing.

Results: Speech recognition performance and subjective ratings will be compared across positions at equivalent performance levels and equivalent intensity levels. Psychometric functions for the three positions will be presented to demonstrate the extent to which position affects thresholds. The effects of position on performance will be discussed in terms of speech recognition performance across positions. Lastly, subjective ratings of perceived effort will reveal the extent to which position impacts perceived effort.

Conclusions: Results from our study can contribute to the evidence base for positioning recommendations. Specifically, our findings may reveal how patients can orient themselves in a noisy environment so as to maximize speech understanding while also reducing the costs of maintaining understanding. Being able to demonstrate to patients that they have some agency in these challenging listening situations (i.e., their position affords them differing levels of understanding and/or effort) would result in a powerful counseling tool that could combat social isolation and disengagement.

Category: Speech Perception

Poster #: 103

Novel Insights into Spatial Unmasking: The Impact of Audio-Visual Congruence

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Objectives: Spatial separation of target and competing (masker) speech improves the accuracy and perceived ease with which typically hearing (TH) listeners can identify the target. Under these experimental conditions, behavioral measures like percent correct scores are not designed to also provide insight into the momentary accumulation of information about the auditory stimuli that informs the ultimate perceptual judgement. In this study, we adapted the "visual world paradigm," wherein eye-gaze was monitored as participants selected, on a computer monitor, the image representing the target described by the auditory stimulus. This study investigated novel effects of target-masker configurations, signal to-noise ratio (SNR), and audiovisual congruence on percent correct and more importantly on the eye gaze behaviors unfolding over the time course of target determination. The study focuses initially on normative data, with a second experiment being piloted in bilateral cochlear implant listeners.

Design: Target and masker stimuli were from the coordinate-response measure (CRM) sentences and produced by male talkers. CRM sentence syntax varies only in the "call sign" (e.g., "Baron", "Hopper"), color, and number spoken. The target call-sign was always "Baron," but the masker call-sign varied randomly across trials, and target and masker sentences were spoken by different talkers on each trial. Target stimuli were played at 65 dBA via loudspeakers located at +/- 90¬∫ azimuth. They were presented in quiet, or with a co-located or spatially separated speech masker at 0 dB or -8 dB SNR. Participants responded by clicking the image depicting the target on a computer monitor containing four images. Each quadrant of the screen contained the target number in the target color (target), the masker number in the masker color (incongruent foil), or a partially congruent foil. Half of the trials were audio-visually congruent (i.e., the target image was drawn on the side of the monitor closer to the target loudspeaker). The design includes twenty-five TH adults.

Results: As expected, speech target identification was higher when the masker was spatially separated from (compared to co-located with) the target. Analysis of the eye-gaze behavior suggests that participants committed to their target determination more quickly and consistently when the target was presented alone, or when with a spatially separated masker. On trials with co-located maskers, participants were more likely to reconsider visual competitors after fixation to the target image. Audiovisual congruence decreased the latency to maximum target looks across target-masker configurations and SNRs.

Conclusions: In addition to demonstrating improved speech target intelligibility from spatial separation of target and masker stimuli, the participants in this study demonstrated that spatial release from masking can increase the speed, certainty, and confidence with which a target sound is identified. We will present a more detailed analysis of the interaction of the effects of audiovisual congruence, SNR, and target-masker configuration after concluding this study with TH listeners. Our longer-term plan is to investigate how the gaze behavior of listeners with bilateral cochlear implants is affected by differences in these and other factors.

Category: Speech Perception

Poster #: 104

Evaluating the Contribution of Speech Fine-Structure at Different Signal to Noise Ratios

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Objectives: Fine structure (FS) is considered important for the perception of speech in the presence of noise. Clinical tests for FS processing utilize non-speech stimuli, however, they do not inform real-world speech perception. An open question exists if fine structure (FS) contributes to speech in noise perception beyond the envelope and recovered envelopes, and if we can develop tests of speech in noise perception targeting FS processing. In this study, we propose a novel speech-based test for assessing FS processing in different signal-to-noise ratios, by circumventing the current confounds associated with speech-based tests for FS processing. Our test evaluates the temporal integration of FS as a metric of FS processing. We hypothesize that listeners leverage FS cues for speech perception in noise at difficult signal-to-noise ratios (SNR) than at favorable SNRs. Further very little is known about the speech FS processing in the auditory cortex. We use our novel approach of manipulating FS and evaluate encoding of the FS in the cortex using electroencephalography responses to the speech envelope imposed on informative and uninformative FS carriers.

Design: We evaluate parametric changes in the amount of FS information needed to improve speech perception in noise, which can in turn be interpreted as the magnitude of speech perception benefit provided by FS cues. We introduced FS glimpses of parametrically varying duration in speech while keeping the envelope constant and traced changes in speech perception in noise scores at +6, +2, and -2 dB SNRs. We used a within-subjects design with 2 within-subject factors (3 levels of noise and 11 FS timescales) to study the contribution of FS to speech perception across different SNRs. Twenty-one typically hearing adults participated in the study. The sentences from the different FS conditions were presented in a random order to avoid order effects, and participants' verbal repetition of the stimuli was recorded. Live scoring and offline scoring were performed. A psychometric function was constructed to evaluate the relationship between FS timescale and speech perception in noise. In a subset of participants, we recorded EEG while they performed the sentence recognition task for a limited set of conditions with varying amounts of FS. We evaluated the encoding of the envelope of speech across the different FS conditions as a proxy of FS encoding at the cortex.

Results: We observed that listeners leverage FS cues maximally at +2 dB SNR and -6 dB SNR than at +6 dB SNR. The contribution of FS to speech perception shows a non-monotonic increase with an increase in temporal integration of FS. We also found distinct spatiotemporal neurophysiological signatures that can serve as a potential neural marker of speech FS processing.

Conclusions: Our approach to assessing speech FS processing is not confounded by the recovered envelopes at the output of the auditory filter. Thus, it is promising in effectively evaluating speech FS processing. We also demonstrate a viable speech-based neural marker that informs speech FS processing.

Category: Speech Perception

Poster #: 105

Impact of Hearing Loss Compensation on Tracking of Noise Tolerance

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Objectives: The Tracking of Noise Tolerance (TNT) test measures the amount of background noise an individual chooses to "put up with" (i.e., tolerate) while still perceiving to understand >90% of the speech information. The TNT test is administered at a fixed the speech presentation level of 75 dB SPL. Thus, the audibility and/or loudness may not be adequate for listeners with larger degrees of hearing loss when tested unaided. We created the Hearing Loss Compensated Tracking of Noise Tolerance (HLC-TNT) test, which frequency shapes and amplifies the test materials to compensate for listeners' hearing losses. We hypothesized that, compared to the original uncompensated TNT test, the HLC-TNT test would result in increased tolerable noise levels, especially for listeners experiencing reduced speech audibility and/or loudness unaided. Additionally, we hypothesized that HLC-TNT may improve TNT's ability to predict real-life hearing aid satisfaction.

Design: Twenty older hearing impaired (HI) and 20 normal hearing (NH) adults were recruited to perform the noise tracking task to determine noise acceptance thresholds and the range of noise levels explored during the tracking. All listeners were tested unaided using the original TNT test. HI listeners were also tested using the HLC-TNT test. Both tests were administered at a 75 dB SPL speech level in the presence of two types of collocated background noises (continuous speech shaped noise and babble noise). The significance of hearing loss compensation on TNT indices were evaluated using a linear mixed effects model. We also evaluated if the HLC-TNT would predict HI listeners' satisfaction with their own hearing aids examined using the MarkeTrak questionnaire.

Results: Data collection and analyses are ongoing with preliminary results with 6 NH and 6 HI participants available. Speech Intelligibility Index (SII) based analysis on speech materials indicated that HLC-TNT provided full speech audibility for speech in quiet for all HI listeners. Despite the ensured speech audibility, the HLC-TNT did not increase the HI listeners' tolerable noise levels compared to the uncompensated TNT. HI listeners tolerated 2 dB less noise than NH listeners even after the hearing loss compensation. Re-analysis of the data, including HLC-TNT test's ability to predict hearing aid satisfaction, will be completed once data collection is finalized.

Conclusions: The preliminary results suggest that factors underlying HI listeners' reduced noise tolerance compared to NH listeners extends beyond audibility of speech cues in quiet. While the hearing loss compensation improves the audibility of speech, it also increases the loudness of the noise. These two effects may have the opposite impact on noise tolerance. The detailed analysis of the study results will

inform which listeners may benefit from hearing loss compensation when evaluating their noise tolerance.

Category: Speech Perception

Poster #: 106

Effect of Noise on the Intelligibility of Dysarthric Speech

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Objectives: Dysarthria is a motor speech disorder of neurological origins that often results in significant decreases in speech intelligibility. Our previous work, including both empirical studies and cognitive interviews with patients and their communication partners, has shown that, relative to typical speech, dysarthric speech is particularly susceptible to the negative influence of background noise. This is especially true when that noise is complex, as generally encountered in everyday situations (e.g. cafeteria noise). However, much is still unknown about the specific influences of noise on dysarthric speech, including potential differential effects as a function of dysarthria type. Dysarthria is a highly heterogenous speech disorder that results from various etiologies including stroke and Parkinson's Disease, and its perceptual consequences vary considerably across individuals. These divergent perceptual characteristics, such as reduced loudness and accelerated speech rate associated with hypokinetic dysarthria, or irregular articulation errors and slow speech rate associated with ataxic dysarthria, may interact with background noise in different ways.

Design: To examine the effect of noise as a function of dysarthria type, we selected speech recordings from four speakers with equal baseline intelligibility in quiet (75-77% correct) but who presented with the characteristic features of four different types of dysarthria (hypokinetic, hyperkinetic, ataxic, and mixed). The speech recordings, which consisted of phrases that follow the rules of English syntax but have no semantic predictability, were mixed with a cafeteria noise at three signal-to-noise ratios (+10, +6, and +2 dB). A total of 24 listeners with typical hearing were recruited from the student population of The Ohio State University and received course credit for participation. Listeners were divided into three groups, and each listener heard all four talkers at one of the three signal-to-noise ratios. Responses were scored for percent words correct and averaged across conditions.

Results: In general, intelligibility scores decreased for all four types of dysarthria as a function of decreasing signal-to-noise ratio. However, the decrease differed as a function of dysarthria type, with the hyperkinetic dysarthria speaker being less disrupted by small amounts of noise, and the hypokinetic dysarthria speaker being more disrupted by small amounts of noise. Of note, while the decrease in overall performance as a function of noise differs across the dysarthria types, there does not appear to be an interaction between dysarthria type and signal-to-noise ratio.

Conclusions: These data demonstrate that even relatively favorable signal-to-noise ratios (e.g. +10 dB) can result in substantial decreases in intelligibility. In addition, it appears that there may be a differential effect of noise by dysarthria type, with some perceptual characteristics perhaps being more fragile to the

negative influence of noise. These findings have important clinical implications. Current clinical practice does not directly address the impact of noise on communication for speakers with dysarthria and their conversation partners. Because so little is known about the effects of noise on dysarthria, these patients do not currently have their complaints validated by evidence, and strategies to address these concerns are not available. The current data are an important step toward remedying those issues.

Category: Speech Perception

Poster #: 107

Association of Subjective and Objective Speech Perception and Listening Effort

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Objectives: This study aims to investigate the relationships among subjective and objective speech perception scores and listening effort in adults who self-report normal hearing. The hypotheses are that subjective and objective hearing scores were highly correlated, and that listening effort scores were expected to be higher in conditions with lower signal-to-noise ratios (SNR).

Design: A total of 52 native English speakers, who began learning English at age 5 or younger, participated in the study. The participants, aged 18-25 years (mean = 19.7 years, 33 females), self-reported normal hearing in both ears. Forty-one of these participants were part of a larger study. All participants completed tasks online via a Qualtrics link, following the same testing order, starting with a validated SHOEBOX online hearing screening.The tasks included a validated subjective hearing evaluation questionnaire (the 12-item Speech, Spatial, and Qualities of Hearing Scale; SSQ12) and an objective hearing-in-noise test (digit-in-noise; DIN) at three SNRs: -9, -12, and -15 dB. Participants also completed a subjective listening effort questionnaire (NASA Task Load Index; NASA-TLX) at each SNR. The SSQ12 had three subdomains: speech, spatial, and quality. Both overall and subdomain scores were analyzed in relation to DIN and NASA scores. Correlation models were used to explore the relationships among these three factors after a normal transformation.

Results: The mean SSQ12 score was 7.23 (standard deviation [SD] = 1.27). The average DIN scores at SNRs of -9, -12, and -15 dB were 90.19 (SD = 15.15), 71.15 (SD = 24.63), and 16.92 (SD = 17.66), respectively. The average NASA-TLX scores were 27.45 (SD = 20.76), 34.80 (SD = 19.49), and 62.42 (SD = 16.45) at SNRs of -9, -12, and -15 dB, respectively.Correlation results:1.SSQ12 and DIN Scores:No significant correlation was found between SSQ12 and DIN scores across the three SNRs ($r = -0.02$, -0.10, and -0.10 for SNRs -9, -12, and -15 dB, respectively). Similarly, no significant correlations were observed between the three subdomains of SSQ12 and the three DIN scores.2.SSQ12 and NASA-TLX Scores:The correlation coefficients between the overall SSQ12 score and NASA-TLX scores at SNRs -9, -12, and -15 dB were -0.27 ($p = 0.05$), -0.15 ($p = 0.29$), and 0.05 ($p = 0.70$), respectively. No significant or strong correlations were found between the subdomains of SSQ12 and NASA-TLX scores at the three SNRs.3.DIN and NASA-TLX Scores:Subjective listening effort scores were significantly negatively correlated with DIN scores ($r = -0.61$, $p < 0.001$) across three SNRs. Negative correlations were observed at three SNRs: $r = -0.03$ ($p = 0.81$), -0.34 ($p = 0.02$), and -0.15 ($p = 0.30$) at -9, -12, and -15 dB, respectively.

Conclusions: Subjective and objective hearing evaluation scores may not be correlated among individuals with self-reported normal hearing. Additional factors, beyond listening effort, should be considered to explain the differences among individuals.

Category: Speech Perception

Poster #: 108

English Band Importance Functions in Competing Speech for Spanish Second-Language Learners of English

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Objectives: Band importance functions (BIFs) characterize the spectral weights applied to each frequency region when recognizing speech. This information can be helpful when programming hearing aids and cochlear implants, or when predicting the benefit of those devices. Thus far, research on spectral weighting has been carried out predominantly with monolingual speakers of the test language who are listening to speech in quiet or in steady noise. It is unknown whether or how spectral weights differ for native speakers and second language learners, particularly in multi-talker environments. The purpose of this study was to compare spectral weighting for speech-in-speech recognition among Spanish speaking second-language learners and monolingual English speakers.

Design: Participants were young adults with normal hearing in two groups; (1) bilingual native speakers of Spanish who learned English as a second language (n=15; Castilian accent) and (2) monolingual native speakers of English (n=10; American accent). English speech recognition was tested using sentences in the presence of a two-talker masker, all produced by different female talkers. Three target talkers produced 100 sentences each (300 targets in total). The first 50 sentences for each target talker were used in an adaptive track to estimate the signal-to-noise ratio (SNR) for 50% correct speech recognition. The second 50 sentences for each talker were then presented at that threshold SNR. Monolingual participants were tested monaurally (right ear). Bilingual participants were tested with the target and masker in one ear (right) and the masker alone in the other. Presenting the masker alone contralateral to the target+masker makes the task easier, such that the SNR associated with 50% correct recognition was similar between groups. Band importance functions were estimated based on the fixed-SNR data by evaluating the association between the SNR in each spectral band and the score (correct or incorrect) for each keyword.

Results: As expected, initial results show that the adaptive thresholds are similar for the monolingual and bilingual participants for all three target talkers; mean thresholds by target talker were within 1.6 dB across groups. Fixing the SNR at each participants' threshold resulted in mean scores of 49-57% across talkers and listener groups. The band importance functions characterizing spectral weighting across frequency differed between talkers, but they were similar for monolingual and bilingual participants.

Conclusions: Despite differences in language proficiency, monolingual and bilingual participants appeared to weight speech information distributed across frequency in a similar manner when overall

performance and SNR were matched. This result does not indicate a need for different device fitting strategies for this population. However, future studies are needed to determine whether language groups differ when compared for the same stimulus conditions; this type of comparison would capture differences encountered in natural listening environments, where bilingual and monolinguals are listening in the same circumstances.

Category: Speech Perception

Poster #: 109

Observational and Enrichment Analysis Study of Tinnitus and Speech-in-Noise Deficits

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Objectives: Tinnitus is a phantom perception of sound in the ears or head without any external source. Individuals with tinnitus often have trouble understanding speech-in-noise (SIN). SIN deficits refer to difficulties understanding speech against background noise. Previous studies investigating SIN deficits in individuals with tinnitus revealed mixed results. Genetic variants associated with tinnitus and SIN deficits was identified by recent genome wide association study (GWAS). The present study investigated SIN deficits in individuals with tinnitus and conducted complementary analyses using GWAS summary statistics to identify tissues and molecular pathways shared between the two phenotypes.

Design: 216 normal hearing (hearing thresholds ≤20 dB HL for 250-8000 Hz) young adults (87 with chronic tinnitus) aged 18-37 years participated in the study. Speech, Spatial, and Quality of Hearing scale (SSQ12) and QuickSIN were used to evaluate SIN perception. Extended high-frequency audiometry and dichotic digit test (DDT) were performed. A linear mixed model (LMM) was used to identify the influence of tinnitus on audiological measures while controlling the effects of confounders. GWAS summary statistics for SIN deficits were obtained from open resources (N=453,482, Ncases=171,586). MAGMA-based gene set enrichment analysis was performed on GWAS summary statistics. The results for SIN deficits were compared with published reports of tinnitus to identify shared enrichment result.

Results: Significantly elevated hearing thresholds, lower SSQ12, and poorer DDT scores were obtained for young adults with tinnitus. Tinnitus severity was correlated with SSQ12. Elevated hearing thresholds and lower SSQ12 were associated with high LNE and firearm use. Several brain tissues, such as the brain cortex, frontal cortex, nucleus accumbens, cerebellum, anterior cingulate cortex , caudate, amygdala, hippocampus, putamen, and hypothalamus, were identified by MAGMA based analysis, which was shared between tinnitus and SIN deficits. Outer hair cells were associated with tinnitus but revealed a modest association with SIN deficits.

Conclusions: Results suggests that young adults with chronic tinnitus experience significant SIN deficits. Self-reported auditory-cognitive measures could be more sensitive than performance-based measures for evaluating SIN perception. The shared enrichment of genomic signals points toward the central origin of SIN deficits in normal-hearing young adults with tinnitus.

Category: Speech Perception

Poster #: 110

Effect of Talker on Listening Effort in AzBio Sentences

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Objectives: This study used pupillometry to examine the effect of AzBio talker on listening effort in adults with normal hearing and hearing impairment. Patients often report subjective listening difficulties in relation to certain AzBio speakers in clinic, even when speech recognition scores remain at or near ceiling. Based on these claims, it was hypothesized that certain AzBio talkers elicit greater listening effort than others despite intelligibility remaining intact.

Design: Twenty-one adults with normal hearing and nine adults with hearing loss participated in this cross-sectional exploratory study. Participants who wore hearing aids were tested while wearing their own devices in their every-day setting. Participants listened to AzBio sentences presented at 60 dBA in quiet and in +5 dB SNR while a remote eye tracker measured changes in their pupil dilation. Participants listened to a total of 40 sentences in quiet and 40 sentences in noise. Traditional measures of peak and mean pupil dilation were analyzed as a function of condition and talker.

Results: Participants, regardless of hearing status, showed larger pupil dilations to male talkers, but only in the presence of background noise. Participants with hearing loss exhibited significantly larger mean pupil responses and peak pupil responses than participants with normal hearing across all conditions.

Conclusions: This preliminary data provides additional evidence that pupillometry can be used to explore more subtle aspects of listening effort, such as talker differences, that do not affect word recognition. Our findings may be of interest to clinical audiologists who utilize these widely used materials, and may offer further insight into listening burdens of patients.

Category: Speech Perception

Poster #: 111

Masker Head-Orientation Angle Effects on Speech Recognition and Extended-High-Frequency Cues

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Objectives: Understanding speech in multi-talker environments poses significant challenges as multiple speech signals compete for attention. Among many factors affecting listeners' speech perception, talker head orientation and extended high-frequency cues—derived from the mismatched head orientations of talkers—have been shown to play a role in speech recognition in multi-talker environments. Studies of masker head orientation were mostly limited to a few angles, and the influence of different masker head orientation angles on listeners performance is still unclear. In this study, we investigated the effect of talker head orientation-related (THOR) spectral cues and extended high frequency (EHF) energy on speech recognition using eight different masker head orientation angles ranging from 0° (facing the listener) to 180° (facing away from the listener). Our hypothesis was that increasing masker head orientation angle would improve speech recognition performance and improve access to EHF cues.

Design: Subjects were young, normal-hearing adult listeners (age 18-34 yrs) with thresholds ≤20 dB HL in standard audiometric frequencies (500 – 8000 Hz) and extended high frequencies (9000 Hz – 16000 Hz). Target speech consisted of digit triplets spoken by a female talker. Masker stimuli were created using two female narrative speech samples. The target talker faced the listener in all conditions (0°), and maskers were co-located with the target. Eight masker head orientations (0°, 22.5°, 33.75°, 45°, 67.5°, 90°, 135°, 180°) and two filtering conditions (full-band and low-pass filtered at 8 kHz) were used, resulting in a total of 16 conditions. Maskers were set to a constant overall level of 72 dB SPL each regardless of orientation angle, removing natural THOR overall level cues. In each trial, participants needed to correctly identify all three digits for the trial to be considered correct. A speech reception threshold (SRT) was calculated for each condition as the mean of 6 reversals in a two-down one-up adaptive track.

Results: A significant THOR benefit of 2.7 dB was observed at a masker head angle of 67.5° and this benefit increased as the masker head angle increased to 180°. The maximum benefit at 180º was 8.1 dB. Providing EHF cues was beneficial for masker orientations ≥33.75º, except for 90º. A maximum EHF benefit of ~2.3 dB was observed at 67.5°.

Conclusions: The data indicate that the benefit from THOR spectral cues for speech-in-speech recognition can be as large as 8 dB for the highest masker head angles, even when overall levels are equated. Providing additional THOR overall level cues would likely increase the THOR benefit due to substantial reductions in masker level. Beyond 33.75º, an EHF benefit was consistently observed, likely due to the directional nature of EHFs in speech. Providing realistic head orientation cues in speech recordings could improve assessment of the communication challenges that listeners face in natural multi-source environments. [Supported by NIH grant R01DC019745 (BBM)]

AUDITORY PROCESSING

Category: Auditory Processing

Poster #: 112

Dual Sensory Impairment and Cognition Among Older Adults in India

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Objectives: This study investigates the cross-sectional association between Dual Sensory Loss (DSL) and cognition. We hypothesize that older adults with DSL have lower global and domain-specific cognitive function than those with normal sensory function or HL or VL alone.

Design: Data (3,237) were from Wave II (2024) of the Longitudinal Aging Study in India - Diagnostic Assessment of Dementia (LASI-DAD). Better-ear hearing thresholds and better-eye distance visual acuity, obtained using gold-standard objective measures, were used to create four categories of DSL: no sensory loss, HL only, VL only, and DSL. Global and cognitive domain factor scores were derived by factor analysis of a comprehensive cognitive test battery. Associations were assessed using multivariable linear regression models.

Results: Participants were 69.5 years old (SD=6.5) and 49% female. The prevalence of sensory loss in our the study population was high, with 11.12% (n=360), 37.00% (n=1,198), and 35.99% (n=1,165) classified as having vision loss only, hearing loss only, and DSL, respectively. Compared to those with no sensory loss, HL only and VL only scored 0.08 (95% CI: 0.02-0.14) and 0.10 (95% CI: 0.01-0.18) units lower in global cognition, while those with DSL scored 0.16 (95% CI: 0.09-0.22) units lower. Similar patterns were observed across all cognitive domains with DSL having the largest magnitude among them. Those with DSL scored 0.14 (95% CI: 0.21-0.06) units lower in memory, 0.15 (95% CI: 0.21-0.08) units lower in executive functioning, 0.19 (95% CI: 0.26-0.12) units lower in language, and 0.13 (95% CI: 0.20-0.06) units lower in visuospatial.

Conclusions: In comparison to those with no sensory loss, those with DSL are at a statistically significant higher risk of lower scores in global cognition and across all cognitive domains. Understanding the negative effects of sensory loss on cognition can provide insight to preventative measures for dementia. It is possible burden of dementia can be alleviated with treatment of hearing and vision loss. Given the strong association of DSL with cognitive function, its impact on late-life cognitive health in India should be further investigated for critical public health planning.

Category: Auditory Processing

Poster #: 113

Understanding the Performance-Perceptual Test in Veterans with mTBI History

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Objectives: Multiple studies of patients with known or suspected acquired auditory processing disorders (APD) have reported poor correlation between measures of self-reported hearing difficulty and auditory performance. This discrepancy may be due, in part, to a propensity of some individuals to underestimate their actual hearing performance ability relative to other listeners. The purpose of this study was to investigate if Veteran's with behaviorally measured auditory processing deficits have an accurate perception of their auditory performance in background noise compared to those with no auditory processing deficits.

Design: Participants included Veterans aged 26-49 years old with history of mild TBI and/or blast exposure and abnormal performance on at least one clinical measure of APD (N=26) and age-matched control participants with normal performance on all APD measures (N=19). The clinical APD test battery consisted of the Gaps-in-Noise (GIN) test, and the Frequency Patterns Test (FPT), and all diagnostic subtests of the SCAN-A. Participants' actual versus perceived auditory performance was assessed with the revised Performance-Perceptual Test (PPT) applied to the QuickSIN test. Each participant's Perceptual SNR-50 was then subtracted from their Performance-based SNR-50 to determine their Perception-Performance Discrepancy Score (PPDIS). The Speech Spatial and Qualities (SSQ) of Hearing questionnaire served to measure overall self-perceived hearing ability among participants.

Results: After controlling for PTA, no significant group differences were found for any measures of the PPT as measured with the QuickSIN, including the PPDIS. Significant Group differences were found on the SSQ and each of the CAPD tests measured except for the FPT. SSQ scores were significantly correlated with the performance and perceptual portions of the PPT as well as PTA, Age, and most CAPD measures. However, a stepwise linear regression analysis revealed performance on the QuickSIN was only predicted by SCAN-A summed score. Considerable heterogeneity was found among mTBI participants on the types and number of CAPD tests failed. Multiple participants performed abnormally on each test measure and the average number of tests failed was 1.9 ranging from 1 (12/26) to 4 (1/26) of the five-test battery. Compared to published norms, 14/26 participants would be considered to have APD consistent with ASHA criteria.

Conclusions: Results from the present study suggest that Veterans with previous mTBI and/or blast exposure do not underestimate their performance on speech-in-noise tests when compared to age-matched controls. Similar to previous work, this study revealed considerable variability within the mTBI group on CAPD test performance, thus reiterating the need for a diverse test battery to ensure deficits are captured. Speech-in-noise testing alone is not adequate to screen or diagnose auditory dysfunction in this population. Overall, these results contribute to the validity of using subjective measures to contribute to the assessment of auditory processing performance in the mild TBI and/or blast exposed population. Most importantly, these findings provide evidence that the mild TBI and/or blast exposed populations are accurate reporters and do not overstate their level of difficulty when completing speech-in-noise tasks.

Category: Auditory Processing

Poster #: 114

Subtle Hearing Decline is Related to Cognitive Changes in Older Adults

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Objectives: Hearing loss is commonly associated with significant cognitive declines, with research showing a greater risk for Dementia with increasing degrees of hearing loss in older adults. However, the cognitive changes in older adults with 'clinically normal' hearing acuity are still underexplored. In this study, we explored whether hearing acuity, traditionally defined to be within normal limits, can predict cognitive function.

Design: A total of 111 participants were recruited for the study with 56 young adults (18-35 years) and 55 older adults (50-70 years). All participants were right-handed, native speakers of the Kannada language with at least 12 years of formal education and no complaints/history of otological and/or neuro-psychiatric disorders. Further, all participants passed the screening test for CAPD and mild cognitive impairment. Standard pure-tone audiometry (250-8000 Hz) was performed on all participants and thresholds at each frequency were recorded. The pure-tone average (PTA), measured as the mean of thresholds at 500 Hz, 1000 Hz, 2000 Hz, and 4000 Hz was ensured to be< 15 dB for both ears in all participants. Further, absolute thresholds were ensured to be< 15 dB below 2000 Hz and<25 dB below 4000 HzNext, they performed a series of tests to evaluate cognitive functions - working memory (forward digit span, backward digit span, reading span, & operation span) and attention/executive function (Eriksen Flanker task). Using an adaptive procedure, the mean of the last four reversals were taken as the span lengths for both digit span tests. The Partial Credit Score (weighted) was calculated as the span lengths for the reading and operation span tests. The reaction times for the congruent and incongruent were measured for the Flanker task as well as the conflict resolution metric (incongruent - congruent).

Results: Separate Principal component analyses (PCAs) were performed to reduce dimensions and obtain composite values for pure-tone thresholds (1 PC), working memory (1 PC corresponding to digit tasks considered as 'simple spans', and 1 PC corresponding to the dual complex tasks - reading and operation spans), and Flanker task (1 PC corresponding to the RT for congruent and incongruent). Pearson's correlation (controlled for age) showed a significant relationship between the hearing thresholds and flanker task reaction time (but not conflict resolution) and complex span PCs (but not simple spans).

Conclusions: The outcomes from our study show that despite 'clinically normal' hearing acuity, there are already indications of cognitive decline in older adults. The study adds to a growing body of research that shows the cognitive consequences of hearing loss in older adults. Even these 'subtle' hearing deficits likely increase the load on the cognitive processing of information in older adults. This, further, adds to the growing evidence that slight auditory declines can serve as early markers of cognitive changes.

Category: Auditory Processing

Poster #: 115

Electrophysiological Correlates of Age-Related Auditory Dysfunction and Speech-in-Noise Intelligibility

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Objectives: Older adults with age-related hearing loss (ARHL) often complain of difficulty understanding speech in noise even after adjusting for the audibility, indicating that other neural mechanisms underlie the age-related decline in speech-in-noise intelligibility. The study aimed to investigate the effects of ARHL on neural response change at different levels of the auditory pathway and to identify any electrophysiological correlates between these changes and age-related declines in speech-in-noise intelligibility.

Design: Auditory brainstem response (ABR) and auditory middle latency response (AMLR) were simultaneously recorded using clicks and tone bursts at 500 Hz and 2000 Hz, at stimulus levels of 70-100 dB SPL. For group comparison, participants included young adults with normal hearing and older adults with ARHL. The ARHL was classified as mild to moderate sloping high-frequency sensorineural hearing loss above 1000 Hz, with normal middle ear function. Amplitude-intensity function (AIF) was compared between the ABR wave V and the AMLR Pa component for both groups. Additionally, the Revised Speech Perception in Noise (R-SPIN) test was administered, and the correlation between electrophysiological findings and R-SPIN scores was calculated for the older group. Only low-predictability R- SPIN (R-SPIN-LP) scores were included in the data analysis. The Montreal Cognitive Assessment (MoCA) was administered to older adults to rule out age-related cognitive impairment. A diagnostic click-evoked ABR test was completed for all participants to rule out retrocochlear pathology.

Results: The Pa amplitudes were significantly enhanced at suprathreshold levels in older adults compared to young adults, indicating neural hyperexcitability at central levels in the aging auditory system. However, wave V amplitudes were significantly reduced at all stimulus levels from 70 to 100 dB SPL in older adults compared to young adults, reflecting reduced auditory sensitivity associated with ARHL. The AIFs of the Pa component increased steeply with higher stimulus levels in older adults, whereas the AIFs of ABR wave V remained nearly parallel with increasing stimulus levels in both groups, with consistently lower wave V amplitudes at all stimulus levels in older adults. The differing AIF patterns between ABR wave V and the AMLR Pa component may indicate the differential effects of ARHL on auditory neural processing at distinct levels of the auditory pathway in the aging auditory system. In order adults, significantly enhanced Pa amplitudes for 500 Hz and 2 kHz tone bursts at suprathreshold level of 100 dB SPL were correlated with poorer R-SPIN-LP scores, suggesting an association between age-related neural changes to suprathreshold sounds and age-related declines in speech-in-noise intelligibility.

Conclusions: Age-related enhancement of suprathreshold Pa amplitudes may reflect the impact of ARHL on auditory neural processing at the central levels of the aging auditory system. The ARHL may have differential effects on peripheral and central levels of auditory processing in older adults. Age-related enhancement of Pa amplitude at suprathreshold levels may be associated with reduced speech understanding ability in noisy environments, potentially suggesting electrophysiological correlates of age-related declines in suprathreshold processing. AMLR Pa component can be served as an electrophysiological indicator for age-related neural changes underlying ARHL at the central level.

Category: Auditory Processing

Poster #: 116

Implementing Throughput as a Performance Metric to Working Memory Tasks

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Objectives: Mild traumatic brain injury (mTBI) can cause a variety of symptoms, among them working memory difficulty. Previously, performance on the Audio-Visual Divided Attention Task (AVDAT), a cognitive test of selective and divided attention used to assess auditory and visual working memory, has been measured in different ways. However, these metrics do not clearly demonstrate how participant performance progresses as the task gets harder. To address the issue, a measure called throughput was introduced to evaluate performance based on speed and accuracy as a function of task difficulty. In this study, multiple AVDAT metrics will be compared to determine if mTBI has a significant effect on AVDAT performance.

Design: From a sample of 55 participants with normal hearing levels, 28 had a history of mTBI and 27 were controls. Mean age for each group is 37 and 36 years, respectively. The participants completed the AVDAT task on the iPad app P.A.R.T. The AVDAT tests a participant's memory by presenting a sequence of characters that they must recall. There are single and dual modality conditions; the single modality requires recalling a single stimulus, whereas the dual modality requires divided attention to auditory and visual stimuli presented simultaneously. Throughput scores were calculated at a rate of correct characters per second. Average scores and span scores were also calculated. Linear mixed effect models were used to evaluate the main effect of different participant variables (such as age, pure-tone hearing sensitivity, and mTBI status) and main effect of AVDAT condition, and interactions between them, on each AVDAT metric.

Results: Results showed that measuring AVDAT performance using the throughput metric was more sensitive to the effects of participant age and mTBI history compared to the span score and average score metrics. For instance, results showed a differential effect of mTBI history on different AVDAT conditions that was not apparent when using the other two AVDAT metrics.

Conclusions: This difference in statistical output can be explained by the fact that span scores are mainly used to quantify memorization ability and the throughput scores quantify the accuracy of the participants' answers, indicating overall performance through the entire task. Since throughput is a measure of performance over time, it allows us to examine the additional effects of age and mTBI status on information processing rate. This work shows that the AVDAT measure may be a useful tool for exploring the effects of mTBI on auditory performance in future research. It also highlights the importance of considering different metrics for assessing performance on perceptual tasks like the AVDAT. Previous research suggested that performance on AVDAT is linked to speech perception ability;

future work will examine relationships between these AVDAT metrics and speech understanding in noise abilities in individuals with mTBI.

Category: Auditory Processing

Poster #: 117

The Time-Compressed Digits Test and Auditory Processing Disorder

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Objectives: The objective of this project was to evaluate the feasibility of the Time-Compressed Digits (TCD) test as a screening tool for auditory dysfunction, specifically auditory processing disorder, to provide initial differential diagnosis of auditory processing disorder. Auditory processing is one of the main functions of the brain likely to deteriorate following blast exposure or traumatic brain injury, both of which are common in Military Service members and veterans. Up to 87% of those who have a history of traumatic brain injury experience chronic auditory difficulties and up to 40% of veterans who have a history of blast exposure fail subsequent auditory processing batteries. A typical auditory processing test battery takes a minimum of an hour and a half to administer, so a more efficient and time-sensitive screening tool for auditory processing disorder in veterans and Service members is needed. Auditory processing disorder poses major risks to the communication abilities of active-duty Service members and veterans alike, so an efficient screener for auditory processing disorder is needed. An aim of this project was to develop a statistical model to predict deficits in central auditory processing based on an individual's performance on the TCD test.

Design: Data for this project were collected from a protocol that was performed in 2020. Study participants included veterans who were discharged within the last 5 years and had normal or near-normal hearing, which would indicate fitness for deployment. Since the data was collected across multiple clinic visits during the COVID-19 pandemic, full data sets could not be obtained for all participants. Data for this study included 77 partial data sets. The total number of data sets including both TCD and auditory processing test data, the main data needed for analyses, was 66. Auditory processing tests included the Dichotic Digits Test, Frequency Patterns Test, Staggered Spondaic Words test, Masking Level Difference test, and the Gaps-in-Noise test.

Results: Initial analyses revealed a significant negative relationship between TCD score and number of auditory processing tests failed, such that poorer performance on the TCD test was correlated with a higher number of auditory processing tests failed. A Receiver Operating Characteristics (ROC) analysis was conducted to assess the diagnostic feasibility of the TCD test as a screening tool for auditory processing disorder. The ROC analysis revealed that the TCD test may be a useful screening tool for auditory processing disorder that does not require specialized equipment and long appointment times. Currently, the false positive rate is too high for this to be clinically feasible, but this provides promising outlook for a larger-scale study assessing the clinical feasibility of the TCD test as a quick, easy to administer auditory processing disorder screener.

Conclusions: This study suggests that the TCD test can be a quick, easy-to-administer screening tool that may be used to detect auditory processing deficits in the future. Future research needs to be done to determine the feasibility of the implementation of the TCD test in clinical and military protocols as an auditory processing disorder screening tool for veterans and Service members.

Category: Auditory Processing

Poster #: 118

Effects of Music Aptitude on Speech Perception in CI Users

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Objectives: Cochlear implant (CI) outcomes vary widely between individuals, with poor complex sound processing overall. Identifying predictors of complex auditory outcomes could enhance patient counseling and guide rehabilitation. There is some evidence that musical training may be associated with better complex sound perception, but previous studies did not account for innate musical ability. The present preliminary study investigates the relationship between innate musical perception abilities and speech-in-noise outcomes in adult and pediatric CI users versus age-matched normal hearing listeners (NHL).

Design: Twenty-one adult NHL, 9 adult CI users, 8 pediatric NHL, and 7 pediatric CI users were recruited. They completed demographic, music experience, and hearing history questionnaires followed by music aptitude testing and speech-in-noise tasks. Music aptitude was assessed using the Profile of Music Perception Skills (PROMS) test, a validated battery evaluating perceptual musical skills in melody, pitch, timbre, tuning (harmonic resolution), rhythm, accent (dynamics sensitivity), and tempo domains. Speech testing included AzBio sentence tests and BKB-SIN. CI users were tested at +10dB and +5dB signal-to-noise ratio (SNR), while NHL were tested at 0dB and -3dB SNR. Performance on PROMS was compared between adult/pediatric CI users and NHL using ANCOVA regression. Relationships between musical perception and speech-in-noise tasks were evaluated with multiple linear regression, adjusting for years of musical training.

Results: Overall, both adult and pediatric CI users performed worse than their NHL counterparts on PROMS (adult: p=0.0005, pediatrics: p=0.008). Adult CI users performed worse on Melody (p=0.0002), Timbre (p=0.01), Tempo (p=0.04), Pitch (p=0.03), Tuning (p=0.01), and Accent (p=0.008), while pediatric CI users scored lower on Tempo (p=0.04), Pitch (p=0.03), and Tuning (p=0.01).In adult NHL, the Timbre subtest correlated positively with 0dB AzBio, -3dB AzBio, and BKB-SIN performance (p=0.02, p=0.009, p=0.03), while Accent was negatively associated with 0dB AzBio (p=0.04). Among adult CI users, there was a significant positive association between Accent and +10dB AzBio (p=0.03). While the relationship between Accent and +5dB AzBio was not significant (p=0.06), there were significant associations between Accent, Rhythm-Melody, total PROMS and BKB-SIN (p=0.005, p=0.03, p=0.02).In pediatric NHL, there were significant positive associations between Pitch and 0dB AzBio (p=0.04) as well as Timbre and

-3dB AzBio (p=0.01). Of note, there was also a significant relationship between years of training and -3dB AzBio scores (p=0.01). In contrast, there were no significant associations between any PROMS subtests and AzBio or BKB-SIN for pediatric CI users.

Conclusions: Among both adult and pediatric NHL, there is a strong relationship between timbre perceptual abilities and speech-in-noise outcomes. Adult and pediatric CI users did not show the same relationships. Adult CI users' accent and rhythm-melody perception were correlated with speech-in-noise performance, while pediatric CI users had no relationships between music perception and auditory performance. It appears that adult CI may be employing a different strategy than NHL for recognizing speech-in-noise that is related to their ability to perceive accent and rhythm-melody. In contrast, pediatric CI users may use an entirely different strategy that is unrelated to processing musical paradigms, or our sample size may be too small to detect this relationship.

Category: Auditory Processing

Poster #: 119

Electroencephalographic Correlates of Auditory Selective Attention in Hearing Loss

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Objectives: Listeners use auditory selective attention to focus on one speech stream from a specific spatial location while suppressing other streams in crowded environments. Despite using assistive technologies such as hearing aids, individuals with hearing loss often struggle to understand speech in these settings. Across different sensory modalities, spatial attention is associated with lateralization of alpha band oscillations (7-15 Hz) in the parietal and occipital regions of the brain. Additionally, attention has been shown to modulate the evoked potentials of the attended stream, enhancing these neural responses. To investigate auditory selective attention in hearing loss, here, we test the hypothesis that patients with hearing loss will exhibit reduced alpha lateralization power in the parieto-occipital regions and a reduced modulation of the evoked responses as measured through electroencephalography (EEG).

Design: Simultaneous 32-channel EEG recordings and behavioral measurements were performed. The matrix sentence test material was used to create a speech-on-speech task where the target and masking streams were constructed using the same group of words in the same speaker's voice at 0 dB target-masker ratio. The target and masker streams were lateralized to opposite hemifields using interaural time differences. At the start of each trial, subjects were cued to attend to one spatial location using the first word of the target stream. Following a two-second interval, the two-stream mixture was presented.After the stimulus presentation, subjects responded by clicking the words they heard in the attended stream and feedback was provided with the number of words reported correctly. Crucially, the stimulus presentation was designed to have very low sensory demand by temporally staggering target

and masker utterances. The staggered presentation would also allow us to isolate EEG evoked responses to each word for investigating whether attention modulates neural responses to the attended stimuli. Target location and stimuli were counterbalanced. The study seeks to enroll N=15 participants with sensorineural hearing loss and age-matched controls with normal audiograms.

Results: We calculated the average scalp topography maps for the induced alpha band oscillatory power during the pre-stimulus and during-stimulus time periods. Specifically, we contrasted the alpha power when the subject attended to the left stream compared to the right during both the time periods. With this contrast, our analysis revealed positive (i.e., higher) alpha oscillatory power on the left parieto-occipital sensors in both pre-stimulus and during-stimulus time-periods and negative alpha power in the corresponding channels on the right side of the scalp. To estimate the strength of attentional modulation of evoked responses, trials were grouped into 'Attend lead' and 'Attend lag' trials regardless of the target location, and the evoked potentials were calculated for for EEG channels at locations Fz, Cz, FC1 and FC2 . Both analyses revealed robust EEG correlates of attention.

Conclusions: The findings of this study indicate that auditory spatial attention significantly modulates alpha band oscillations in the parietal and occipital regions of the brain, as evidenced by the enhanced alpha power observed when participants attended to specific spatial locations. Furthermore, attention also modulates the evoked potentials associated with the attended stimuli. We are currently collecting data from individuals with bilateral sensorineural hearing loss to directly test whether EEG signatures of top-down selective attention(alpha lateralization) or attentional modulation of sensory representations (evoked response metrics) are weaker. The insights gained from these can inform the design of more effective auditory assistive devices.

Category: Auditory Processing

Poster #: 120

Quarter-Octave Band-Limited Noise Loudness Reduction Observed in Categorical-Loudness-Scaling Measurements

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Objectives: In a loudness-matching paradigm, a reduction in the loudness of sounds with bandwidths less than one-half octave compared to a tone of equal sound pressure level has previously been observed for five-tone complexes at 60 dB SPL centered at 1 kHz. Here, we explore this loudness-reduction phenomenon using band-limited noise across wide ranges of frequency and level. Additionally, whether loudness reduction interacts with hearing loss is investigated.

Design: Eighty-three adult participants with various degrees of sensorineural hearing loss were recruited. They were assigned into either a normal-hearing (NH) or hearing-loss (HL) group, based on the pure-tone average threshold. For each participant, equal loudness contours are estimated from 250-6000

Hz using the categorical loudness scaling paradigm. Narrowband stimuli are presented through insert earphones, and the participant makes loudness judgements corresponding to labels from "Can't hear", "Soft", …, "Medium", …, "Loud", "Too loud". The presentation level and center frequency of the test stimulus was determined according to a Bayesian adaptive algorithm designed to improve test efficiency. This algorithm enabled estimating equal-loudness contours within 100 trials of testing, approximately 5 minutes. In separate test conditions, three types of stimuli were presented: (1) pure-tones, (2) quarter-octave band-limited noise and (3) one-octave band-limited noise. The estimated equal-loudness contours from these three conditions were then compared to examine loudness reduction (increase in equal-loudness contours for quarter-octave band-limited noise relative to a pure tone) and loudness summation (decrease in equal loudness contours for octave band-limited noise relative to quarter-octave band-limited noise).

Results: For both the NH and HL listener groups, loudness reduction was observed using quarter-octave band-limited noise. The amount of loudness reduction depended on both stimulus level and frequency. For the level dependence, loudness reduction increased with level up to 60-80 dB SPL and then decreased for higher levels. For the frequency dependence, loudness reduction increased from 0.25 to 1 kHz and then decreased for higher frequencies. The amount of loudness reduction was also greater among NH listeners compared to HL listeners. The greatest amount of loudness reduction was about 6 dB, observed for the NH group and for the 1-kHz, 60-dB SPL stimulus. For HL listeners and at high frequencies (4 and 6 kHz) that were most impacted by age-related hearing loss, negative loudness reduction (lower equal-loudness contours for noise compared to tone) was observed. Besides loudness reduction, loudness summation was also observed, with consistently lower equal-loudness contours for octave band-limited noise than quarter-octave band-limited noise.

Conclusions: The rapid Bayesian adaptive procedure makes it feasible to collect equal loudness contours across wide frequency and level ranges and for multiple stimulus bandwidths, from a relatively large groups of listeners. Loudness reduction is the greatest, at moderate stimulus levels, at frequencies near 1 kHz, and for NH listeners. This phenomenon cannot be explained by the standard loudness models. Future modeling efforts may consider the dynamic temporal envelope of band-limited noise and the role of fast-acting compression in cochlear mechanics. This phenomenon also has implications for how loudness judgements are formed in the central auditory system.

Category: Auditory Processing

Poster #: 121

Hearing Abilities and Longitudinal Cognitive Outcomes in Older Adults

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Objectives: Cognitive decline and dementia, particularly Alzheimer's disease, is more prevalent among those with hearing loss, warranting an investigation into shared common causes as well as directionality of their association. Here we investigated the extent to which self-reported and measured hearing abilities predicted global cognition longitudinally, while accounting for other common risk factors for both hearing loss and Alzheimer's disease. Our hypothesis was that abilities on complex hearing tasks would be related to cognitive ability longitudinally.

Design: In this longitudinal cohort investigation, older adults (aged 50+ years) who were part of 5 cohorts in the Rush Alzheimer's Disease Center were followed for an average of 4.82 years. Global cognition was assessed across 5 cognitive domains (perceptual speed, semantic memory, episodic memory, working memory, and visuospatial abilities). Self-reported hearing loss was assessed using two yes/no items: trouble hearing in a quiet room and difficulty hearing on the phone. In a subset of the participants, we also measured hearing abilities at a single timepoint, using four different hearing assessments: 1) pure-tone audiometry for speech frequencies (1-4 kHz); 2) Quick Speech in Noise; 3) just-detectable difference in the starting phase of a spectral ripple stimulus; and 4) pattern discrimination in noise for a frequency modulated stimulus. Additional covariates included age, race, sex, education, vascular disease risk, and genetic risk. Vascular disease risk was calculated using self-reported diagnosis of diabetes and hypertension, and smoking status. Genetic predisposition for age-related hearing loss and Alzheimer's disease was determined based on the polygenic risk scores computed based on previous literature. Linear mixed modeling was used to assess statistical significance of relationships.

Results: Of 2,003 participants with self-reported hearing and longitudinal cognitive outcomes, a subset (n = 103) also had measured hearing abilities. This group consisted of similar numbers of Black/African American and White/Caucasians and primarily women with mean age and education of 75.6 years and 15.3 years, respectively. There was no relationship between self-reported hearing loss and cognitive ability at follow-up, after controlling for age, sex, race, education, vascular and genetic risk (β=0.001, SE = 0.008, p = 0.877 for hearing trouble in quiet and β=-0.001, SE = 0.005, p = 0.807 for hearing trouble on the phone). Measured tests of hearing also did not predict global cognition at follow-up (β=-0.001, SE = 0.001, p = 0.660 for pure-tone audiometry; β=-0.003, SE = 0.003, p = 0.320 for QuickSIN; β=0.014, SE = 0.022, p = 0.523 for spectral ripple just-detectable difference; β=-0.000, SE = 0.002, p = 0.8311 for spectral pattern discrimination in noise) However, pattern discrimination in noise was predictive of longitudinal changes in the working memory domain only (β=0.036, SE = 0.015, p = 0.018).

Conclusions: While measured hearing abilities did not predict longitudinal cognitive performance globally, pattern discrimination ability predicted longitudinal performance on cognitive tasks engaging working memory. This suggests an important role of central auditory processing tests in understanding the relationship between hearing and cognition, which warrants further investigation. Additional clinical implications of these findings will be discussed.

COCHLEAR IMPLANTS

Category: Cochlear Implants

Poster #: 122

Attrition in Cochlear Implant Clinical Research: Influence of Sociodemographic Variables

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Objectives: Recruiting and maintaining a research participant sample that is representative of the target patient population is paramount in ensuring appropriate generalization and application of research findings. This goal could be accomplished with intentional study design and recruitment methods, and by review of the variables associated with study withdrawal to determine potential areas for intervention, outreach, and strategic support. The aim of the present study was to review what sociodemographic variables may influence whether or not research participants completed a long-term, repeated-measures clinical research study.

Design: A retrospective review was completed for adult cochlear implant research participants in a long-term, repeated-measures study investigating outcomes with different mapping procedures. Data were reviewed for participants who enrolled between 2019 (study initiation) and October 2023, such that all reviewed participants would have reached the study endpoint (12 months post-activation). Participants were categorized into two groups: 1) those who completed the study protocol, and 2) those who elected to withdraw prior to the study endpoint. Reviewed sociodemographic variables included: biological sex, age at study enrollment, race, and ethnicity. Also, analyses of socioeconomic position, rurality, and drive time to the clinic were completed at the ZIP code level. An additional exploratory review of frequency-to-place mismatch between the two groups was completed to investigate if participants with larger magnitudes of mismatch elect to withdraw as compared to those with less or no mismatch. Nonparametric test measures for continuous and categorical data were completed for statistical analysis comparing the two groups.

Results: Data were collected for 110 research participants; 86 participants (78%) completed the study procedures, and 24 participants (22%) elected to withdraw prior to the study endpoint. No statistically significant differences were found between the two groups for biological sex, age, racial or ethnic distribution, socioeconomic position, rurality, or drive time to the clinic. A preliminary review of frequency-to-place mismatch suggests that the withdrawal group tended to have larger magnitudes of mismatch than those who completed the study endpoint.

Conclusions: This study suggests that the present recruitment model and study design for the reviewed research study is effective in recruiting and maintaining a representative sample in terms of sociodemographic variables. Decisions to withdraw from research participation are likely multifactorial, and potentially influenced by individual factors other than the sociodemographic variables reviewed in this study.

Category: Cochlear Implants

Poster #: 123

Assessing the Role of Social Factors in Cochlear Implant Outcomes

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Objectives: Recent studies have identified a strong association between hearing loss (HL) and social withdrawal, thus underscoring the need for effective HL intervention. Cochlear implants (CIs), while promising in their ability to restore hearing, result in highly variable outcomes, with a substantial gap in our understanding of the factors driving this variability. Identifying modifiable influences on CI outcomes is critical, as they represent potential targets for improving post-implantation experiences. Among these influences, social network and activity characteristics, such as social isolation, support, and self-efficacy in social situations, are increasingly recognized for their adaptability over time and their potential to impact health outcomes. However, little is known about how social activity changes with cochlear implantation, and how social activity may impact CI outcomes. This study explores in adults with HL 1) the impact of cochlear implantation on social activity, including perceived social support, isolation, and social self-efficacy, and 2) the relationship between pre-operative social activity and CI outcomes, including sentence recognition, subjective communication abilities, and hearing-related quality of life (QoL).

Design: Twenty-three adult CI recipients (mean age = 67.5 years, SD =10.3) were included. Participants completed self-report questionnaires to assess social support, isolation, and social self-efficacy pre-operatively and at 1-, 3-, and 6-month post-CI activation. Participants also completed a behavioral sentence verification task (SVT), a questionnaire on self-reported hearing-related QoL using the Cochlear Implant Quality of Life-35 Profile (CIQOL-35), and assessments of listening effort and fatigue via the Listening Effort Questionnaire-Cochlear Implant (LEQ-CI) and the Vanderbilt Fatigue Scale-Adult (VFS-A) also pre-operatively and at 1-, 3-, and 6-months post-CI activation.

Results: Addressing the first research question, social network metrics improved significantly by 3 months post-CI, including perceived social support, social isolation, and social efficacy (all p's< .05). For the second research question, correlations of moderate effect size, though not always statistically significant were found between preoperative social activity metrics and CI outcomes at 3 months. Specifically, preoperative social isolation correlated with the postoperative VFS-A social subdomain (rs =

.59), CIQOL-35 social subdomain (rs = -.48), and CIQOL-35 global score (rs = -.40). Preoperative social self-efficacy was linked to faster SVT reaction times (rs = -.46).

Conclusions: These preliminary results suggest that social activity improves with cochlear implantation and that preoperative social activity impacts CI outcomes. Notable improvements in perceived social support, isolation, and social self-efficacy post-CI were observed, suggesting that hearing restoration through CI has a positive impact on social activity. Furthermore, participant pre-operative social activity, including social isolation and social self-efficacy, were associated with CI outcomes, suggesting that social experiences may play an important role in the rehabilitation process. These findings, though preliminary, underscore the potential value of targeted social interventions focused on enhancing engagement and self-efficacy as part of CI rehabilitation programs. However, further research is needed to substantiate these observations.

Category: Cochlear Implants

Poster #: 124

Characterizing Binaural Speech Fusion in Children with Normal Hearing and Bilateral Cochlear Implants

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Objectives: The objective of this study was to (1) validate a dichotic vowel formant perception task for measuring binaural fusion in children with normal hearing (NH) and bilateral cochlear implants (BiCIs), and (2) characterize speech fusion abilities in the pediatric population. We hypothesized that (1) one formant would be insufficient for good vowel recognition in NH and BiCI children due to previous literature indicating that vowels are primarily identified by the first two formants, and (2) children with NH would demonstrate better vowel formant fusion than children with BiCIs due to across-ear asymmetries that compromise important fusion cues in cochlear implant users.

Design: Participant recruitment is ongoing. Preliminary data from nine children with normal hearing (range: 6.8-14.5 years old) and five children with bilateral cochlear implants (range: 12-17 years old) are discussed below. All children completed a screening to ensure normal hearing sensitivity for the control group (thresholds<25 dB HL from 250-8000 Hz) and good detection of soft sounds for the BiCI group (CI-aided detection thresholds of 20-30 dB HL from 250-6000Hz). Stimuli consisted of six English vowels spoken by a male in an hVd context (had, head, hid, heed, hud, and hood) that were processed to preserve or remove specific formants. Closed-set vowel recognition was measured for each vowel in five conditions: 1) Formants 1-4 presented diotically, 2) Formants 1-2 presented diotically (baseline), 3) Formants 1 and 2 presented dichotically (fusion test condition), 4) Formant 1 presented diotically, and 5) Formant 2 presented diotically. For each trial, participants selected the vowel they heard from a closed-set of the six possible vowels. Conditions were randomized and split into five blocks with breaks given as needed.

Results: Preliminary results indicated good vowel recognition in the Diotic F1-F4 condition for both normal hearing and bilateral cochlear implant groups. Performance in the Diotic F1F2 condition (baseline) was similar, indicating that two formants were sufficient for good vowel recognition. Single formant conditions (Diotic F1 and Diotic F2) revealed that some vowels were identifiable by one formant alone; this was consistent across groups. Single formant identification has not been previously examined but is essential for accurate interpretation of fusion results. Finally, all groups demonstrated some degree of fusion, but normal hearing children were able to more effectively fuse formants and approach or reach baseline performance, whereas children with bilateral cochlear implants did not.

Conclusions: Consistent with previous studies, our results indicate that a dichotic vowel formant task can be used to measure binaural speech fusion in normal hearing listeners. Importantly, we show that this paradigm can also be used to objectively measure fusion in CI listeners. An unexpected finding was that some vowels were identifiable by a single formant alone, which indicates that any future studies utilizing this paradigm should include single formant conditions. In the future we plan to compare performance between children and adults and examine relationships between fusion and other spatial hearing abilities such as binaural unmasking. [Supported by NIH-NIDCD T35 DC008763]

Category: Cochlear Implants

Poster #: 125

Unilateral Hearing Loss as Function of Demographics and Mapping Techniques

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Objectives: Asymmetric hearing loss (AHL) and Single Sided Deafness (SSD) can have a significant impact socially and emotionally for those it affects, especially when it occurs rapidly. Current FDA criteria states that patients with unilateral hearing loss with a duration of deafness<10 years can be candidates for a cochlear implant. In recent years, our clinic has implanted eighty-five adult recipients with unilateral hearing loss from varying etiologies, such as sudden SNHL, Meniere's disease, autoimmune disorders, as well as progressive losses. Maximizing outcomes as soon as possible for this patient population is important to restore binaural hearing as well as reduce emotional impacts of this unique hearing loss.

Design: Our retrospective study identified eighty-five patients implanted with a Med-El cochlear implant from 2018-2024 that met criteria for AHL or SSD. We identified and analyzed various demographics, mapping techniques, and subjective questionnaires to determine what was most impactful in relation to speech outcome scores and overall patient satisfaction rating. We looked at age, duration of deafness, etiology, residual hearing, datalogging, angular insertion depth, and anatomy-based fitting through the use of Otoplan On Demand, as well as patient ratings to SSQ-12 and CI-QOL questionnaires in relation to speech outcome scores (spatially separated noise & CNC words) at 3-, 6- and 12-months post implantation.

Results: To maximize outcomes in the AHL and SSD cochlear implant population, the leading factor of impact was angular insertion depth and the application of post-operative anatomy-based fitting. A

secondary finding of interest was no significant difference in percentage of improvement over time for speech outcomes was found between etiologies.

Conclusions: Cochlear implantation for single sided deafness and asymmetric hearing loss was approved by FDA starting in 2019. Audiologists still have alot to learn about counseling and expectations for this patient population. Our study has identified that these patients (SSD & AHL recipeints) are satisfied with cochlear implants for other reasons outside of speech clarity. We have also seen that these recipients need to be counseled on binaural hearing capabilities.

Category: Cochlear Implants

Poster #: 126

Spoken Language Outcomes after Early Cochlear Implantation in Children with Congenital Deafness

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Objectives: Children born with severe-to-profound sensorineural hearing loss (SNHL) are at significant risk of language delays because of their limited access to sound. Cochlear implantation (CI) is the standard of care to provide access to sound; however, landmark studies on CI outcomes based on historical implantation criteria suggest that absolute language levels plateau below those of their typically hearing peers. These historic findings have led to a narrative that even with CI, deaf babies do not have full potential for primary spoken language development. Our aim was to evaluate spoken language outcomes in children with severe-to-profound hearing loss who have undergone early cochlear implantation and aural habilitation according to current best practice.

Design: Multi-institutional study of children since 2017 with bilateral severe-to-profound SNHL who underwent cochlear implantation prior to 24 months of age. Children were excluded if they had cochlear nerve aplasia or hypoplasia, cochlear malformations (other than enlarged vestibular aqueduct or incomplete partition type II) or moderate or severe global developmental delay independent of hearing loss. Spoken English and Spanish outcomes were determined by Preschool Language Scales (PLS), a validated, age-normed measure of expressive, receptive, and total language for which a standard score of 100 indicates age-appropriate language. Sociodemographic status was measured using the Social Vulnerability Index, a validated, national geocoded measure based on residential home address.

Results: 33 patients (66.7% female) identified at two separate institutions were included in the study. Average age at implantation was 11.5 months. Average age at PLS testing was 31.5 months. The mean and standard deviation of total language PLS score for the early-implanted group (N=22) was 100.4 ± 18.9,

which was indistinguishable from typically-hearing children (100 ± 15). These language outcomes were significantly better than those for children implanted between 12-24 months (80.4 ± 13.1 p = 0.003). Social vulnerability index (SVI) indicated that our population was appropriately diverse (0.5043 ± 0.2910 SVI for the cohort), and was strongly associated with PLS scores (p< 0.001). SVI was not associated with age at implantation (p = 0.30) or aided best ear pure tone average (p = 0.18).

Conclusions: Absolute language outcomes in deaf babies implanted before 12 months of age are comparable to normal hearing counterparts, suggesting that cochlear implantation provides sufficient access to sound to support full development of spoken language. Social vulnerability did not predict age at implantation but was strongly associated with PLS, suggesting that sociodemographic factors play a very significant role in the variability of language outcomes in this population.

Category: Cochlear Implants

Poster #: 127

Early Cochlear Implant Outcomes Predict Long-term Speech Recognition: Part II

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Objectives: Early identification of cochlear implant (CI) users at risk for worsening audiological outcomes is crucial for facilitating timely intervention and optimizing long-term CI benefit. Part I of this two-part study demonstrated that adding early post-CI CNC word score to logistic regression models, developed on a training cohort of adult CI users to predict long-term improvement in speech recognition, significantly improved performance compared to pre-CI data alone. In Part II, we aim to evaluate the external validity of these models in an independent cohort.

Design: In this retrospective cohort validation study, pre-CI and 1-, 3-, and 12-month post-CI CNC word scores as well as demographic factors were obtained from 309 adult CI users with bilateral hearing loss implanted at our academic center. Logistic regression models predicting 12-month post-CI CNC improvement from pre-CI and early (1- or 3-month) post-CI CNC scores trained and developed using a cohort from another institution were applied to a separate validation cohort. CNC improvement was defined as a patient improving from pre-CI to 12-month post-CI CNC score beyond previously established 95% confidence intervals. Model A (pre-CI CNC), Model B (pre-CI CNC, 1- or 3-month CNC), and Model C (pre-CI CNC, 1- or 3-month CNC, age at implantation, duration of deafness) were compared using DeLong's likelihood ratio test and examining area under the curve (AUC), sensitivity, specificity, and F1 score. AUCs for each model applied to training and validation cohorts were then compared.

Results: Of patients who did not demonstrate measurable CNC improvement by 1 month, 59% improved by 12 months. Of patients who did not improve by 3 months, 53% improved by 12 months. Nearly all patients who improved by 1 and 3 months had continued improvement through 12 months. Compared to Models A and C, Model B better predicted 12-month CNC improvement with both 1-month (F1 score: 90%, AUC: 0.93) and 3-month (F1 score: 91%, AUC: 0.93) data. Model AUCs did not significantly differ with 1-month data, but with 3-month data, Models B and C outperformed Model A (B: $p=0.011$; C: $p=0.019$). Sensitivity was greatest at 1 month with Model B (A: 79%, B: 84%, C: 74%) and at 3 months with Model A (A: 88%, B: 86%, C: 76%). Model C achieved the greatest specificity with both 1-month (A: 73%, B: 82%, C: 91%) and 3-month (A: 56%, B: 78%, C: 93%) data. Between validation and training cohorts, each model performed similarly with 1-month (AUC differences: 0.11, 0.01, 0.02) and 3-month (AUC differences: 0.07, -0.01, -0.01) data.

Conclusions: Models with superior predictive performance regarding improvement vs. non-improvement of CI users incorporated early post-CI CNC word score as a predictive factor. The results of this study validate the predictive ability of these models and highlight the utility of measuring early post-CI CNC scores. Adopting these tools in clinical practice addresses the need to identify patients in the early postoperative period at risk for not improving on speech recognition and may also allow for proactive, targeted interventions (e.g. auditory rehabilitation, increased datalogging) to improve outcomes for these high-risk patients.

Category: Cochlear Implants

Poster #: 128

How Aging and Processing Speed Affect Temporal Cue Encoding in Adult Cochlear Implant Listeners

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Objectives: Precise encoding of temporal auditory cues is important for speech understanding in those with and without cochlear implants (CIs). Temporal cue encoding, such as silent gap detection, in cochlear implant (CI) users is quite good, and often better than non-implanted listeners. However, often improves in CI users when increasing pulse rate, but underlying factors to encoding of gaps at low and high rates is poorly understood. In non-CI users, gap detection generally declines with increased age due to declines in both peripheral and cognitive function. Given that the majority of adult CI users are over the age of 65 it is important to determine contributing factors to temporal precision in CI users. The overall aim of the current study was to determine the underlying factors contribute to gap detection sensitivity in CI users when using low and high pulse rates. Further, we examined if gap detection sensitivity is related to speech recognition in the same listeners.

Design: 18 cochlear implant recipients with adult-onset hearing loss (Ages 43-87) have been examined thus far. Auditory nerve health was assessed using electrically-evoked compound action potential (ECAP) measures and electrodes with better and poorer neural health were selected for each listener. Psychophysical gap detection thresholds were assessed using a 4AFC approach and were measured on selected electrodes for each listener using a 500 and 3500 pps stimulus. The Connections Test was used to evaluate processing speed for each listener. Speech recognition in noise (AzBio Sentences, +10 dB SNR) were presented at 60 dBA, and scored as percent correct for each listener.

Results: Preliminary data suggest that gap detection worsened with increased age, but for all participants thresholds were better when using a higher pulse rate; there was a significant interaction between age and pulse rate, with younger listeners showing greater improvement in gap detection thresholds when increasing the pulse rate. Contrary to our predictions, in this preliminary data set, AN health was not a significant predictor of gap detection thresholds. Slower processing speed was independently associated with poorer gap detection thresholds and speech understanding in noise, regardless of pulse rate, AN status or listener age.

Conclusions: Preliminary results suggest that decreased processing speed is a primary contributing factor to age-related declines in encoding of silent temporal gaps in CI users.

Category: Cochlear Implants

Poster #: 129

Cochlear Implant Sound Quality Impacts Overall Quality of Life

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Objectives: 1) To define the relationship between cochlear implant (CI)-aided speech recognition and subjective CI sound quality ratings, hypothesizing that poorer speech recognition correlates with lower

sound quality ratings due to signal degradation. 2) To define the relationship between subjective CI sound quality ratings and CI-related quality of life, hypothesizing that lower sound quality ratings correlate with reduced quality of life due to the impact of perceiving the degraded auditory signal in everyday life.

Design: This prospective study enrolled 41 adult CI users (29 female, 12 male; mean age 59 years, range 18-80 years) with at least six months of CI experience. Participants were tested in their best-aided condition (21 bilateral CIs, 13 bimodal CI + hearing aid, 7 unilateral CI). Assessments included speech recognition tasks (words in quiet, and sentences in quiet and noise), the Speech, Spatial, and Qualities (SSQ) questionnaire, and the CI Quality of Life questionnaire (CIQOL). The "Qualities" sub-section of the SSQ was used to quantify CI sound quality ratings. The CIQOL provided scaled global and domain scores (communication, emotional, entertainment, environment, listening effort, and social). Relationships between variables were analyzed using Pearson correlations.

Results: CI sound quality ratings were not significantly correlated with speech recognition measures: words in quiet ($r = .08$, $p = 0.683$), sentences in quiet ($r = 0.15$, $p = 0.419$), or sentences in noise ($r = -0.32$, $p = 0.08$). However, sound quality ratings were positively correlated with CI-related quality of life global scores ($r = 0.54$, $p < 0.001$) and all domain scores: communication ($r = 0.67$, $p < 0.001$), emotional ($r = 0.54$, $p < 0.001$,), entertainment ($r = 0.44$, $p = 0.007$), environment ($r = 0.48$, $p = 0.003$), listening effort ($r = 0.56$, $p < 0.001$), and social ($r = 0.37$, $p = 0.028$).

Conclusions: Better CI sound quality is related to better CI-related quality of life, but not related to CI-aided speech recognition. These results highlight CI sound quality as an important outcome metric for CI users' real-world functioning and satisfaction. Incorporating CI sound quality as an additional outcome metric could provide a more comprehensive understanding of CI outcomes. Future item-level analyses with the questionnaires will identify specific sound quality features driving the relationship with CI-related quality of life with the goal of informing future CI optimization strategies to maximize sound quality and quality of life.

Category: Cochlear Implants

Poster #: 130

Immunological Memory and Electrode Impedance in Sequential Cochlear Implant Users

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Objectives: To explore electrode impedance and activation status as biomarkers for latent immune responses in sequentially-implanted bilateral cochlear implant (CI) recipients. We hypothesize that the first CI primes the contralateral ear to more robustly respond to sequential implantation, leading to earlier increases in electrode impedances and earlier electrode deactivation.

Design: Retrospective data including 2361 unique patients were acquired from the University of Iowa Custom Sound SQL database. Data were serially processed using MATLAB, resulting in 119 subjects

meeting initial inclusion criteria (bilateral, non-simultaneous implants; CI24RE or newer devices; matched electrode arrays across ears; and no explantations). After review of medical/audiological records to exclude subjects with low/fluctuating/asymmetrical usage, insufficient longitudinal data (recent implantation, lost-to-followup), history of cochlear malformations, labyrinthectomy, unilateral petrosectomy, and long-term corticosteroid/immunosuppressant usage, the cohort was reduced to 80 subjects. Final data included patient/implant identifiers; dates associated with implantation, initial stimulation, and impedance recordings; and impedance measurements and deactivation status across 22 electrodes. The MP2 stimulation mode was selected for impedance measurements due to stability of the case ground and relatively consistent effects on each intracochlear electrode. Impedance measurements were removed for all deactivated electrodes from initial deactivation until the end of the current record. Deactivated electrode count at each visit was summated across all electrodes. Impedance data were considered relative to baseline visit defined as the visit directly after initial activation, usually two weeks. Absolute impedances and impedance change relative to baseline impedance were plotted across all 22 electrodes in both sequentiality conditions. Kaplan-Meier analysis with log-rank testing was used to quantify time-to-first deactivated electrode as a measure of operational integrity.

Results: Impedance data were considered for 1028 and 732 post-operative visits for the first and second implants, respectively. The average duration of follow-up was 30.58±38.50 months (first) and 30.87±40.74 months (second), with maximum durations of 219.58 months and 195.65 months, respectively. Second implants demonstrated increased variability in impedance change relative to baseline and marginal increases in the overall distribution of absolute impedance data within the first twelve months compared to first implants across most electrodes. Deactivated electrode count was higher in the second implant for 21 subjects and in the first implant for 22 subjects. Preliminary Kaplan-Meier curves demonstrated a nearly two-month decrease in mean survival time-to-first deactivated electrode for second-implanted ears compared to first-implanted ears. More robust statistical analysis is ongoing and will be presented.

Conclusions: Despite similar absolute impedances and deactivated electrodes across ears, second-implanted ears demonstrated faster time-to-electrode status change. To the extent that electrode deactivation is a consequence of changes in the intracochlear environment, these data support the hypothesis of a latent immune response predisposing the contralateral ear to accelerated inflammation and fibrosis. Given limitations with retrospective data, these preliminary results warrant additional investigation with more sensitive impedance models that enable analysis of local changes by electrode. Prospective research in animal models will enable more direct assessment of latent immune responses and associated pathology. Future work should also evaluate potential impacts on the effectiveness and functionality of sequential implants in bilateral CI users.

Category: Cochlear Implants

Poster #: 131

Impact of Auditory, Vestibular, and Balance Impairments on Developmental Outcomes in Children with Cochlear Implants

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Objectives: This study aimed to examine the combined developmental impact of concurrent vestibular and balance impairments on working memory, language skills, and academic performance in children with bilateral cochlear implants. While prior research has identified cognitive and academic deficits in cochlear implant users, the additional influence of vestibular and balance impairments on these outcomes remains unclear. It was hypothesized that children with combined hearing, vestibular, and balance impairments would demonstrate greater deficits in cognitive and academic domains compared to those with hearing loss alone.

Design: Study participants were 76 children (4.65 - 17.85 years of age) who were grouped as: (1) typically developing (n=32, mean age (SD) = 11.44 (2.85) years), (2) bilateral cochlear implant (BCI) users (n=44, mean age (SD) = 10.54 (2.90) years). Vestibular function was measured using cervical vestibular evoked myogenic potentials (cVEMP), video head impulse test (vHIT), and/or the caloric, and balance was measured using the Bruininks-Oseretsky Test of Motor Proficiency balance subtest (BOT). Within the BCI group, clinical findings revealed partial vestibular impairment in 9 children (mean age (SD) = 8.48 (2.58) years); complete vestibular impairment in 14 children (mean age (SD) = 10.45 (4.00) years); and poor balance in 19 children (mean age (SD) = 10.54 (3.49) years). Three developmental domains were assessed using specific tests: 1) working memory (Dot Matrix, Corsi Block, and Digit Span tests); 2) academic performance (Weschler Individual Achievement Test (WIAT)); 3) language abilities (Clinical Evaluation of Language Fundamentals (CELF)). Data were analyzed using mixed-model regressions, accounting for age, group, and vestibular impairment or balance effects.

Results: Age-related improvements were evident for children in all 3 groups in all assessment domains: 1) working memory ($F(1)=54.72$, $p<0.01$); 2) academics ($F(1)=110.45$, $p<0.01$); and 3) language ($F(1)=37.25$, $p<0.01$). Poorer outcomes were measured in children with bilateral cochlear implants compared to the control group in all domains: 1) working memory (dot matrix: ($t(70)=-2.97$, $p<0.01$), 2) academics (math ($t(70)=-1.85$, $p<0.07$)) and 3) language (CELF $F(1)=13.97$, $p<0.01$)). There was no additional effect of vestibular impairment on: 1) working memory ($t(70)=0.88$, $p=0.81$)); 2) academics ($t(199)=-0.054$, $p=1.00$)); and 3) language (CELF ($t(70)=-0.31$, $p=0.99$)). BOT scores had a significant impact on working memory ($F(1)=6.37$, $p<0.02$)) but did not have a significant impact on academics ($F(1)=1.11$, $p=0.29$)), and language (CELF ($F(1)=0.67$, $p=0.42$)). No significant group differences were found on the corsi blocks ($t(61)=0.99$, $p=0.33$), digit span ($t(70)=0.27$, $p=0.79$), word reading ($t(61)=-1.32$, $p=0.19$), and pseudoword reading ($t(62)=-1.39$, $p=0.17$) tests.

Conclusions: These findings indicate that, despite improvements with age, children with bilateral cochlear implants continue to exhibit gaps in visuospatial working memory, math, and language compared to typically developing peers. These gaps are not explained by vestibular and/or balance deficits and thus reflect the importance of hearing in development.

Category: Cochlear Implants

Poster #: 132

Anticipated Difficulty Affects Listening Effort in Cochlear Implant Users

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Objectives: The effort of listening to speech can interfere with quality of life for people with cochlear implants. As they anticipate the difficulty of an upcoming conversation, there is an invisible burden created by the effort prepared and used for listening. Although numerous studies have measured effort during or after listening, little is known about how effort is prepared in anticipation of upcoming speech. This study is designed to test whether effort is allocated differently before speech is heard based on the expected level of difficulty.

Design: In a sentence-repetition task, 19 adults with cochlear implants were given an explicit cue before each trial signaling the difficulty of the upcoming sentence. The cue was either easy (coherent sentence), hard (semantically anomalous sentence), or XXXX (equally likely to be easy or hard). There were 33 cued easy trials, 33 cued hard trials, and 56 neutral-cue trials split evenly into easy and hard. Changes in pupil size were recorded to measure effort. Additionally, the rate of microsaccades was used as a signature of instantaneous attentional gain. Generalized additive mixed effects were used to analyze both time-series data types.

Results: Easy stimuli were repeated more accurately when preceded by an "easy" cue, suggesting that uncertain difficulty led to increased mistakes. There was a marginal increase in errors for hard stimuli when preceded by a "hard" cue. Incoherent responses (known to elicit longer-lasting effort) were more likely following "hard" cues, and also following neutral cues compared to stimuli that were cued to be easy. When trials were preceded by a "hard" cue, there was greater pupil dilation before the sentence began, which sustained as elevated dilation through the end of the trial. A neutral cue in the pre-listening stage resulted in intermediate pupil dilation for both easy and hard stimuli; easy stimuli became harder and harder stimuli became easier. These observations mainly emerged in the second half of the testing block. Notably, the pattern of stronger microsaccade suppression for hard stimuli was also observed for any stimulus preceded by a neutral cue; when uncertain about the difficulty, listeners appeared to apply the same attentional gain as if they expected it to be hard.

Conclusions: For cochlear implant users, the expectation of difficult listening or uncertainty about the level of difficulty adds to the effort of processing speech. This effort is engaged before the speech is even heard and sustains until after the sentence has already been heard. This pattern is affected by how much time the listener has been exposed to the signal. Intelligibility scores suggested a slight performance cost for known hard situations as well as a clear performance cost for uncertainty. Understanding how cochlear implant users allocate effort based on anticipation of difficulty will help us understand the overall listening experience and impacts on quality of life.

Category: Cochlear Implants

Poster #: 133

Music Enjoyment in Cochlear Implantees is Independent of Listening Modality

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Objectives: Prior work has suggested that music appreciation and emotional responses to music are diminished in cochlear implant (CI) users, and CI users listen to music significantly less compared to normal hearing individuals. While improvements in music enjoyment among CI users can be difficult to achieve given the limitations of current technology, smaller interventions such as changes in the listening environment may impact music enjoyment. However, despite anecdotal reports from implantees, the use of direct streaming into CIs ‚Äì a capability built into almost all modern CIs ‚Äì has not been investigated as a potential modulator of music enjoyment. We aimed to compare bilateral implantees‚Äô music enjoyment and emotional response to music when listening in a sound field and via direct streaming.

Design: Thirteen bilateral CI users were recruited through a tertiary academic center and community hearing loss groups. Participants listened to 10 musical excerpts, varying in genre and mood. Music enjoyment was measured via previously validated measures of pleasantness, naturalness, and musicality, ranked on a 10-point Likert scale. Emotional response to music was measured via previously validated measures of valence and arousal, ranked on a 9-point pictorial assessment. Each participant listened to the excerpts via external speakers into the sound field and via direct streaming into their CI.

Results: Nine participants (69.3%) indicated that they prefer to listen to music through their CIs via direct streaming. However, there was no significant difference in any music enjoyment measures between the sound field and direct streaming conditions; the mean (SD) pleasantness using external speakers was 5.54 (1.32) and 5.63 (1.28) with direct streaming (p=0.73), naturalness was 5.77 (1.60) vs. 5.90 (1.79) (p=0.67), and musicality was 6.40 (1.62) vs. 6.55 (1.72) (p=0.54). There was also no significant difference in emotional response; the range (SD) of valence was 5.32 (1.83) vs. 5.50 (1.62) (p=0.54), and arousal was 5.45 (1.63) vs. 5.31 (1.35) (p=0.70).

Conclusions: Despite the majority of participants self-reporting a preference of listening to music through direct streaming, there was no difference in music enjoyment or emotional response to music as measured by pleasantness, naturalness, musicality, valence, and arousal when listening via external speakers or direct streaming. This has positive implications for implantees‚Äô ability to enjoy music in live or concert settings. This research was conducted with the support of an NIA-funded T35 grant (T35AG044303).

Category: Cochlear Implants

Poster #: 134

Current Focusing Enhances Cochlear Implant Users' Virtual Channel Ranking Performance

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Objectives: Cochlear implants (CIs) use only 12-22 electrodes to create place-pitch percepts. Additionally, monopolar (MP) stimulation mode generates broad electrical fields and neural excitation patterns, leading to unintended activation of non-targeted neurons and poor spectral resolution. Electrical field-shaping techniques reduce the spread of excitation by current focusing and create intermediate pitch percepts (virtual channels) by current steering. Previous research suggested that current steering in focused partial tripolar (pTP) mode, such as virtual tripole stimulation, may enhance CI users' place-pitch sensitivity compared to current steering in broad MP mode. However, no study has evaluated the effectiveness and variability of combined current focusing and steering across the electrode array. This study aimed to (1) explore the extent to which current focusing can improve CI users' place-pitch sensitivity to virtual channels across the electrode array, and (2) assess whether the quality of electrode-neural interface, indicated by detection thresholds of focused pTP stimuli, can predict the baseline pitch-ranking performance of MP-mode current steering and the performance improvement with pTP-mode current steering.

Design: Virtual channel ranking (VCR) was tested for all available electrode pairs using two stimulation modes—MP and pTP—in a randomized order. In pTP mode, 75% of the current from each main electrode $EL_{(n)}$ was evenly distributed to both the basal and apical non-adjacent flanking electrodes $EL_{(n+2)}$ and $EL_{(n-2)}$ ($\sigma = 0.75$), while the remaining 25% was directed to an extracochlear ground electrode. For each pair of adjacent main electrodes in each stimulation mode, participants ranked the pitch of two stimuli in each trial: one with all current on the apical main electrode $EL_{(n)}$ but no current on the basal main electrode $EL_{(n+1)}$ (reference) and the other with 1-α of the current on $EL_{(n)}$ but α of the current on $EL_{(n+1)}$ (target). VCR thresholds (i.e., the smallest α with 70.7% correct VCR performance) were measured with an adaptive procedure, so were detection thresholds for focused pTP stimuli without current steering.

Results: Preliminary data from nine implanted ears of seven postlingually deafened adult CI users showed that middle electrode pairs had better VCR thresholds than apical and basal pairs, and pTP stimuli yielded better VCR thresholds than MP stimuli. Additionally, MP stimuli exhibited lower detection thresholds than pTP stimuli, and basal electrodes had lower detection thresholds compared to middle and apical electrodes. Across electrodes, normalized detection thresholds of focused pTP stimuli did not correlate with normalized MP-VCR or pTP-VCR thresholds or with improvements in VCR threshold with current focusing. However, across ears, higher mean detection thresholds of focused pTP stimuli were associated with better mean MP-VCR and pTP-VCR thresholds, as well as less mean improvements in VCR threshold with current focusing.

Conclusions: Current focusing may enhance CI users' place-pitch sensitivity to virtual channels created by current steering. Additionally, poorer electrode-neural interface, as reflected by higher detection thresholds of focused pTP stimuli, may cause greater fusion of electrical fields, leading to better outcomes of MP- and pTP-mode current steering but less improvements with current focusing. Future research will examine neural factors influencing the effective use of electrical field-shaping techniques.

Category: Cochlear Implants

Poster #: 135

Validating an Observer-Based Psychophysical Procedure for Psychoacoustic Tuning Curves

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Objectives: Cochlear implants can help restore hearing to people with profound hearing loss. However, certain aspects of perception are not restored completely. One challenge area is reduced frequency selectivity in cochlear implant listeners compared to normal hearing listeners. Recent pilot data has suggested that pediatric cochlear implant recipients may have better frequency selectivity than adult cochlear implant recipients. If so, it could provide evidence to support optimizing programming specifically for children. Frequency selectivity is often measured with psychophysical tuning curves (PTCs), which can take a long time to complete and are difficult to measure on young children. Recently, a faster method to measure PTCs has been developed, which can be combined with an observer-based psychophysical procedure (OPP) to be tested on infants. The objective of this experiment is to validate the new OPP procedure in normal-hearing and cochlear implant listeners over the age of five with the faster PTC method.

Design: Five participants have been tested so far, including three cochlear implant users and 2 normal hearing participants, however data collection is ongoing. The ages range from 11-79. Stimuli were presented to cochlear implant listeners via Bluetooth. Participants completed the faster PTC method and the OPP version. The faster PTC method involved an alternative forced choice (AFC) procedure in which the frequency of a forward masker was adapted to be closer to a probe as the task became more difficult. The probe was at a frequency corresponding to electrode 8. The OPP method followed similar steps, however had participants listening to a continuous masker and raising their hand when they heard the probe, rather than the AFC procedure.

Results: The two methods will be compared by calculating the correlation coefficient between the two results. Preliminary data shows a weak trend between the faster PTC method and the OPP method ($R2 = 0.5647$, $p = 0.3213$). However, more data will be collected.

Conclusions: Preliminary results are promising, but the relation between tuning obtained with the OPP method and the faster PTC method is still unclear. An OPP, PTC could be used with infants to better determine how frequency selectivity changes with age and cochlear implantation, assisting future pediatric cochlear implant recipients.

Category: Cochlear Implants

Poster #: 136

Reverberant Auditory Cues Access for Spatial Unmasking by Cochlear Implantees

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Objectives: To measure the impact of reverberation on the release of speech-on-speech masking provided by individual auditory cues, including head shadow, binaural redundancy, and interaural differences by bilateral cochlear implant (CI) users. Prior work shows bilateral CI users receive the largest intelligibility benefit from monaural head shadow, while some take advantage of binaural cues. With reverberation degrading the magnitude of both monaural and binaural cues, we predict reduced benefits for all cues in reverberation compared to free-field. We further explore classification of bilateral CI users based on their use of monaural versus binaural cues.

Design: The procedure used in this study mimicked the design used by Peng and Litovsky (2021). Eleven young bilateral CI users from 11-22 years old participated in the study. Participants were tested in virtual acoustic space that was simulated using non-individual head-related transfer functions with and without reverberation. For reverberation, a small classroom with typical size and interior absorption was simulated in ODEON, with the direct path from sound sources to the listener and all reflection patterns off room surfaces properly modeled. Speech stimuli were target AuSTIN sentences with a two-talker speech babble masker. Speech reception thresholds (SRTs) were measured in four configurations, with two target-masker spatial separations (co-located vs. spatially separated 180Àö) and two ear conditions (binaural vs. monaural). Auditory cue benefits were calculated by comparing SRTs across the four conditions.

Results: On the group level, listeners show elevated (poorer) SRTs in reverberation compared to anechoic, with a larger increase when maskers are 180Àö separated than co-located. For speech-on-speech masking, all bilateral CI users demonstrate unmasking benefits from monaural head shadow. On average, binaural redundancy and interaural differences provide much smaller unmasking benefits. There is large individual variability in how listeners use auditory cues for unmasking. Participants who receive a larger intelligibility benefit from the monaural head shadow or binaural redundancy cue generally demonstrated a smaller benefit or even interference from interaural difference cues. When reverberation is introduced, intelligibility benefits become smaller for head shadow but slightly larger for binaural redundancy, likely due to the reduced interaural level differences.

Conclusions: This study supports previous work which demonstrates that bilateral CI uses primarily rely on the monaural head shadow cue for SRM, with attenuated benefit when exposed in reverberation. Preliminary clustering analysis shows classification of listeners based on benefit versus interference in their use of interaural differences for unmasking. Bilateral CI users experience challenges in reverberation for both speech perception and their access to spatial cues for improving speech-in-speech understanding.

DIAGNOSTIC AUDIOLOGY / OTOLOGY

Category: Diagnostic Audiology / Otology

Poster #: 137

Health Outcomes Associated with Hearing-Vestibular Function in Substance Misuse

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Objectives: Substance use disorders (SUDs) can negatively impact hearing thresholds and central vestibular function. Health and social factors may mitigate these effects in people with SUDs but this remains unexplored. The study objectives were to determine (1) differences in demographic, health, and social factors in persons with SUDs as compared to persons without SUDs, and (2) how health and social factors and duration of substance misuse influenced hearing and vestibular-balance outcomes. It was hypothesized persons with SUDs would have more health comorbidities and lower socioeconomic position (SEP), and longer substance misuse leads to greater declines in hearing and/or vestibular-balance outcomes. Non-minority participants would also potentially have poorer hearing/vestibular-balance.

Design: As part of an ongoing large-scale study, participants were recruited across three regionally and ethnically diverse sites and included adults aged 18-59 years with history of SUD using illicit drugs, prescription opioids, and/or alcohol. Preliminary data were analyzed for 78 adults with SUD and 44 adults without SUD history. Participants completed a health and substance-use questionnaire, the Montreal Cognitive Screening (MoCA), and underwent auditory and vestibular testing. Outcomes for analyses included number of health comorbidities, age, sex, minority status, SEP, years of substance use, mean left and right all-frequency pure-tone-averages (PTAs; 250-16,000 Hz) and binary normal verses anormal vestibular-balance function (based on vestibular bedside, oculomotor testing, and standing balance).

Results: Results indicated significant group differences in mean age (SUD M=41.97, SD=10.59; control M=31.70, SD=10.57), median number of active health conditions (SUD 2; control=1), SEP (SUD M=0.35; control M=0.46), and MoCA performance (SUD M=23; control M=25). There were no group differences in sex or minority status. The SUD group showed significantly higher mean PTAs (M= 22.5, SD= 13.98; control M= 10.86, SD=8.12) and higher association to abnormal vestibular–balance (60%; control 11%). The influence of health and social factors was tested with SUD as a covariate to determine if SUD mediated any effects. For hearing, age and PTA were significantly correlated (r=0.49), however, a SUD did not influence this relationship (p=0.74). There was a significant negative correlation between PTA and SEP (r=-0.23), but SUD did not influence this relationship (p=0.73). Health comorbidity, sex, or minority status had no influence on mean PTAs. Non-parametric testing revealed mean age, sex, minority status, health comorbidity, or SEP had no influence on vestibular–balance regardless of group. There was a

significant relationship between the duration of substance use and PTA (ρ=0.50) with higher PTAs correlating to longer years of use. Abnormal vestibular–balance was significantly associated with > 10 years of substance misuse (χ^2= 27.21).

Conclusions: Results to date show negative impacts to hearing and vestibular-balance function in people with SUDs. New findings suggest that people with SUDs may have higher risk for hearing and vestibular decline based on substance use patterns. Continued analyses will investigate potential effects by other factors like substance type and frequency. Given the study group's reduced cognitive, SEP, and higher health comorbidity, findings potentially warrant routine hearing-vestibular screenings for SUD populations and identification of social constructs that affect their health.

Category: Diagnostic Audiology / Otology

Poster #: 138

Hearing Assessment Measures as Predictors of Self-Reported Hearing Difficulty in Noise

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Objectives: When a patient presents with concerns about hearing in noisy environments, their audiogram becomes a crucial tool for determining their care. Yet, over 12% of people with clinically normal thresholds have been shown to experience significant challenges in noisy settings. Many studies have attempted to identify objective hearing measures that predict this difficulty better than audiogram, but the results have been inconclusive. Recent studies suggest that self-report questionnaires regarding hearing difficulty in noise may offer better predictive value. This study used principal component analysis (PCA) and linear regression to determine the relation between objective hearing measures and self-reported hearing difficulty in both quiet and noisy environments.

Design: Thirty-four participants, ages 18-35, were recruited for this study. All listeners had normal tympanometry, no history of middle ear pathology or surgery, and pure-tone thresholds below 25 dB HL between 0.25 and 8 kHz. During an intake questionnaire, participants rated their hearing difficulties in both quiet and noisy environments on a 1-to-10 scale. Objective hearing measures included standard pure-tone audiometry, high-frequency audiometry, stimulus-frequency otoacoustic emissions (SFOAEs), QuickSIN scores, and three speech segregation efficiency measures: obtained efficiency reflecting overall speech segregation performance; weighting efficiency measuring the individual's use of available cues; and noise efficiency (i.e., internal noise) reflecting degradations in the internal representation of segregation cues resulting from stochastic neural processes. Principal component analysis was used to identify groupings of objective measures to simplify the complex data set. The first three components (PC1, PC2, PC3) captured 78.95% of the variance. These components were then utilized in a multivariate linear regression to assess their relationship with questionnaire responses.

Results: PC1 showed strongest loadings from the efficiency measures on the speech segregation task, PC2 on the SFOAEs levels and OAE level-to-noise ratios, and PC3 on the pure-tone audiometry. The QuickSIN task did not have load strongly enough on the principal components to be included in the regression

model. Multivariate linear regression using principal components revealed that PC1 and PC2 explained more variance in questionnaire responses to difficulty in noise, while PC3 accounted for more variance in responses to hearing difficulty in quiet.

Conclusions: For clinically normal hearing listeners, pure-tone audiometry best predicted self-reported difficulty listening in quiet, but speech segregation efficiency measures and SFOAEs best predicted self-reported difficulty listening in noise. The results suggest that supplementary testing using self-report measures could enhance diagnostic accuracy, supporting more tailored interventions for people with perceptual auditory difficulties not captured by standard audiometry.

Category: Diagnostic Audiology / Otology

Poster #: 139

Repeatability of Clinical Speech Recognition Measures in Quiet and Noise

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Objectives: The most common complaint among individuals with hearing loss is difficulty understanding speech in noisy environments. Despite this, for over 70 years, routine audiologic practice has defaulted to word-recognition testing in quiet settings. This mismatch has led many researchers and clinicians to advocate for routinely including speech-in-noise tests in clinical practice or even replacing word-recognition in quiet as the primary assessment of speech recognition. To implement these changes, clinicians and researchers require vital data, such as the between-session repeatability of any speech recognition measure. This consistency is crucial for medical and rehabilitative management of the patient. However, large-scale studies assessing repeatability in clinical populations are limited. In this study, we address this gap by evaluating between-session repeatability of speech recognition scores using the NU-6 word lists (word recognition in quiet) and the QuickSIN (speech perception in noise) across thousands of patients at our facility.

Design: We identified over 100,000 audiograms from patients evaluated at our facility, each of whom underwent pure-tone audiometry. Most of these patients also completed monaural word-recognition testing in quiet, assessed using the NU-6 word lists. Additionally, a subset of approximately 12,000 audiograms included monaural speech-in-noise performance, measured with the QuickSIN. We then focused on patients with minimal hearing changes between sessions, defined as a ≤5 dB difference in the high-frequency pure tone average (1, 2, and 4 kHz). 6187 patients had similar hearing thresholds with monaural word-recognition scores, while 440 of these patients also completed monaural QuickSIN. To assess repeatability, we compared word-recognition scores and QuickSIN dB SNR losses across sessions, focusing on whether each measure fell within a critical difference determined by confidence intervals. For word recognition scores, we also examined pre-specified values (e.g., 10-15%) used to guide medical referral decisions.

Results: Our preliminary findings indicate that around 10% of word-recognition scores showed between-session performance differences that might warrant physician referral, while 19% of patients demonstrated a difference in QuickSIN SNR loss greater than 2.7 dB. These results are complicated by the fact that most patients achieved near-perfect word-recognition scores (e.g., at or near 100%), whereas QuickSIN SNR losses rarely reached ceiling levels. Our initial results suggest that, after accounting for ceiling effects, the between-session reliability of the two measures becomes more comparable. We are currently investigating these effects in greater depth, as well as examining the impact of hearing loss on the repeatability of these measures.

Conclusions: Although preliminary, our findings suggest that once adjusted for ceiling effects commonly observed in word-recognition tests in quiet, speech-recognition measures in both quiet and noise exhibit similar levels of between-session repeatability. This investigation provides essential information for further integrating speech-in-noise measures into routine clinical practice. We plan to expand this work to explore these effects in conditions often associated with repeat audiograms, such as sudden hearing loss, vestibular schwannoma, and Meniere's disease.

Category: Diagnostic Audiology / Otology

Poster #: 140

Subclinical Audiologic Differences in Preterms with Sepsis and/or Gentamicin Exposure

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Objectives: Up to 4% of neonatal intensive care unit (NICU) graduates (preterms) have sensorineural hearing loss (SNHL), compared to 0.3% of full-term births. One factor is the use of ototoxic therapies, such as gentamicin, to treat systemic infections that contribute to mortality and comorbidities in NICU infants. Yet, the risk of gentamicin-induced SNHL in NICU infants remains unclear due to conflicting reports, and lower frequency ranges (<4 kHz) used in newborn hearing screening programs that cannot detect the onset of ototoxicity at higher frequencies. Our long-term objective is to reduce both the incidence and severity of drug-induced SNHL in NICU graduates, as this has long-lasting developmental implications. We tested the hypotheses that cumulative dosing and (suspected) sepsis increase the incidence of drug-induced SNHL in NICU graduates.

Design: We prospectively enrolled 320 NICU infants, of whom 294 underwent audiological screening prior to discharge, and 226 had a follow-up diagnostic visit. Subclinical group differences for distortion product otoacoustic emissions (DPOAEs, 4-10 kHz) and tone-burst auditory brainstem responses (tb-ABRs, 1-8 kHz) at screening (DPOAEs) and at diagnostic follow-up (DPOAEs, ABRs) were evaluated for infants exposed to< or ≥3d of gentamicin and presence/absence of sepsis. Mixed effect models were adjusted for corrected age and frequency, with random effects for site, subject, and ear. Wideband

absorbance, co-morbidities with ≥10% prevalence, family history of hearing loss, demographics, and co-therapeutics were added to models separately to identify potential confounders for future study. Sensitivity analyses assessed continuous days of gentamicin exposure.

Results: Mean corrected age at screening was higher in groups with sepsis than without. In adjusted models, DPOAE signal-to-noise ratio (SNR) and level estimates (95% CI) were lower in the no sepsis, ≥3d gentamicin group (n=7) compared to the no sepsis,<3d gentamicin group (reference group, n=243). Among those with sepsis, the<3d gentamicin group (n=21) had similar SNR and level measures, and the ≥3d gentamicin group (n=11) trended lower but was not significantly different. For tb-ABRs, no groups significantly differed from the reference group. Among potential confounders, corrected age was associated with all outcomes; higher wideband absorbance was associated with higher DPOAE SNRs and levels at screening; retinopathy of prematurity was associated with lower DPOAE levels at screening; and female gender was associated with lower latency at diagnostic visits. In sensitivity analyses adjusted for corrected age, an increase of one day in continuous days of gentamicin was associated with lower DPOAE levels (P=0.048) and marginally non-significant decreases in SNR.

Conclusions: Improved NICU protocols and antibiotic stewardship that likely reduced the prevalence of (suspected) sepsis and aminoglycoside therapy compared to earlier decades, limited this study. Nonetheless, subclinical DPOAE differences in the no sepsis, gentamicin group were observed. These observational results may be confounded by age differences between groups. If human studies validate preclinical data that sepsis-associated inflammation exacerbates the risk of gentamicin-induced SNHL, refined clinical protocols to reduce gentamicin-induced SNHL in NICU infants will be predicated to better preserve lifelong hearing and improve rehabilitative outcomes.

Category: Diagnostic Audiology / Otology

Poster #: 141

Normative Audiometric Data to Assess Extended High-Frequency Cochlear Function

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Objectives: Clinically, hearing is assessed from 250 Hz to 8 kHz, but extended high frequencies (EHFs) above 8 kHz hold valuable diagnostic potential. Current data regarding EHFs in the literature are variable due to differences in equipment, participant ages, and units of measurement (dB HL versus SPL). Clinicians are left with inconsistent results and reference values to use in practice. The current study aims to obtain normative data for EHFs across the lifespan for the Madsen Astera and IHS Duet in dB HL to assess 1) age effects for EHF audiometric thresholds and EHF distortion product otoacoustic emissions (DPOAEs) and 2) whether audiometric thresholds differ between the two systems. We hypothesize that 1) audiometric thresholds will increase and DPOAE amplitudes will decrease with age but DPOAE changes will precede EHF threshold changes due to sensitivity and 2) EHF pure tone averages (PTAs) for the IHS Duet and the Madsen Astera will be significantly different due to differences in system transducers and dB HL conversions.

Design: Audiometric thresholds and DPOAEs have been collected for 47 participants to date. Inclusion criteria were ages 5 years and up with no diagnosed or suspected hearing loss. Audiometric thresholds were obtained with the IHS Duet and Madsen Astera Clinical Audiometers, and DPOAEs were obtained with the IHS Duet. Data were averaged across ears and participants by the following age groups: 5-12, 13-18, 19-29, 30-39, 40-49, 50-59, 60-69, and 70+ years. EHF DPOAE testing was performed to objectively assess cochlear function to evaluate the relation between EHF audiometric thresholds and DPOAE amplitudes as a function of age. By the end of the data collection phase, the goal is to have 90 participants.

Results: Data collection is ongoing. Preliminary results show poorer audiometric thresholds as age of the participant increases, as expected. DPOAE amplitudes decreased prior to decreases in EHF audiometric thresholds. There was a negative correlation between the DPOAE amplitudes and the Duet audiometric thresholds [r = -.135, p = .120]. There was a negative correlation between the DPOAE amplitudes and the Madsen Astera audiometric thresholds [r= -.177, p =<.001]. A significant difference in EHF pure tone averages (PTA) of all participants was present between the Madsen Astera and IHS Duet [t = 5.593, p =<.001], however, there was no significant difference in standard frequency PTAs of all participants [t = -1.857, p = .106].

Conclusions: The preliminary data corroborated with the study hypotheses. The largest increases in EHF audiometric thresholds were seen in participants 50 years and older for both testing systems. Current study findings may encourage clinicians to utilize DPOAEs to detect hearing loss prior to the loss being detectable in behavioral audiometry, especially if a patient is struggling with speech understanding in noise. Future researchers may consider including an examination of EHF hearing loss on speech in noise testing performance.

Category: Diagnostic Audiology / Otology

Poster #: 142

Veterans' Perspectives on Chemotherapy-Related Ototoxicity and its Management

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Objectives: Ototoxicity is a common adverse effect of leading chemotherapy treatments, but ototoxicity management (OtoM) is not a routine part of cancer care in most clinical settings for adults. Guidelines call for patient experiences to inform health care delivery improvement initiatives and policy formation in cancer care. However, few studies have systematically explored patients' experiences and viewpoints on ototoxicity. Audiometric testing at the point of (cancer) care, PoC, may be an effective method of integrating OtoM into cancer care to increase access. This study aims to describe the perspectives of Veterans with cancer on ototoxicity as well as other treatment-related side effects during cancer treatment. The focus is on two themes: 1) The importance of managing ototoxic symptoms (hearing loss, tinnitus, and dizziness/imbalance) in the context of their disease and other side effects; and 2) The benefit of audiological assessments at the PoC.

Design: Thirty-five participants receiving one of three platinum-based chemotherapies (cisplatin, carboplatin, oxaliplatin) were recruited from a larger investigation on risk factors for chemotherapy-induced ototoxicity and its functional impacts. A phone-call survey was conducted with Veterans undergoing cancer treatment. The survey consisted of 12 questions (three Likert scale, one rank-order, and eight open-ended questions). Questions on ototoxicity impact were analyzed quantitatively using descriptive statistics. Questions on the benefit of PoC audiologic assessment were analyzed qualitatively using an inductive qualitative approach.

Results: Thirty-seven percent of participants agreed or strongly agreed that the negative impact of tinnitus was greater after treatment compared to their pre-treatment baseline; 29% felt that hearing loss had a greater impact after treatment; and 9% felt that dizziness had a greater impact after treatment.Patients were asked to rank nine potential non-lethal side effects of chemotherapy in order of which had the greatest negative impact on their everyday life. Nausea was ranked as the most impactful symptom (n=5) followed by tinnitus and loss of taste which were both ranked equally and perceived as the second most impactful (n=4). Remaining symptoms were had the lowest rankings as being the most impactful side effect: hearing loss (n=3) and "other" (mood changes n=1, not specified n=2). Qualitative analysis of open-ended responses suggested that patients perceived benefit in taking precautions for their auditory function and liked the convenience of PoC audiologic assessment. Analysis also suggested patients wished they had better understood the side effects of their treatment, especially tinnitus and hearing loss.

Conclusions: A large percentage of cancer survivors treated with an ototoxic chemotherapy felt their treatment negatively impacted their tinnitus and hearing. This study provides evidence that patients endorse adoption of a routine OtoM and had a favorable opinion of PoC testing. Patients were commonly unaware of treatment side effects, especially related to the increased risk of tinnitus and hearing loss. This suggests an area of improvement for cancer counseling and education. These patient perspectives may be used to inform integration of routine OtoM in cancer care across the VA healthcare system and other cancer care settings.

Category: Diagnostic Audiology / Otology

Poster #: 143

Mapping the Gap: Texas Audiology Workforce Geographical Distribution and Sufficiency

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Objectives: To evaluate the spatial distribution of licensed audiologists across Texas and assess workforce adequacy in different regions using established healthcare provider-to-population ratios.

Design: This study examined data from 1,386 licensed audiologists in Texas during 2022. We categorized all 254 Texas counties as having sufficient or insufficient audiology coverage based on three population-to-provider benchmarks: 3,500:1 (primary care equivalent), 5,000:1 (dental care equivalent), and 10,000:1 (educational audiology standard). We then compared workforce sufficiency across Public Health Service Regions (PHSRs), urban-rural classifications, and border/non-border areas using Fisher's Exact Tests due to anticipated small cell counts.

Results: Our analysis revealed a stark disparity in audiologist distribution, with nearly two-thirds of Texas counties lacking any licensed audiologist. The majority of these underserved areas were in non-metropolitan regions. Depending on the benchmark applied, between 96% and 99.6% of counties were deemed to have an insufficient number of audiologists. Notably, every county along the US-Mexico border was classified as workforce insufficient. Significant variations in workforce adequacy were only observed among PHSRs when using the 10,000:1 benchmark ($p=0.045$). We found no statistically significant differences in workforce sufficiency based on urban-rural classification or border status.

Conclusions: This study highlights a critical shortage of audiologists across Texas, particularly in rural and border regions. These findings indicate an urgent need for strategic initiatives to address "audiology deserts" and enhance access to hearing healthcare services statewide. Potential strategies include expanding remote care options, boosting training program capacity, and implementing targeted recruitment efforts for underserved areas. Ongoing monitoring of workforce capacity is essential for informed resource allocation and future healthcare planning in Texas.

Category: Diagnostic Audiology / Otology

Poster #: 144

Clinical Feasibility of the Audible Contrast Threshold (ACT™) Test

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Objectives: Hearing-in-noise testing is an important supplement to conventional audiometry to better quantify communication function. The Audible Contrast Threshold (ACT™) test is a new assessment, developed as a way to predict aided speech-in-noise hearing ability. This test was designed as an efficient and language-independent assessment of hearing-in-noise. The purpose of the current study was to evaluate the clinical feasibility of using the ACT test across a diverse patient population.

Design: A retrospective chart review was completed on 108 patients who were administered the ACT test during a comprehensive audiometric evaluation at Henry Ford Hospital.

Results: Results show that we were clinically successful in obtaining outcomes on 100 out of 108 patients. The test was sensitive to complaints of hearing difficulty, even in those with normal audiometric thresholds (thresholds 20 dB or less). The ACT test demonstrated 100% specificity at predicting normal hearing-in-noise function, for patients with normal hearing sensitivity and no complaints of hearing difficulties.

Conclusions: In summary, the ACT test is a feasible addition to the routine clinical test battery, and it may assist providers in guiding individual patient recommendations.

Category: Diagnostic Audiology / Otology

Poster #: 145

Balancing Scientific Rigor with Community Feedback: STAR Trials Implementation Experience

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Objectives: Childhood hearing loss is a global public health concern, which is exacerbated in rural and underserved communities where nearly 75% of children have preventable hearing loss. Limited access to hearing specialists creates barriers to care. Two stepped wedge cluster randomized hybrid implementation trials (STAR: Specialty Telemedicine Access for Referrals) in rural Alaska and Kentucky are evaluating a novel model of enhanced hearing screening and school-based specialty telehealth follow-up to improve access to hearing care for school-aged children. The STAR trials are pragmatic; designed to balance the importance of community engagement and responsiveness to feedback with scientific rigor. Select findings from the first trial adaptation period are presented, and the significance of community input on the execution of pragmatic trials is discussed.

Design: The STAR trials include 88 rural schools across 14 counties in Kentucky and three regions in Alaska. The first pre-determined adaptation period followed the rollout of the enhanced hearing screening component of the STAR model. The implementation evaluation was conducted at the conclusion of screening across each participating region and included interviews and focus groups with those who were involved in implementing screening. Rapid analysis methods were used to analyze data and identify areas where adaptations were needed using the Consolidated Framework for Implementation Research (CFIR) framework.

Results: A total of 26 interviews and/or focus groups were completed across both trials in Kentucky and Alaska. Community member feedback resulted in themes related to the equipment, software, training/screening process, screening personnel, parents/children, and setting. A primary finding was that screeners faced significant challenges using the equipment which were not adequately addressed in the initial intervention. These included equipment set-up and software interface, use of a lower screening level (15 dB vs 20 dB) to meet the new global definition of hearing loss, and limited options for manual control of the automated hearing screening. From this feedback, modifications were made to the hearing screening protocol, equipment, hardware connectivity, and training/screening process. Taken together, the gravity of community input and modifications necessary to be fully responsive indicated a need to adjust the timeline of the trials. A second year was added to implement and evaluate the modified enhanced hearing screening prior to implementation of the specialty telehealth follow-up component of the STAR model. This change in trial design was iteratively discussed with investigators, biostatisticians and community members. It was determined that incorporating this change would not compromise the scientific integrity of the trials while increasing trust and strengthening engagement with community partners, who reported greater confidence in the research process and enthusiasm for participating in the trials.

Conclusions: The community-centric and pragmatic design of the STAR trials allows for adaptation to ensure responsiveness to community needs and concerns. Often, community feedback occurs after or as an aside at the conclusion of research studies. In contrast, pragmatic trials that incorporate community member input in real-time can foster deepened community buy-in and development of evidence-based interventions that are more likely to be adopted and implemented outside of the research context.

Category: Diagnostic Audiology / Otology

Poster #: 146

Electrical Hearing Thresholds in Unilateral and Bilateral Hearing Loss Patients

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Objectives: Auditory electrostimulation involves placing surface electrodes on the head proximal to the auditory system to generate an electric field. High-frequency audio carrier signals and modulation signals are combined and transmitted through external electrodes, resulting in high-fidelity auditory perception. Compared to conventional air and bone transduction, electrostimulation offers access to a broader

frequency range. By bypassing the outer and middle ear, electrostimulation allows for auditory perception in the presence of conductive hearing loss or with hearing protection. The purpose of the study was to assess equivalency between air, bone, and electrical thresholds. We determined how electrical hearing thresholds differ in patients with various degrees, types, and configurations of hearing loss. Our objectives were: (1) to assess how bone conduction thresholds and electrical thresholds were related, and (2) to compare electrical and acoustic thresholds in patients with unilateral hearing loss and patients with bilateral sensorineural hearing loss.

Design: This data was collected as part of a pilot study. There were 13 participants (6 female, 7 male). Of the patients, 7 had bilateral sensorineural hearing loss (4 with symmetrical hearing loss, 3 with asymmetrical hearing loss). The other 6 patients had unilateral hearing loss (3 with unilateral sensorineural hearing loss, 1 with unilateral conductive hearing loss, and 2 with single-sided deafness). Twenty-nine normal hearing participants (14 female, 15 male) served as controls, for whom equivalent reference levels have already been established. Acoustic thresholds (dB HL and dB SPL) and electrical thresholds (mV) were obtained at the following frequencies: 0.25, 0.5, 1, 2, 4, 8, 10, 12.5, 16, and 20 kHz. Acoustic thresholds were obtained with ER 3A inserts at the octave speech frequencies and high frequency thresholds were completed with DD450 headphones. An electrical headset was used to obtain electrical hearing thresholds. Testing was performed in a single channel placement of two electrodes on the mastoid processes with steady-state pure tones. A descending method, decreasing in increments of 0.5 mA and then increasing in increments of 0.2 mA, was used to obtain electrical thresholds in milliamps (mA) at each frequency.

Results: Preliminary results indicate that the electrical thresholds of patients with unilateral hearing loss followed their best bone thresholds and, consequently, the air thresholds of their normal hearing ear. There was no significant difference between electrical thresholds of patients with unilateral hearing loss and patients with normal hearing in both ears. Participants with bilateral sensorineural hearing loss had electrical thresholds that were greater than participants with unilateral hearing loss. The configuration of their electrical thresholds was similar to that of their hearing loss.

Conclusions: This early research promotes equivalency between acoustic and electrical thresholds. This could potentially promote the clinical use of an electrical audiometer one day. This research has clinical applications, as noninvasive electrical stimulation may be an effective means of auditory stimulation for specific populations, such as those with unilateral hearing losses. For military purposes, electrostimulation presents as an alternate mode of communication that will provide better security in field applications while allowing for use of hearing protection.

Category: Diagnostic Audiology / Otology

Poster #: 147

Lumped-Element Model of Middle-Ear Mechanics Enhances Ear-Canal Acoustic Measurements

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Objectives: A lumped-element model (LEM) of middle-ear mechanics can enhance the clinical interpretation of wideband acoustic immittance (WAI) measurements. Choosing the optimal LEM depends on clinical objectives and circumstances. This study explores how the choice of LEM is influenced by two clinical trade-offs: (1) the desire for automated diagnosis versus diagnostic insight into the underlying mechanism and (2) whether an air-bone-gap (ABG) measurement is obtainable along with the WAI measurement. For automation, a simplified LEM that focuses on ear drum vibration-modes may be sufficient. However, for etiological insight, the LEM must accurately represent vibration modes of the ear's individual anatomical structures. Additionally, when ABG measurements are available they can help optimize parameter selection of a structure-based model.

Design: WAI measurements, behavioral hearing thresholds and ABGs were collected from 71 participants including a normal hearing (NH) group and a group with varying degrees of sensorineural hearing loss (HL). Four WAI measurements were made in each ear. Two LEMs were developed: (1) a vibration-mode model (LEMvib) consisting of a nonuniform transmission line to represent ear canal acoustics and three parallel resonant branches to represent the modes of eardrum vibration and (2) an anatomical-structure model (LEMstruct) of middle-ear mechanics. LEMstruct includes the same transmission line of the ear canal along with damping, mass, and stiffness terms for the ossicles and unpropagated motion of the eardrum. It also contains the parameters incudo-stapedial joint, cochlear input impedance and ossicular lever gain. Each WAI measurement was fit to LEMvib and LEMstruct without ABG data and LEMstruct was used to predict ABGs. A variation of LEMstruct (LEMstruct+) was created that utilized ABG data during parameter selection. An additional LEMstruct model was developed (LEMstruct+) that utilized ABG data in its parameter selection and simulate the ABG with the model.

Results: The mean absolute deviation (MAD) errors for model fits to WAI data varied among the models, with LEMvib having the smallest error followed by LEMstruct, and LEMstruct+. Only LEMstruct and LEMstruct+ were capable of predicting or simulating ABGs, with LEMstruct+ being the most accurate (~1.2 dB). For automatically classifying ears as either having NH or HL, the models exhibited different levels of error, with LEMstruct performing more accurately than the others. Cumulative parameter distributions were evaluated revealing significant shifts above for ears with a mean ABG above or below the median (2.5 dB). Significant findings included increased eardrum stiffness and damping, decreased stapes stiffness, increased malleus effective-mass, decreased high-frequency notch effective-mass, and increased cochlea effective-mass.

Conclusions: These results demonstrate that the optimum LEM depends on (1) the need for automated classification and (2) the availability of ABG data. Analysis of the present WAI dataset indicates that the structural models (LEMstruct) outperformed the mode model (LEMvib) for both clinical objectives, automation, and insight, even though the vibration-mode model best fit individual WAI measurements. When ABG is available, the optimal LEM is the structure model with ABG-guided parameter selection. If ABG is unavailable, the structure-based model (LEMstruct) was optimal.

Category: Diagnostic Audiology / Otology

Poster #: 148

Listening Fatigue is Associated with Hyperacusis Symptoms in Autistic Adults

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Objectives: Autism is a neurodevelopmental condition characterized by social differences and repetitive interests, behaviors, or activities. Most autistic individuals also have sensory sensitivities, with 50-70% experiencing hyperacusis (reduced tolerance to everyday sounds) at some point in their lives. Persistent hyperacusis may lead to chronic auditory overstimulation, increased listening effort, and elevated listening-related fatigue. However, to our knowledge, no studies have addressed the fatigue that autistic individuals may experience due to auditory hypersensitivity. The present study evaluates relationships between autism traits, hyperacusis symptoms, and listening-related fatigue. We hypothesized that autistic individuals would experience more listening fatigue and more symptoms of hyperacusis relative to their allistic peers. We also hypothesized that individuals with more hyperacusis symptoms will experience more listening fatigue, irrespective of autism status.

Design: To date, we have collected data from 19 participants (age 20-35 years) with normal hearing sensitivity bilaterally between 250 and 8000 Hz. Thirteen participants had clinical diagnoses of autism spectrum disorder (ASD). We administered the Ritvo Autism Aspergers Diagnostic Scale - Revised (RAADS-R), the Hyperacusis Questionnaire (HQ), and the Vanderbilt Fatigue Scale (VFS) to assess participant's self-reported autism traits, hyperacusis severity, and listening fatigue symptoms, respectively.

Results: Questionnaire data were analyzed as continuous variables. We observed a strong, positive correlation between the RAADS-R and VFS ($r = 0.79$, $p < 0.001$, $n = 16$), suggesting that individuals with high autism traits experience more listening-related fatigue than individuals with low autism traits. We also observed a strong, positive correlation between the RAADS-R and HQ ($r = 0.85$, $p < 0.001$, $n = 16$), suggesting that individuals with high autism traits experience high levels of sound sensitivity relative to those with low autism traits. Lastly, we found a strong, positive correlation between HQ and VFS ($r = 0.81$, $p < 0.001$, $n = 19$), indicating that people with high levels of sound sensitivity also experience high levels of listening fatigue irrespective of autism traits. To support the correlational analyses, we also assessed differences in listening fatigue and sound sensitivity between allistic participants (i.e., those without an ASD diagnosis) and those who had a clinical ASD diagnosis. Two-tailed t-tests revealed a significant difference in VFS ($t(17) = -4.71$, $p < 0.001$) and HQ ($t(17) = -2.89$, $p < 0.01$) scores between groups, indicating that the autistic individuals experience higher levels of listening-related fatigue and sound sensitivity, respectively, relative to allistic peers.

Conclusions: This study indicates that autistic individuals and individuals with sound sensitivity experience significantly more listening fatigue compared to their peers. These relationships are consistent regardless of whether autistic traits are evaluated on a continuum across all participants or whether participants are grouped based on presence or absence of a formal ASD diagnosis. It is possible that autistic individuals with more day-to-day listening fatigue may become more sensitive to sound because of perpetual auditory overstimulation, or vice versa. Future research will investigate the independent contributions of listening fatigue and sound sensitivity to quality of life in autistic people as well as the effects of auditory interventions on those symptoms.

Category: Diagnostic Audiology / Otology

Poster #: 149

Bone Conducted Responses Using The Parallel Auditory Brainstem Response Paradigm

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Objectives: Auditory brainstem responses (ABRs) are used to diagnose hearing loss across multiple frequencies in infants and others who cannot participate in behavioral testing. The parallel ABR (pABR) paradigm measures response waveforms to all frequencies from 500-8000 Hz in both ears all at once, rather than serially in one ear at a time. Our data in adults show that the pABR provides thresholds more than twice as fast as serial ABR and predicts hearing loss with very high accuracy. Work so far has been with air conducted stimuli through insert earphones, but bone conducted stimuli are also an essential part of diagnosing the type of hearing loss. Although tympanometry can indicate conductive middle ear issues, bone conduction ABR is necessary to determine the relative contributions of conductive and sensorineural hearing loss. This study aimed to confirm the feasibility of bone conduction pABR.

Design: We recruited a cohort of young adults with normal hearing. An intensity series of two-channel ABRs were measured to pABR stimuli played through ER2 insert earphones as well as with a B71 bone vibrator with contralateral masking. Behavioral thresholds were also measured for both transducers to compare dB nHL correction factors. To keep sessions under 3.5 hours only one ear was tested with bone conduction. The ear with bone conduction and the order of transducers was counterbalanced across participants. Waveform morphologies for each transducer were compared by their wave V latencies and amplitudes.

Results: Responses to both transducers aligned well. Wave V latencies were similar and although the amplitudes were slightly smaller for bone conducted stimuli at lower levels, thresholds were similar for both transducers. While stimulus artifacts can be an issue with bone conduction, the steps we took to mitigate it in the pABR were effective: while a bit noisier, clear bone conducted responses were measured. Bone conducted responses to 8 kHz were weak, which was not surprising given the physics of bone conduction and the output capabilities of the bone vibrator. As expected, behavioral thresholds were higher for pABR than pure tone stimuli, and by the same median offset for both transducers. The dB nHL values differed due to the difference in reference equivalent threshold levels for inserts and the bone vibrator.

Conclusions: Air and bone conduction provided similar waveforms, indicating that bone conduction pABR is feasible. Together with establishing dB nHL values, this work represents an important step towards translating the pABR for diagnosing hearing loss.[Funded by NIDCD R01DC017962]

Category: Diagnostic Audiology / Otology

Poster #: 150

Culturally Safe Training Program to Increase Aboriginal Audiometry Workforce

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Objectives: Increasing the skilled and credentialled Indigenous ear and hearing care workforce within community can improve early detection of middle ear disease and connection to care. This can reduce the downstream consequences associated with recurrent and chronic middle ear disease and hearing loss. In Australia, in 2022, there were no Aboriginal Audiometrists and the enrolment-to-completion rate over a 4 year period (2016-2019) was 16% for any student enrolling.

Design: A novel approach was used to establish a 12 month culturally safe cohort-based training program through a university-vocational training partnership. The culturally-safe approach was modelled on the Poche 7 step model and clinical education as modelled on the approach used to train Master of Clinical Audiology students. This enabled peer-to-peer mentorship and rapidly enhances skill development, rather than heavily relying on industry support. Clinical training was also conducted within three Aboriginal Medical Services in New South Wales to strengthen clinical practice within community. Evaluation was conducted using focus groups 2 years after graduation with 7 of the original participants.

Results: 16 Aboriginal health workers or people in community enrolled in the Diploma in 2021, 11 qualified with a Diploma of Audiometry, and 1 with a Certificate IV in Audiometric Assessment (75% completion rate compared with previous completion rates of any student of 16%). Three withdrew from the course, and one is continuing. Evaluation results included challenges in the delivery of the Diploma, lack of available position in community, and the scope of the role was not fully fit to purpose. Benefits were that this provided a skilled and credentialled ear and hearing workforce within community, greater workforce sustainability than ear and hearing short-courses (circa 10 hours), a scaffolded pathway into the Master of Clinical Audiology course, and the establishment of a community of practice for the cohort.

Conclusions: The development of a culturally safe cohort-based training program is responsive to community-needs, supports sustainability of a workforce and enables timely ear and hearing care in community. This approach can be scaled beyond Australia to support community-based models of care globally.

Category: Diagnostic Audiology / Otology

Poster #: 151

Physiological Profiling of Sensorineural Hearing Loss for Predicting Speech-in-Noise Outcomes

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Objectives: Although the audiogram is the cornerstone of clinical hearing assessment, individuals with similar hearing thresholds often differ in their performance on suprathreshold listening tasks. This variation is likely related to underlying differences in cochlear pathologies that affect neural coding of sound but are hidden from the audiogram, such as cochlear synaptopathy, auditory nerve damage, and inner-hair-cell dysfunction. There is a need for non-invasive biomarkers that are sensitive to these pathologies, even when outer-hair-cell dysfunction is also present. Precision diagnostics that reflect an individual's unique profile of cochlear dysfunctions are critical for personalizing hearing loss interventions, including emerging pharmaceutical treatments. Prior work from our lab in pre-clinical chinchilla models of sensorineural hearing loss suggests that distinct cochlear pathology profiles differentially affect a battery of non-invasive biomarkers. To test the hypothesis that variations in the underlying cochlear pathologies explain individual variations in suprathreshold listening, we tested whether our battery of biomarkers predicted individual speech-in-noise outcomes. Specifically, we hypothesize that biomarker profiles will better predict speech-in-noise performance than the audiogram alone.

Design: Subjects across the continuum of normal hearing and mild-to-moderate sensorineural hearing loss completed a battery of physiological measures including distortion product and stimulus frequency otoacoustic emissions, wideband middle ear muscle reflex, envelope following responses elicited by rectangular amplitude modulated tones, and the auditory brainstem response to a high-level, high-pass click. These biomarkers were the same used in our parallel study in chinchillas. Speech-in-noise perception was evaluated using the Modified Rhyme Test materials. An unmodulated inharmonic tone complex which was spectrally matched to the target word was used as a masker to maximize peripheral interactions between the target and masker (i.e., energetic masking). To ensure adequate audibility for participants with SNHL, the speech-masker mixtures were amplified using a hearing aid simulator to approximate DSLv5 gain targets. Data collection is ongoing, but to date, 30 subjects (11 with SNHL) have been tested.

Results: Large individual variation in both biomarker profiles and speech-in-noise score were observed even across participants with similar audiometric thresholds or clinical hearing loss configurations. Measures sensitive to hidden cochlear pathologies, such as the envelope following response, were correlated with scores on the speech-in-noise task. Our preliminary results also revealed interesting differences between the physiological responses in humans and in chinchillas; for example, distortion product otoacoustic emissions were larger than stimulus frequency otoacoustic emissions in chinchillas, while the opposite was true in humans. We also see that many individuals with normal hearing sensitivity in the standard clinical frequency range (250-8000 Hz) have at least some degree of extended high frequency hearing loss, which contributes to individual differences in participants with clinically normal hearing sensitivity.

Conclusions: Preliminary results suggest that speech-in-noise perception, even when audibility of the signal has been restored, is not well predicted by audiometric thresholds alone, but that other biomarkers can help explain these sources of variability. This dataset also highlights the benefit of

coordinated cross-species studies of hearing loss and our multi-metric approach toward improving the precision of hearing loss diagnosis.

Category: Diagnostic Audiology / Otology

Poster #: 152

Addressing Barriers to Equitable Hearing Healthcare for non-English Speaking Patients

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Objectives: The World Health Organization estimates by 2050, approximately 2.5 billion people will experience hearing loss (HL), with about 700 million requiring treatment. In the United States, many of these individuals may not speak English as their first language; according the U.S. Census Bureau, ~68 million people speak a non-English language at home. This underscores the increasing need for equitable hearing healthcare. In the U.S., the most common non-English audiology word list that is used is Spanish, while many other languages either do not have validated word lists or are not available for use by audiologists. For languages in which testing material is not available, including Hmong, diagnosis and treatment of HL are often determined solely by pure-tone thresholds. This restricts the ability to assess treatment outcomes and limits best-practice recommendations for candidacy and effectiveness of hearing technology. The work presented here is two-fold: (1) Create and validate a Hmong word list for audiologic testing; and (2) Examine the current state of use of non-English word lists and identify barriers to implementation and access to these in audiology clinics.

Design: This study involved three phases. The first phase involved creating four professionally recorded phonetically-balanced monosyllabic word lists in White Hmong dialect, a language in which word lists were not available. The second phase validated the word lists with Hmong individuals with normal and HL. Third phase administered a 37-item survey that was shared with audiologists throughout the U.S., to gauge interest in and feasibility of using non-English word lists in the clinic. The survey focused on the following: (1) experience working with non-English speaking patients and medical interpreters, (2) word lists, and (3) demographics.

Results: We created four-word list, each containing 50 unique words, and were recorded by a male Hmong speaker (2 lists) and a female Hmong speaker (2 lists). The Hmong word lists were validated on bilingual 70 English/Hmong individuals with normal hearing; equivalency between recorded English word lists and the four recorded Hmong word lists was confirmed. Further testing with 48 Hmong individuals with varying degrees of HL revealed word recognition performance from 60-95% correct, following our expectation for the degree and configuration of HL as typically seen in English-speaking patients. The next step was to investigate the ability and desire of audiologists to use non-English word lists during the hearing evaluation; total of 233 respondents participated. Majority reported treating patients whose primary language is not English at least 1-5 times/month, while only 1/3 of these individuals had an interpreter available for the appointment. Additionally, 33% of survey respondents reported not even having access to recorded word lists for non-English languages.

Conclusions: This work has allowed us to develop validated audiologic testing material to expand access to healthcare for the Hmong population. Furthermore, we found that audiologists lack access to medical interpreters, and, in fact, it was the main barrier to non-English word lists during the hearing evaluation. Next steps are to addresses this barrier by developing an artificial intelligence (AI) automated scoring approach to use with non-English word lists.

Category: Diagnostic Audiology / Otology

Poster #: 153

Measuring Adaptation with Minimally Invasive Electrocochleography Techniques

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Objectives: Adaptation patterns in electrocochleography (ECochG) recordings may be useful in estimating site of lesion for auditory neuropathy (AN). Importantly, these patterns have been observed using transtympanic electrodes, a procedure only performed on pediatric patients under anesthesia. Furthermore, the literature speculates that slower presentation rates may elicit an auditory brainstem response (ABR) Wave V in some individuals with AN that originates at the inner hair cell ribbon synapse. This study evaluates the feasibility of using a novel forward masking paradigm to measure adaptation in ECochG responses while also maintaining a slow overall presentation rate. Measurements are recorded with ear-canal electrodes to determine how well responses can be visualized using an extratympanic montage. We hypothesize that measurable adaptation will be observed for the summating potential (SP) and compound action potential (CAP) measured with ECochG and for the ABR Wave V in normally hearing young adults.

Design: Data collection is ongoing. To date, participants are three normal-hearing (250-8000 Hz, bilaterally) young adults. Two stimulus conditions are tested: (1) a pair of clicks separated by 94ms of silence (unmasked); (2) the same click pair but with a 75-ms masker interjected between the clicks (beginning 15ms after the first click and ending 4ms before the second click [masked]). The masker is a broad-band noise with 10ms onset/offset ramps to eliminate any masker-evoked ABR. For both conditions, the 94ms stimulus complex is presented at a rate of 4.37/s, with click intensity = 75 dBnHL and noise intensity = 70 dB SPL. Recordings are made using an ear-canal electrode referencing the contralateral mastoid (ECochG; horizontal) or high forehead (ABR; vertical). Masked and unmasked responses are analyzed to assess: (1) relative changes in the amplitude of the SP and CAP in the horizontal recordings; and (2) Wave V latency and amplitude in the vertical recordings.

Results: Results to date suggest that forward masking induces neural adaptation. This result is evident for all participants in the ECochG CAP recordings and ABR Wave V responses to the second click in the masked stimulus. For these recordings, high pass filter settings were initially set to 100 Hz to assess overall patterns in adaptation. Despite this conservative filter setting, one participant demonstrated a clear SP and CAP in the unmasked condition. With masking, the SP revealed only a small effect of adaptation, reflecting the SP's origin as primarily a receptor potential. Importantly, the CAP measured with the forward-masked stimulus was substantially reduced, consistent wtih neural adaptation.

Conclusions: Preliminary results support the idea that a forward masking stimulus can be utilized to measure neural adaptation in ECochG and later ABR waveforms. Furthermore, results preliminarily support the use of extratympanic recordings to explore changes in the relative amplitude of SP and CAP responses to measure adaptation. Future participants will be tested using high-pass filters with 5-10 Hz cutoffs to optimize SP extraction. It is hoped that these recordings could eventually be implemented in clinical settings to provide additional information about AN site of lesion in infants without the need for sedation.

Category: Diagnostic Audiology / Otology

Poster #: 154

Exploring the Correlation Between Extended High-Frequency Thresholds and Distortion Product Otoacoustic Emissions

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Objectives: Hearing assessments typically cover frequencies up to 8 kHz, although testing can extend to 16 or 20 kHz. The range beyond 8 kHz is commonly referred to as the extended high frequency (EHF) range. This study aimed to investigate the connection between EHF hearing thresholds (HTs) and distortion product otoacoustic emissions (DPOAEs) in adult subjects. Factors such as the presence of spontaneous otoacoustic emissions (SOAEs), gender, ear side, and aging were of interest.

Design: Participants consisted of 95 adults. The age ranged from 21 to 77 years, with an average of 42 ± 14. There were 55 women, comprising 58% of the whole group. All subjects had normal middle ear function verified by 226 Hz tympanometry. None had any known history of otologic disease. DPOAEs were measured using the HearID system (Mimosa Acoustics Inc., Cham-paign, IL, USA) with an ER-10C probe (Etymotic Research, Elk Grove Village, IL, USA). DPOAEs were measured at 9 selected frequencies for F2 of 1, 1.5, 2, 4, 6, 8, 10, 12, and 16 kHz. Only ears which gave a signal-to-noise ratio (SNR) greater than 6 dB at 3 of the 4 frequencies from 2, 3, 4, and 6 kHz were analyzed.SOAEs were acquired using the in-built routine (SOAE50) provided by the HearID system, resulting in a measurement of so-called synchronized SOAEs (SSOAEs).

Results: The key findings indicate that DPOAEs, both within the standard frequency (SF) range (0.125-8 kHz) and the EHF range (10-16 kHz), decrease as thresholds deteriorate. Age significantly influences DPOAEs and HTs in both ranges, with EHFs being particularly affected. The presence of SOAEs was the only other significant factor influencing DPOAE level. Gender and ear side had minor and non-significant effects on both DPOAEs and HTs.

Conclusions: In conclusion, DPOAEs in the EHF range emerge as reliable predictors of EHF HTs, and given their correlation with age, they may serve as suitable markers for early signs of presbycusis.

ELECTROPHYSIOLOGIC RESPONSES

Category: Electrophysiologic Responses

Poster #: 155

Aging Effects on Spectro-Temporal Resolution, Cognition, and Degraded Speech Perception

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Objectives: Although aging is thought to negatively impact spectral and temporal resolution, cognition, and speech perception abilities, few studies have considered the effect of aging on all of these factors together. The goal of this study was to investigate the effect of aging on spectro-temporal resolution, cognition, and speech perception, in younger adults with normal hearing and older adults with no more than a mild-moderate high frequency hearing loss. One novel aspect of this study is that spectral and temporal resolution were examined both behaviorally and electrophysiologically in the same listeners. It was expected that older adults would have poorer performance on behavioral and electrophysiological measures of temporal, and possibly spectral, resolution as well as poorer cognitive abilities and speech perception scores. Consistent with previous studies, older adults were expected to have better vocabulary.

Design: Eighteen younger (18-23 years) and eighteen older adults (65-82 years) took part in this study. Psychophysical thresholds were obtained in the left ear at 70 or 80 dB SPL, using 3-alternative forced-choice tasks and the method of constant stimuli. The frequency discrimination and temporal interval discrimination tasks employed two 1000-Hz, 15-ms tone pips (inter-stimulus interval [ISI] 100 ms) as the standard stimulus. The signal stimuli consisted of a slightly lower frequency and longer ISI, respectively. The signal for gap detection consisted of an 800-ms band-pass noise band with a gap occurring 400 ms after onset, presented in continuous white noise. Electrophysiologically, the Acoustic Change Complex (ACC) was obtained in response to the same 800-ms gap stimulus, and in response to two 400-ms pure tones changing from 1000 Hz to a lower frequency, both presented to the left ear at 70 dB SPL. The cognitive domains of nonverbal reasoning, vocabulary, working memory, and processing speed were also assessed v

Results: Older adults had poorer performance on the QuickSIN test but not on the noise-vocoded sentences. Of the psychophysical measures, only gap detection revealed an age effect. However, older adults had longer ACC P2 latencies in the electrophysiological frequency change paradigm, and longer ACC P1, N1, and P2 latencies in the gap duration paradigm. In addition, older adults had lower scores on nonverbal reasoning, working memory, and processing speed tests, but better vocabulary, as expected. The aging effects on all but the working memory test remained after hearing thresholds were included as a covariate.

Conclusions: This study revealed aging effects on speech perception in noise, gap detection, cognition, and neural processing of spectral and temporal features of sounds, even for listeners with no more than a high frequency age-related hearing loss. These results support the notion that there are age-related declines in the neural processing of spectral and temporal aspects of sounds and in cognition, which likely underlie perceptual deficits.

Category: Electrophysiologic Responses

Poster #: 156

Attentional Components and Neural Speech Encoding in Adverse Listening Environments

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Objectives: Attention plays a vital role in speech perception, particularly in noisy listening environments. Attention is comprised of unique components (i.e., alerting, orienting, executive control, vigilance) that assist in identifying and tracking a talker of interest, all while suppressing irrelevant, competing background noise. While speech-in-noise (SPiN) perception and attention have been extensively studied, much remains unknown about how early sensory encoding and later cognitive functions, such as attention, interact to result in successful SPiN understanding. Thus, this study aimed to (1) evaluate how the components of attention relate to SPiN perception and (2) clarify the relationship between attentional components and the neural encoding of SPiN. We hypothesized that each attentional system would contribute to SPiN perception and strongly relate to cortical responses.

Design: Behavioral assessments of attention and SPiN perception were used to evaluate the relationship between discrete attentional components and speech recognition ability in 20 young, normal hearing adults. Participants completed the ANTI-Vea task to objectively measure their alerting, orienting, executive control, and vigilance abilities. Performance for each attentional component was correlated with SPiN performance to identify which, if any, measures of attention predicted SPiN accuracy. To enhance our understanding of neural processes and attentional influences underpinning speech understanding in noise, we used electrophysiologic techniques to record subcortical and cortical responses during a speech perception task. Behavioral assessments of speech understanding and attentional components were then correlated with neural responses to relate neural encoding differences to behavioral outcomes.

Results: Analyses revealed that certain attentional components, particularly alerting, relate to SPiN perception. Participants who were more accurate in identifying a target when no additional cue was presented (i.e., more challenging task) also demonstrated better SPiN perception abilities. This suggests a reliance on cognitive strategies when acoustic cues are degraded by noise. When relating neural responses to attentional components, significant relationships were noted between attention and cortical responses (i.e., N1 and P2).

Conclusions: This study provides novel insight into the complex relationship between attentional components and SPiN perception. Findings indicate that certain attentional strategies may improve an individual's ability to successfully communicate in background noise. The use of electrophysiologic

measures further contributes to understanding the brain-behavior relationship between attentional mechanisms, neural processing, and SPiN understanding. Overall, these results underscore the significance of attention in SPiN perception and suggest promising directions for future interventions to enhance speech understanding in adverse listening conditions.

Category: Electrophysiologic Responses

Poster #: 157

Comparison of 90Hz and 40Hz Next-Generation ASSR Thresholds to Behavioral Thresholds

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Objectives: The auditory steady-state response (ASSR) is a sustained phase-locked electrophysiological response evoked by a repetitive stimulus. ASSR provides a quick, accurate, and objective estimation of behavioral hearing thresholds. The new generation ASSR, which uses NB-CE Chirp stimuli, has demonstrated superior amplitude, shorter testing time, consistency across tested frequencies, resistance to sleep-state interference, and a reduced mean difference when compared to behavioral thresholds. There is a gap in the literature regarding comparing 40Hz and 90Hz new-generation ASSR protocols with behavioral thresholds. This study evaluated the relationship between new-generation ASSR thresholds obtained with 40 Hz and 90 Hz protocols and compared them to behavioral thresholds. We hypothesized that the 40 Hz protocol would yield lower and more accurate thresholds at lower frequencies than the 90 Hz protocol.

Design: The study recruited 15 normal-hearing participants from the local population. A two-channel recording montage was utilized. The non-inverting electrode was placed at the forehead at the hairline, two inverting electrodes were placed on each mastoid, and the ground electrode was placed on the mid-forehead. ASSR recordings were completed while the subject relaxed or, in most cases, slept on a recliner. Multiple-Stimuli ASSR were recorded for 40Hz and 90Hz protocols via insert earphones. Behavioral thresholds were obtained through a modified Hughson and Westlake procedure and compared with ASSR thresholds obtained using the 40Hz and 90Hz protocols.

Results: The preliminary analysis indicates that the 40Hz ASSR exhibited lower thresholds than 90Hz ASSR at 500Hz and 1000Hz, averaging 15 dB and 10 dB lower, respectively. However, at 2000Hz and 4000Hz, the 40Hz and 90Hz ASSR protocols displayed comparable thresholds. The difference between ASSR and behavioral thresholds is reduced for 40Hz compared to 90Hz ASSR protocols at 500Hz and 1000Hz, but similar results were obtained for 2000Hz and 4000Hz.

Conclusions: This study affirms the stability and precision of the new-generation 40Hz ASSR protocol, mainly when applied in an asleep protocol. The 40 Hz ASSR thresholds closely align with behavioral thresholds, maintaining consistency within a 5dB range across 500Hz to 4000Hz. These robust outcomes stem from generating larger amplitude responses using the 40Hz protocol. These findings advocate for incorporating a dedicated 40Hz protocol or a hybrid strategy, incorporating 40Hz for lower frequencies

and 90Hz for higher frequencies in clinical assessments. Additionally, these research results highlight the urgent need for a comprehensive large-scale assessment to gauge the effectiveness of the new-generation 40Hz protocol in assessing infants' ASSR.

Category: Electrophysiologic Responses

Poster #: 158

Alpha-Band Power Measured Across Different Speech Reception Thresholds

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Objectives: Electroencephalographic (EEG) activity in the alpha-band (8-12 Hz), commonly observed to increase with the difficulty of speech-in-noise (SiN) tasks, has been considered as a neural proxy for listening effort. Previously, we have demonstrated that alpha-band activity in hearing aid wearers follows the expected difficulty of the different SiN test conditions included in an integrative SiN assessment known as the Repeat-Recall Test (RRT). However, whereas it was expected that alpha-band power would change non-monotonically across the test's signal-to-noise ratios (SNRs), reflecting less effortful listening at the most positive SNR and loss of motivation to listen at the most negative SNR, we instead observed alpha power to increase with decreasing SNR and plateau at SNRs of 0 and -5 dB. Here we assess whether the use of fixed SNRs might have obfuscated expected non-monotonic relationships between alpha-band power and background noise levels. Specifically, we use a Bayesian-guided algorithm to estimate listeners' SiN psychometric functions (PFs) for the RRT speech materials and extrapolate the SNRs corresponding to each listener's speech reception thresholds (SRTs) for different levels of understanding. We then test listeners SiN abilities at fixed SNRs corresponding to these SRTs while measuring EEG activity in the alpha-band. We expect alpha power to be maximal at SRT-75 where following speech in the background noise is moderately challenging, and lower both at SRT-90 where it should be less effortful and SRT-50 where understanding would be unlikely to support real-life communication.

Design: Twenty older adult listeners with NH and 20 with HI were recruited to participate in the study. Target RRT sentences were presented at a fixed level of 68 dBA SPL from a single loudspeaker positioned 1 m directly in front. Bayesian-guided PF estimation was conducted over 32 sentence presentations with co-located background maskers, either speech-shaped noise (SSN) or two-talker babble noise (2TBN), presented at varying levels corresponding to SNRs selected by the test algorithm. In addition, listeners were tested using RRT sentences with either high or low availability of sematic context. All listeners were then tested with 32 sentences at fixed SNRs corresponding to their individualized SRTs for 50, 75, and 90% performance at each combination of masker type and context availability. Listener EEG activity was measured during this fixed SNR phase. Listening effort outcomes were also surveyed after each sentence block in the fixed SNR condition.

Results: Data collection is presently ongoing. Linear mixed effect models will be used to evaluate alpha-band power across the three SiN performance levels (i.e., SRTs) as measured from NH and HI listeners for SSN and 2TBN types as well for high and low context RRT sentences. Planned analysis will also compare alpha-band power to listeners' ratings of listening effort across the different test conditions.

Conclusions: Targeting specific performance levels (i.e., SRTs) for different listeners and test conditions might help to reveal expected non-monotonic relationships between exerted listening effort and expected task difficulty. Study results could further inform which performance level(s) should be targeted to maximize exerted effort in NH versus HI listeners.

Category: Electrophysiologic Responses

Poster #: 159

Auditory Processing in Down Syndrome: EEG Source Localization Using Individual MRI-Based Head Models

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Objectives: Previous EEG studies show some evidence that individuals with Down syndrome (DS) exhibit auditory processing deficits attributed to peripheral hearing loss and brain structural atypicality, but the neural sources underlying these deficits remain unclear. The sparse literature using EEG source localization to investigate neural generators relies on generic head models based on the average brain anatomy of typically developing (TD) adults. The use of realistic head models derived from the individual subject MRI scans has been shown to dramatically improve the accuracy of EEG source estimates. This study evaluates the technical feasibility of using individual-specific head conductivity models for EEG source estimation to explore neural generators linked to altered auditory processing in young adults with DS. Our ongoing EEG study examining cortical auditory evoked potentials (CAEPs) in DS shows enhanced P2 peak amplitudes at the sensor level, suggesting compensatory top-down processes. We hypothesize that EEG source estimates of P2 responses will show more distributed cortical activations in adults with DS than in TD adults.

Design: We analyzed data from a small group of young adults with DS and age-matched TD controls, from 128-channel EEG recordings with sensor digitization and high-resolution structural MRI scans. Auditory stimuli consisted of high- and low-frequency /s/ and /m/ phonemes presented monaurally in randomized order. EEG data preprocessing was done in EEGLAB software with attention to rigorously mitigating artifacts. Anatomical segmentation of T1-weighted MRI scans was performed using FreeSurfer software. Brainstorm software was used for source localization analyses. Individual-specific head models were constructed using MRIs and carefully co-registered with digitized sensor locations to account for structural brain differences in DS. Minimum-norm imaging was used for source estimation with focus on CAEPs, specifically the N1 and P2 components, using current source density (CSD), standardized low-resolution brain electromagnetic tomography (sLORETA), and dynamic statistical parametric mapping (dSPM).

Results: The construction of individual-specific head models needed considerable manual adjustment for participants with DS compared to those of TD adults, which often showed good head models with default parameters. After these adjustments, co-registration was acceptable for the DS group. There were method-specific differences; sLORETA revealed more widespread activity, whereas dSPM provided spatially focused results. Preliminary results using dSPM show that TD adults exhibit focal activation in auditory cortices associated with P2 responses. DS participants, however, exhibited larger P2 amplitudes, with broader cortical activation across auditory and frontal regions.

Conclusions: We demonstrated the feasibility of employing individual MRI-derived subject-specific head models for EEG source localization in young adults with DS. Challenges in head model construction and sensor co-registration in movement artifact-prone data from individuals with DS underscore the need for careful methodologies when working with atypical populations. Our preliminary findings of more distributed cortical activations associated with the enhanced P2 amplitudes observed in individuals with DS support the compensatory neural resource allocation hypothesis in DS during auditory speech processing. With ongoing data collection and refinement in source modeling parameters, we anticipate a more comprehensive understanding of the neural dynamics of auditory cortical processing in DS, and associations with hearing loss profiles. [Work supported by NIH-NIDCD R01 DC019511 to R.Y. Litovsky, A. Alexander, and S. Hartley and by a core grant from NIH-NICHD to the Waisman Center (P50HD105353)].

Category: Electrophysiologic Responses

Poster #: 160

Multiband Auditory Brainstem Responses Evoked by Audiobooks

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Objectives: Auditory brainstem responses (ABRs) are used to identify hearing loss across multiple frequencies. We recently created a multiband peaky speech method that evokes ABRs for octave-band frequencies from 500-8000 Hz using continuous speech from narrated stories. Using an engaging story may facilitate hearing screening and evaluation of amplified speech in infants and toddlers who cannot nap, sit still, or participate in behavioral testing. But our previous work showed that testing can take over 30 minutes for some folks, often due to the broader and smaller low-frequency ABRs taking longer to reach a decent signal-to-noise ratio (SNR). For those folks whose low-frequency responses take longer to visualize/acquire, we could combine the two lowest bands (500 and 1000 Hz) to increase response size, which would facilitate a more feasible recording time for children. This study aimed to compare the effectiveness of the different stimulus versions (all bands vs combined low-frequency bands) to evoke robust ABR responses in the fastest recording time.

Design: Eighteen adults with normal hearing listened to 2 hours of narrated speech from audiobooks with randomly interleaved 10-second segments of stories made with 10-band (500, 1000, 2000, 4000, 8000 Hz in both ears) and 8-band (combined 500/1000, 2000, 4000, 8000 Hz in both ears) multiband peaky speech. The multiband peaky speech was created with the fundamental frequency shifted to 90 Hz

and a chirp-phase profile, which we have shown maximizes amplitudes of multiband ABRs to continuous speech. Two-channel ABRs were recorded while the participants reclined in a darkened sound-treated room and listened to the stories through ER2 insert earphones. Response wave V amplitudes and latencies were compared, as well as response SNR and the time for the responses to reach a 0 dB SNR criterion.

Results: As expected, the low-frequency ABR wave V amplitudes - and thus, response SNRs - were largest for the 8-band stimuli and smallest for the 10-band stimuli, although several participants still had robust ABRs for the 10-band stimuli. Only ~25 minutes was required for all 10 ABRs (5-bands in 2 ears) to reach 0 dB SNR in 13 of 18 participants (70%). For the remaining 5 participants, using the 8-band stimuli most effectively evoked robust ABRs within 30 minutes. However, averaging the 500 and 1000 Hz multiband ABRs evoked by the 10-band stimuli also increased response SNR and reduced testing time to under 40 minutes for 3 of the 5 participants.

Conclusions: Measuring octave-band ABRs to audiobook stimuli is possible within 25 minutes for most participants with normal hearing. A 10-band version can evoke all octave-band ABRs from 500-8000 Hz for 70% of participants. For most folks with very small or broad low-frequency ABRs, averaging the two low-frequency band ABRs can improve response detection, thereby reducing testing time. However, the 8-band version appears the most efficient way to ensure detectable multiband ABRs are measured in under 30 minutes in folks with normal hearing. Having reasonable recording times will be necessary for facilitating this method's future application as a hearing screener.[Funded by Hearing Health Foundation ERG #972469]

Category: Electrophysiologic Responses

Poster #: 161

Neural Encoding of Extended High-Frequency Stimuli: Implications for Speech Perception

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Objectives: Many individuals with normal audiograms experience elevated thresholds in the extended high frequencies (EHFs: > 8 kHz), suggesting subclinical cochlear damage that is typically undetected during standard hearing tests. Estimates indicate that EHF hearing loss occurs in 19% to 56% of young adults with normal audiograms, highlighting its prevalence among those considered to have normal hearing. Despite this, the physiological and behavioral consequences of EHF loss remain unclear, with many individuals reporting difficulties in speech understanding despite normal audiometric results up to 8 kHz. EHF loss may contribute to "hidden hearing difficulties," which are often overlooked in clinical settings.Most existing studies suggest that speech perception difficulties associated with EHF loss arise from subclinical cochlear damage in the standard frequency range; however, no studies have investigated how the auditory nervous system extracts useful information from the EHF range. The primary purpose of this ongoing experiment is to examine whether listeners with normal and abnormal EHF hearing differ in their abilities to extract information from standard and EHF ranges of acoustic signals.

Design: Thirty normal hearing listeners (mean age, 25; range, 18-35 years) participated in the study. ASSRs were evoked using 40 Hz amplitude-modulated tones (100% and 63% AM depth) at carrier frequencies of 4, 8, 10, 12, and 16 kHz. Behavioral speech recognition thresholds in noise were assessed using the digit triplet test with three sets of stimuli: 1) original recorded digit stimulus, 2) high-pass filtered stimulus with energy above 4 kHz, and 3) low-pass filtered stimulus with energy below 8 kHz. A multiple linear regression analysis was conducted to examine the effects of carrier frequency, modulation depth, and EHF thresholds on 40 Hz ASSR amplitudes. Additionally, predictive relationships between EHF thresholds and ASSR amplitudes were assessed.

Results: Preliminary data analyses from this ongoing study suggest that EHF ASSRs are measurable up to 12 kHz. Initial findings indicate that EHF thresholds more effectively predict ASSR strength for EHF versus standard carrier frequencies. Participants with EHF loss exhibited reduced EHF ASSR relative to standard carrier frequencies, with 63% modulation depth showing a greater impact than 100% modulation depth. We anticipate that both EHF thresholds and ASSR amplitude strength will correlate with speech-in-noise perception.

Conclusions: This study indicates that the auditory nervous system effectively encodes amplitude-modulated signals from EHF carrier frequencies, with EHF thresholds serving as significant predictors of EHF ASSR strength. This project is a first step in understanding how acoustic features (e.g., envelope cues) are extracted from the EHF range.

Category: Electrophysiologic Responses

Poster #: 162

Optimization of Test Time for the Auditory Brainstem Response

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Objectives: The Auditory Brainstem Response (ABR) can be elicited by click or chirp stimulation, two commercially available broadband stimuli. Multiple studies have repeatedly confirmed that chirps elicit better neural synchrony than clicks, and hence chirp-elicited ABRs are greater in response amplitude than click-elicited ABRs. However, it remains unclear if this observed advantage for the chirp translates to shorter test times for the chirp- vs. the click-evoked ABR. In this study, we aim to describe test times associated with chirp- and click-evoked ABR testing using statistically-based signal-to-noise ratio (SNR) criteria to define the presence of a response. Based on the evidence to date contrasting the click- and chirp-evoked ABR, we hypothesize that the chirp-evoked ABR will reach the target SNR level in a shorter time than the click-evoked ABR.

Design: ABRs were collected using click and chirp stimuli on 20 adults with normal hearing sensitivity. Participants were recruited from the Towson University student community. Three SNR metrics [Split-Sweep Average-based SNR (SSA-SNR), Fsp, and Fmp] were tracked in each waveform at sweep count

increments of 10 sweeps from 0 to 2000 sweeps at nine stimulus intensities (0-80 dB nHL in 10 dB increments). The lowest sweep count at which predetermined criteria levels for SSA-SNR, Fsp and Fmp were met was recorded for each waveform. This sweep count was divided by the stimulus rate to obtain an estimate of the time taken in seconds to reach the predetermined SSA-SNR, Fsp, and Fmp levels.

Results: Preliminary descriptive results indicate chirp-elicited ABRs reach comparable values of SSA-SNR, Fsp, and Fmp at a lower sweep count than click-elicited ABRs. Based on this initial analysis, the average differences in sweep counts between the chirp- and click-elicited ABRs were between 100-300 sweeps, resulting in time savings of 4.73-14.21 seconds. Further inferential statistics using a two-way repeated measures ANOVA will be conducted to describe the effects of varying stimulus type and stimulus intensity level on ABR test time.

Conclusions: A fundamental barrier preventing routine clinical use of the chirp in ABR testing is that there are almost no large volumes of normative data confirming the advantage of this stimulus, particularly as it pertains to test time. Adding to the literature in this area is the first step towards the use of chirp-evoked ABR testing in screening and diagnostic hearing tests. Initial results of the current study suggest that chirp-elicited ABRs are associated with a shorter test time than click-elicited ABRs. Further, identifying time-efficient techniques for hearing acuity assessments in listeners with normal hearing sensitivity lays the foundation for determining if the chirp can offer similar benefits for patients, particularly pediatric populations, with hearing loss. Clinically, such benefits could translate to easier and faster detection of hearing acuity using the chirp, which could have significant implications for both diagnostic and screening ABR tests for both the patient and provider.

Category: Electrophysiologic Responses

Poster #: 163

Impact of Cochlear Nerve Degeneration on Speech-in-Noise Discrimination

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Objectives: Studies from animal models and human temporal bones show that outer hair cell loss can be preceded by loss of synaptic connections between the inner hair cells and a subset of auditory-nerve fibers (ANFs). The silencing of these neurons with high thresholds and low spontaneous rates (SR) degrades auditory processing and likely translates into a variety of perceptual abnormalities, whether or not sensory cell function is compromised. In normal-hearing listeners, we found that different electrophysiological measures of cochlear nerve degeneration (CND) were correlated with performance on a list of 50 words from the NU-6 corpus presented with time compression and reverberation. Here, we examine if these deficits in performance are consistent with a preferential loss of low- and medium-SR fibers using a computational model of the auditory periphery.

Design: The Zilany, Bruce, & Carney (2014) model of the peripheral auditory system was used to simulate the responses of ANFs from different SR groups: low (0.1 spikes/s), medium (5 spikes/s) and high (100 spikes/s). ANF population responses were simulated by adding instantaneous firing rates of 12 fibers

(with 40% low- or medium-SR types) between 0.125 and 16 kHz. CND was modeled by reducing ANF numbers from different SR groups. To quantitatively compare the simulated ANF response to speech stimuli, a time-domain waveform of individual words from the NU-6 corpus was inputted to the model. The output of the model was compared against the wavelet spectrogram of the stimulus using two-dimensional correlation analysis. To enhance temporal alignment between the stimulus spectrogram and the simulated neurogram analysis, spike latencies at each CF were adjusted for cochlear delays.To evaluate the perceptual consequences of CND, we trained a speech recognition neural-network to recognize the simulated ANF responses to the speech stimuli for different degrees of CND in absence of outer hair cell dysfunction.

Results: Correlation coefficients between speech stimulus spectrograms and simulated neural responses varied as a function of SR and stimulus presentation level: at higher SPLs (90 dB SPL), words with time compression and added reverberation were better represented by low- and mid-SR fibers ($p<0.001$) when compared to high-SR fibers. A loss in speech recognition performance was also found using a trained neural network when low- and medium-SR fibers were reduced in number.

Conclusions: Using computational models of the peripheral auditory system, we show that the loss of low- and mid-SR fibers is consistent with deficits in speech recognition performance on difficult tasks.

HEARING LOSS / REHABILITATION

Category: Hearing Loss / Rehabilitation

Poster #: 164

Web-Based Hearing Screening/Auditory Wellness Tool

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Objectives: The objectives of the study were; 1) to provide a tool for consumers to evaluate their perceived hearing difficulty and 2) to investigate the proportion of respondents in the normal, mild and moderate auditory wellness categories currently wearing hearing aids.

Design: A slightly modified version of HHIE-S was completed by individuals visiting the Hearing Industries Association website from March to December 2023. During the 10-month period that followed 6000 unique visits to the site were logged. Duplicate visits were noted and deleted for the current analysis.

Results: A total of 6586 unique visitors were logged, with HHIE scores ranging from 0 to greater than 26. For the entire group 1212 (18%) indicated they were currently wearing hearing aids. Within the group reporting no difficulty (score<10) 129 respondents were wearing hearing aids, For those in the mild-moderate group (score 10-24) 14.4% reported hearing aid use, while and the group reporting the most severe hearing difficulty (score>26) had the highest percentage of hearing aid wearers at 35.2%. These data are consistent with recent reports on adoption of hearing aids in MarkeTrak22. It was also notable

that many hearing aid wearers continue to experience situational and psychosocial challenges post-fitting of their devices.

Conclusions: The results of the study are consistent with reported usage of hearing aids for the significant difficultly group. Secondly, the most widely reported reason for acquiring a hearing aid was, "a test that showed I needed them (MarkeTrak22)." Third, it is important that consumers looking for a method of evaluating their perceived hearing loss/auditory wellness have a reliable, valid, and accessible way of self-evaluating. It is notable that many hearing aid users continue to exhibit difficulty in various environments as scores exceeded the no difficulty range (>10.0) for a high proportion of respondents. This finding underscores the need to continue to monitor patients for follow up and provide additional instruction, or accessories to assist in difficult environments, or when individuals begin to socially disengage because of difficulty self-managing in selected listening situations. Our data suggest that a significant proportion of hearing aid users continue to experience difficulty underscoring the important role of audiologists in on-going management of hearing aid users.

Category: Hearing Loss / Rehabilitation

Poster #: 165

Increasing Access to Hearing Care in Residents of Assisted Living

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Objectives: Implementation science is "the study of methods to promote the systematic uptake of research findings and other evidence-based practices into routine practice" (Eccles & Mittman, 2006 p.1). The application of scientifically valid implementation science frameworks in audiology has significant potential to reduce the research-to-practice gap in our field and strengthen the impact of evidence-based practices (EBP) and programs on hearing health care. The objective of this study is to design and implement a hearing health care program for residents of an assisted living community using a stage-based implementation science methodology.Eccles, M. P., & Mittman, B. S. (2006). Welcome to Implementation Science. Implementation Science, 1(1), 1. doi: 10.1186/1748-5908-1-1

Design: Research design and methods in implementation sciences is a nonlinear iterative process constrained by the contextual barriers of the setting, in this case, an assisted living community. The design of our study uses a stage-based method from the National Implementation Research Network (NIRD). Each stage guides the implementation processes and strategies we use to effectively implement a hearing health EBP. The four stages of the NIRD model include: (1) Exploration - assessing the fit between the needs of our community partner and the proposed EBP; (2) Installation - building the infrastructure and methodology to support the EBP; (3) Initial implementation - the first use of the EBP to provide hearing health care; and (4) Full Implementation - skillful use, acceptability, and support for the EPB.

Results: The results of our study are reported as outcomes of our activities to date in Stages 1 and 2 of the NIRD model. Stage 1: Exploration Outcomes - formed a trusted university-community implementation team to support the EBP; demonstrated the need for the EBP and identified five barriers to implementation; obtained buy-in from our community partner and agreement to move forward. Stage 2: Installation Outcomes - trained research team to perform basic otologic exam; developed a process for boothless hearing screening; created and selected measures for assessing cerumen impaction, quality of life, and hearing aid literacy of residents; created a RedCap repository for data collection and management; recruited residents; created communication feedback loops between community partner and research team.

Conclusions: Using implementation science and an established stage-based model our team was able to develop a trusting relationship with assisted living residents and leadership with the mutual goal of implementing evidence-based practices in audiology to improve hearing health care. We identified context-dependent barriers to EBP experienced by the assisted living community and developed a responsive hearing health care program to bridge the gap between well-established practice for identification and treatment of hearing loss and implementation of these practices in clinical care of residents. Under-detection of hearing loss and under-use of hearing devices among residents of assisted living facilities is a significant healthcare disparity, placing older adults at an increased risk for dementia, falls, and depression. Establishment and scale-up of an implementation process to identify and treat hearing loss in this vulnerable and growing population of adults has significant clinical implications for improving equity in hearing health and decreasing hearing-related comorbidities.

Category: Hearing Loss / Rehabilitation

Poster #: 166

Association Between Suspected Noise Exposure and Medicare Claims for Audiometry/Tympanometry

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Objectives: Despite a high prevalence of age-related hearing loss, hearing healthcare is under-utilized. Low utilization has been attributed to accessibility, cost, and stigma, but the etiology of hearing loss may also drive utilization. Noise exposure damages auditory synapses, causing processing difficulty distinct from age-related hearing loss. Existing literature has focused on socioeconomic barriers to hearing care utilization, but few studies have investigated noise exposure in population-based cohorts. We hypothesize that noise exposure is associated with increased hearing care utilization.

Design: The study population was derived from a cross-sectional sample from Visit 6 (2016-2017) of the Atherosclerosis Risk in Communities (ARIC) Study, with Medicare claims linked to ARIC data. Of the 3,998 participants who attended Visit 6, 1,985 had Medicare records. Hearing care utilization was measured by participants' Medicare claims for audiometry and tympanometry. Pure-tone air conduction audiometry was added to ARIC at Visit 6. Participants missing audiometric (n=400) and key demographic (n=130) data were excluded, leaving a sample of 1,455. A suspected noise exposure algorithm, developed by Deal, Jiang, and Reed (manuscript in preparation), was created to identify noise "notches" on the audiogram. This algorithm accounts for biological variability and age-related hearing loss, and it was verified against self-reported noise exposure questions (e.g., occupational and recreational activities). Descriptive statistics describe demographic characteristics. Multivariable robust Poisson regression models were used to estimate associations between hearing/noise exposure status and hearing care utilization, producing prevalence ratios and 95% confidence intervals.

Results: Participants were 62% female and 24% black, with an average age of 79.1 years. Nearly 30% of the participants had hearing loss (pure-tone average greater than 25 dB in the better hearing ear). In the primary model (adjusted for age, sex, race, education, marital status, income, Medicaid use, Veteran status, urbanity, and Area Deprivation Index percentile), hearing loss was independently associated with a twofold greater prevalence of hearing care utilization relative to those without hearing loss and noise exposure. Noise exposure alone was not associated with increased hearing care utilization. However, having both hearing loss and noise exposure was associated with a 2.8-fold increase in hearing care utilization relative to those without hearing loss and noise exposure. This joint effect was used to evaluate the interaction between hearing loss and noise exposure on both the additive and multiplicative scales. There was evidence of positive interaction on both scales, meaning that having both hearing loss and noise exposure was associated with a greater prevalence of hearing care utilization than expected from either factor alone.

Conclusions: Suspected noise exposure (presence of a noise notch) was not significantly associated with increased hearing care utilization (Medicare claims for audiometry and tympanometry). In other words, people with noise exposure were not more likely to utilize hearing care compared to those without noise exposure. Future work will explore this association using self-reported noise exposure measures, including speech-in-noise data, to better understand the interaction of peripheral and central hearing processes on hearing care utilization in a population-based cohort. Understanding and preventing negative outcomes associated with hearing loss is important from a public health perspective to address disparities and target groups at risk for underutilizing care.

Category: Hearing Loss / Rehabilitation

Poster #: 167

Six Year Prevalence and Incidence of Hearing Loss in Baby-Boomers

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Objectives: Numerous cross-sectional studies have associated hearing loss with a wide range of demographic, physical and mental health factors. Few studies to date have reported on the incidence of hearing loss, and the association that progressive hearing loss has with demographic and other health factors. This objective of this study was to examine the 6-year progression of hearing loss in middle-aged adults, and its association with other variables.

Design: The Busselton Healthy Ageing Study (BHAS) is a population study of Baby Boomers (born 1946 to 1964), who were assessed between 2010 and 2015 and again between 2016 and 2022. Pure tone audiometry, and data on physical and mental health were available for 3599 participants. Audiometry data were summarised by calculating the better-ear four-frequency average (BE4FA). Hearing loss was also classified using World Health Organisation classifications. Linear mixed models were applied to examine the associations between the change in BE4FA and age, sex, body mass index, occupational noise exposure and use of hearing protection, tinnitus, chronic ear infection, smoking, diabetes, cardiovascular disease, and a general health score.

Results: Over the six years, participants with WHO-classified normal hearing reduced from 86.0% to 73.9%, with the percentage of those with mild HL increasing from 12.1% to 20.6%, and those with moderate and greater HL increasing from 2.0% to 5.5%. The six-year incidence of hearing loss i.e. a progression from normal to mild or greater hearing loss was 17.2%.The adjusted linear mixed model showed significant associations with a 6-year change in BE4FA with older age, male sex, a history of chronic ear infection and self-report of tinnitus.

Conclusions: Over six years, close to 20% of those with normal hearing at baseline progressed to a significant hearing loss. The number of those who could potentially benefit from hearing aids almost tripled. This information can be used by clinicians when counselling their clients about their prospective hearing loss.

Category: Hearing Loss / Rehabilitation

Poster #: 168

Discrimination Towards Individuals with Hearing Loss

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Objectives: Stigma, that is, negative attitudes/beliefs, towards individuals with hearing loss, is common. It is possible that stigma could lead to negative behaviors, that is, discrimination, towards individuals with hearing loss. This study aims to determine whether individuals with hearing loss faced greater challenges related to discrimination, in terms of respect, perceptions of intelligence, and fairness in the workplace.

Design: This cross-sectional study included adult participants from the Survey of the Health of Wisconsin (SHOW) between 2008 and 2013. SHOW is a statewide household-based health examination survey collecting comprehensive data on demographics, health and health care utilization, and more. The determinant of interest was self-reported hearing loss. Outcomes were derived from three questions from a discrimination questionnaire and were related to participants being treated by others i) without respect, ii) as though they were not smart, and iii) unfairly at work. We used logistic regression models to determine whether self-reported hearing loss was associated with the three discrimination outcomes. First, we adjusted for age and gender, and next, we additionally adjusted for race/ethnicity and education. Results are presented as odds ratios (OR) with corresponding 95% confidence intervals (95% CI).

Results: A total of 2,954 participants were included in analyses. Participants had a mean age of 48.0 (SD=14.4) years; 56.4% of the respondents were female, and 87.4% were non-Hispanic white. The prevalence of self-reported hearing loss was 30.5%. For the outcomes, 23.6% reported being treated without respect, 21.8% reported being treated as though they were not smart, and 39.4% reported being treated unfairly at work. Hearing loss (vs none) was associated with higher odds of experiencing treatment without respect (OR=1.40, 95% CI=1.15, 1.81) in age- gender adjusted models, and this association remained after full adjustment (OR=1.46, 95% CI=1.20, 1.78). Hearing loss (vs none) was also associated with higher odds of experiencing treatment as though they were not smart in both age-gender adjusted (OR=1.48, 95% CI= 1.21, 1.82) and fully adjusted (OR=1.54, 95% CI=1.25, 1.90) models. Lastly, hearing loss (vs none) was associated with higher odds of being treated unfairly at work in age-adjusted (OR=1.28, 95% CI: 1.08, 1.52) and fully adjusted (OR=1.34, 95% CI: 1.13, 1.59) models.

Conclusions: Overall, the findings suggest that individuals with hearing loss experience higher levels of perceived discrimination in several areas, particularly in respect, perceived intelligence, and workplace treatment. Future analyses will determine whether these relationships vary by demographic factors, including age (at examination) and self-reported age of hearing loss onset.

Category: Hearing Loss / Rehabilitation

Poster #: 169

Hearing-Related Communication Strategies and Reasons for Their Non-Use

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Objectives: To develop and evaluate a communication strategies intervention that is tailored to the needs of individual patients and their willingness to use particular strategies. To this end, we identified the hearing-related communication strategies (a) used by people with hearing loss (PwHL), (b) used by communication partners of PwHL, and (c) recommended by audiologists and we examined the reasons given by PwHL for not using particular strategies.

Design: Ninety-five PwHL and 49 communication partners of PwHL used open-ended text to describe communication strategies they use, and communication behaviours they find particularly helpful or problematic. Eighty-six audiologists described the communication strategies they most often recommend to patients, and which they think their patients find most useful. A further 103 PwHL rated how obvious each strategy is for facilitating communication, how often they use each strategy, and for rarely/never used strategies, the reasons why they do not use them.

Results: Survey responses were analysed using a combination of descriptive statistics for closed-set items and inductive qualitative content analysis for the open-ended responses. Our qualitative analyses indicated 12 categories of strategies in use (e.g. use of facial information, adapting the physical space), most of which were noted by each participant group. However, some were favoured more by PwHL (e.g. use shorter sentences, rephrase), some by communication partners of PwHL (avoid conversation in difficult environments, use humour), and yet others by Audiologists (use context, self-advocate). Preliminary analyses suggest the reasons provided for non-use of strategies fall into 3 themes (Self, Others and Utility) with the former two having multiple subthemes. The Utility theme addresses the overarching notion that the strategy simply does not work. For the Self theme, the subthemes were 'I can't do it', 'It is anxiety-provoking', 'It would reflect negatively on me, is stigmatizing', 'I don't want to draw attention to my hearing problem' and 'It's not my responsibility'. For the Others theme, the subthemes were 'Others won't do it for me', 'Others can't do it', 'I am concern about how others may feel doing it', 'I don't want to change the experience of others', and 'My problem shouldn't impact others'.

Conclusions: Most of the strategies identified were noted by all three participant groups, although there was variability both within and across the groups. The themes identified regarding reasons for non-use of strategies highlights an opportunity for education of both PwHL and audiologists. Specifically, PwHL may benefit from education around self-advocacy, self-efficacy and hearing aid self-management, while audiologists would benefit from understanding their patients' willingness to engage with particular strategies and how to engage patients in discussion about communication strategies. Further, the considerable variability among PwHL regarding their preferred strategies emphasizes the need for individualised, rather than generic, communication strategies counselling.

Category: Hearing Loss / Rehabilitation

Poster #: 170

Therapeutic Effectiveness of Atresiaplasty Compared to Osseointegrated Bone Conduction Devices

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Objectives: External auditory canal reconstruction and placement of an osseointegrated bone conduction device (OBCD) are both options to restore hearing in children with congenital aural atresia. While OBCDs have been reported to provide superior hearing thresholds, previous literature has not taken OBCD utilization into account. We aimed to compare total access to sound in congenital aural atresia patients who underwent atresiaplasty or placement of an OBCD.

Design: A retrospective cohort study at a single tertiary academic center of pediatric patients with complete or partial congenital aural atresia. The primary aim was to compare the therapeutic effectiveness of atresiaplasty and OBCD. To do so, mean disease alleviation (MDA) of the air conduction pure tone average (AC PTA) was calculated based on post-operative change in air conduction thresholds with weighting of the hearing benefit based on device usage in the OBCD cohort.

Results: A total of 169 pediatric patients (56.2% male, 83.4% complete) with congenital aural atresia were identified. The most common hearing intervention was atresiaplasty (33.7%) followed by softband BAHA (27.8%), OBCD (26.0%), no intervention (12.4%) and behind the ear hearing aid (1.8%). 45 ears treated with atresiaplasty and 38 ears implanted with an OBCD were found to have complete pre- and post-operative audiometric data and were included in the analysis. The improvement in AC PTA after OBCD was higher compared to atresiaplasty (59.6% vs 37.1%, $p< 0.001$). However, MDA of AC PTA was greater in the atresiaplasty cohort compared to OBCD (37.1% vs 23.0%, $p = 0.001$). When considering only complete aural atresia cases, MDA remained higher in atresiaplasty compared to OBCD (34.8% vs 22.2%, $p = 0.013$). Multivariable regression accounting for clinical and sociodemographic co-variates also demonstrated a higher MDA for atresiaplasty compared to OBCD ($p = 0.01$).

Conclusions: In select patients with aural atresia, external auditory canal reconstruction may provide improved hearing benefit compared to OBCD due to variable utilization of an external device.

Category: Hearing Loss / Rehabilitation

Poster #: 171

Changes in Audiology Visits Following FDA Over-the-Counter Hearing Aid Ruling

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Objectives: In 2022, the Federal Drug Administration (FDA) permitted the sale of over-the-counter (OTC) hearing aids nationwide. This led to a concern that demand for audiology services would decrease. The purpose of this study is to determine if there has been a change in volume of hearing aid evaluations (HAEs) and audiologic exams at an academic tertiary care audiology practice following the ruling.

Design: This is a retrospective quality improvement study. Data was collected from the billing records of a tertiary academic audiology practice for patients ≥18 years. HAE and complete audiologic exam visits, defined by CPT and HCPCS codes, were included in the analysis. Number of visits were totaled for equal time periods (534 days) before and after the October 17, 2022 FDA ruling. Change in visits/month over the entire period was calculated from the slope of the line of best fit based on a daily interval. Clinic characteristics, including number of providers and appointment no-shows, were considered to reduce potential bias.

Results: The mean age (SD) was 60.5 (18.3) years. There were 20,300 combined HAE and audiologic exam visits during the study period. From May 1, 2021-October 16, 2022 (534 days), there were combined 9,778 visits and from October 17, 2022-April 2, 2024 (also 534 days) there were combined 10,522 visits, representing a 744 (7.6%) increase. For HAE visits in the same timeframes, there were 417 visits before and 474 visits after the ruling, representing a 57 (12.0%) increase. For audiologic exams, there were 9,361 visits before and 10,046 visits after the ruling, representing a 685 (7.3%) increase. Over the entire study period, combined visits (HAE and audiologic exams) had a 4.95 visit/day increase, HAE had a 0.084 visit/day increase, and audiologic exams had a 4.56 visit/day increase. The number of clinically active audiologists (11 before and 11 after the ruling) and appointment no-shows (1,700 before and 1,962 after the ruling) did not meaningfully differ across the two periods.

Conclusions: The FDA OTC hearing aid ruling did not have a meaningful impact on the volume of HAEs and audiologic exams at an academic audiology practice. We found a small trend towards increased volume. Future studies should investigate visit patterns in other practice models, including private practice.

Category: Hearing Loss / Rehabilitation

Poster #: 172

Acceptability of a Community-delivered Hearing Care Intervention: Findings from HEARS

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Objectives: Age-related hearing loss is highly prevalent and associated with adverse health outcomes for older adults. However, relatively few older adults use hearing aids, and disparities exist by race, ethnicity, and socioeconomic position. Among individuals who seek hearing care, low-income older adults can experience worse outcomes and report persistent hearing difficulty despite obtaining hearing aids. Task sharing, specifically partnering with community health workers, is a demonstrated strategy to reduce disparities and improve outcomes across populations that experience disparities. We examined the acceptability and satisfaction of a hearing care intervention delivered by community health workers, using over-the-counter (OTC) hearing technology, among a cohort of urban-dwelling, primarily low-income older adults with hearing loss.

Design: Baltimore HEARS was a randomized controlled trial where older adults 60+ years old with untreated mild to moderate hearing loss and functional communication impairment were recruited from affordable, independent housing complexes for older adults and senior centers throughout Baltimore, MD, and randomly assigned to a waitlist control group or to receive a community health worker-delivered hearing intervention and low-cost OTC device. The primary endpoint was 3-months post-randomization, after which the waitlisted participants received the intervention. All participants were assessed at 3- and 12-months post-intervention, including a staff-administered program evaluation. A total of 151 participants enrolled in the study, with 65 (43%) self-identified as Black and 96 (66.7%) reported an annual income<$25,000. A total of 140 (92.7%) participants completed the HEARS intervention and received an OTC device. Of these, 117 (77.5%) participants completed 3-month post-intervention evaluations and 91 (60.3%) participants completed 12-month post-intervention evaluations.

Results: At 3-months post-intervention, the majority of participants reported "a great deal" (N = 94, 80.3%) or "some" benefit (N=19, 16.2%), gaining "a great deal" (N = 74, 63.8%) or "some" (N = 32, 27.6%) confidence in communicating better, and feeling "a great deal" (N = 63, 53.8%) or "some" (N = 33, 28.2%) independence gained since receiving the device. Participants reported the program made them feel "a great deal" (N = 68, 58.1%) or "some" (N = 33, 28.2%) greater degree of connection to those around them, and felt it was "just as valuable" (N = 60, 51.3%) or "more valuable" (N = 49, 41.9%) than getting hearing care from a doctor or hearing expert at a clinic. Participants used their device an average of 6.7 (SD = 5.4) hours per day, with 91.5% using their device at 3-months post-intervention (85.6% for ≥1 hour per day). When asked to rate their likelihood of recommending HEARS to others on a scale from 0 ("not at all") to 10 ("very likely"), the average rating was 8.9 (SD = 2.3).

Conclusions: The findings of this secondary data analysis of the HEARS RCT demonstrate the high acceptability of a community-delivered hearing care intervention among a diverse cohort of older adults. Partnering with community health workers may be a promising approach to extending access to hearing care responsive to the needs of diverse communities.

Category: Hearing Loss / Rehabilitation

Poster #: 173

The Impact of Hearing Loss and Vision Loss on Dementia in the United States

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Objectives: Hearing and vision loss are treatable risk factors for dementia. National estimates of dementia cases attributable to these factors can inform federal risk reduction strategies and policy. In this study, we quantify the fraction of dementia cases attributable to hearing and vision loss in the United States and characterize differences by age, race/ethnicity, and sex.

Design: We performed a cross-sectional analysis using Round 12 (2022) of the National Health and Aging Trends Study, a nationally representative panel study of Medicare beneficiaries ≥65. A total of 4623 community-dwelling participants completed cognitive, hearing, and vision assessments. We defined hearing loss as a better-ear pure tone average >25 dB hearing loss and vision loss as presenting distance visual acuity of >0.3 logMAR (>20/40 Snellen equivalent), near acuity of >0.3 logMAR, or contrast sensitivity of<1.55 logCS. Dementia was classified using a standardized algorithmic diagnosis (≥1.5 SD below mean on at least one cognitive domain, self- or proxy-reported dementia diagnosis, or AD8 Screener score indicating probable dementia). We computed population attributable fractions of dementia from having at least one sensory risk factor using survey-weighted quasi-Poisson models adjusted for age, sex, race and ethnicity, education level, income, smoking history, and chronic disease multimorbidity. We estimated 95% confidence intervals (CI) using the nonparametric bootstrap.

Results: In the analytic sample (median age group 70-74 years, 54% female, 80% non-Hispanic White), the prevalence of at least one sensory risk factor was 66% and dementia was 9%. The population attributable fraction of dementia from at least one sensory risk factor was 57% (95% CI: 40-70%). Attributable fractions from at least one sensory risk factor were larger for participants under age 80 (59%; 95% CI: 42-74%) and non-Hispanic White (63%; 95% CI: 41-80%) relative to participants 80 or older (33%; 95% CI: -6 - 68%), Hispanic (50%; 95% CI: 16-80%), and non-Hispanic Black (32%; 95% CI: -1 - 64%). By sex, attributable fractions were consistent (male, 55% [95% CI: 31-75%]; female, 59% [95% CI: 38-75%]).

Conclusions: Assuming causal relationships, up to 57% of existing dementia cases in the United States are attributed to treatable sensory risk factors. Addressing common sensory risk factors in older adults could play an essential role in national dementia risk reduction strategies.

Category: Hearing Loss / Rehabilitation

Poster #: 174

Associations of Smoking with the Rate of Age-Related Hearing Decline

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Objectives: The purpose of this study, conducted in a community-based cohort study of individuals from the general population, was to determine the association of smoking history with the rate of pure-tone threshold change per year in aging.

Design: Participants were adults from the Medical University of South Carolina Longitudinal Cohort Study of Age-related Hearing Loss, an ongoing (1988-current) community-based cohort study based in Charleston, SC. Participants reported their smoking history as never, past, or current. If they were past or current smokers, they reported the number of cigarettes smoked per day and the number of years they smoked. This information was used to calculate participants' smoking pack years, which were categorized as 0, >0-5, >5-15, and >15 pack years. The 0 pack years group was used as the referent group for all analyses. Outcome measures were audiometric thresholds (0.25-8.0 kHz), which are measured annually, and pure-tone average (PTA) of thresholds at 0.5, 1.0, 2.0 and 4.0 kHz, averaged bilaterally. We used linear mixed regression models to estimate the effect of age (for every 1-year increase) on the rate of threshold and PTA change for participants across each category of smoking pack years. The effect of smoking on the rate of annual threshold change was determined by an interaction term of age and smoking. We describe results from preliminary unadjusted models.

Results: This study included 1032 participants, with a mean baseline age of 63.3 (SD 14.1) years and a mean PTA of 23.5 (SD 14.4) dB HL; 59.6% were female and 22.0% were racial Minority (21.1% of the sample were Black/African American). Nearly half of the participants had 0 smoking pack years (47.1%), whereas 20.0% had >0 to 5, 12.8% had >5 to 15, and 20.2% had >15 pack years. Compared to participants with 0 smoking pack years, those with >15 pack years had higher age-adjusted baseline hearing thresholds at frequencies 2.0 to 8.0 kHz. In unadjusted linear mixed effects regression models, more smoking pack years were, in general, associated with higher rates of hearing decline per year in the mid to low frequencies. More specifically, i) >0 to 5 (vs 0) pack years was associated with higher rates of decline at 2.0, 4.0, and 8.0 kHz and PTA, ii) >5 to 15 (vs 0) pack years was associated with higher rates of

decline at 0.5, 2.0, 4.0, 8.0 kHz and PTA, and iii) >15 (vs 0) pack years was associated with higher rates of decline at 1.0, 2.0, 3.0, and 8.0 kHz and PTA.

Conclusions: In this longitudinal, community-based cohort study, smoking was associated with a higher rate of hearing decline per year. These results corroborate prior evidence that smoking is a likely modifiable risk factor for hearing loss and provide new evidence that exposure to cigarette smoking is associated with the rate of hearing decline across the entire frequency range (0.25 to 8.0 kHz).

Category: Hearing Loss / Rehabilitation

Poster #: 175

Longitudinal Growth of Hearing Aid Benefits Coverage for U.S. Adults

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Objectives: (1) To describe the longitudinal heterogeneity of hearing aid benefits and coverage reach for adults across the U.S.; and (2) to quantify national yearly averages of the share of people living with hearing aid coverage benefits under private insurance mandates, Medicaid, the Veterans Administration, TRICARE, and Indian Health Services.

Design: By utilizing rigorous policy surveillance methods, we created a comprehensive database of Medicaid, VHA, TRICARE, and IHS hearing aid coverage policies from 2000-2023. Data were retrieved from primary sources, including published statutes and regulations from the U.S. Federal Register, Westlaw and Lexis search engines; Medicaid State Plan Amendments (SPAs); and policies, fee schedules, and hearing aid benefits provider manuals on state Medicaid, VHA, TRICARE, and IHS websites. Policies were included if they described benefits for adults aged 21 years and older. The effective date for any adult hearing aid coverage policy in place and salient policy features based on clinical best practices were coded. To characterize the national share of the U.S. population with mandated hearing aid coverage by healthcare coverage type across time, we merged both our original Medicaid, VHA, TRICARE, and IHS hearing aid coverage policy data and our previously published private insurance hearing aid mandate data onto nationally representative data from the American Community Survey, Integrated Public Use Microdata Series USA (IPUMS) from 2008-2022 (all years for which IPUMS data were available).

Results: We identified 32 states with Medicaid hearing aid coverage for adults aged 21 and over. Statutory language from the U.S. Federal Register demonstrated codified coverage of hearing aids for eligible Veterans as of 12/02/2002 and TRICARE active service members and their dependents as of 08/09/2004. IHS may provide hearing aids to eligible Indigenous, Tribal and Alaska Natives; however, there is extreme variability in coverage under IHS., in part due to inconsistencies in annual federal budget appropriations. The overall percentage of adults<65 years old who had coverage, whether through VA, HIS, a private insurance mandate, or Medicaid eligibility/EPSDT increased from 8.1% to 17.0% from

2008 to 2022, and for adults 65 and older, from 15.0% to 18.0%. In contrast to Medicaid coverage, which varied by state and was subject to frequent changes and interruptions, private insurance mandates for hearing aids were more consistent and generous in providing access to hearing health care. Additionally, findings from the VA and TRICARE indicated better consistency and more generous, comprehensive hearing aid coverage, highlighting the benefits of federal programs in providing stable and equitable access to essential health care services.

Conclusions: Our results identified gaps in coverage of hearing aids, which varied by age and health care coverage type. Expanding hearing aid coverage through comprehensive federal and state policies is essential to ensure equitable access to hearing health care across all age groups and insurance types. By addressing the existing gaps and implementing consistent coverage mandates, we can significantly improve health outcomes and quality of life for individuals with hearing loss, while also reducing the overall burden on the healthcare system.

Category: Hearing Loss / Rehabilitation

Poster #: 176

The Association Between Noise Exposure and Hearing Aid Use: The ARIC study

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Objectives: Noise exposure is associated with peripheral and central hearing loss, as it may damage aspects of auditory encoding and decoding, which could affect hearing aid use patterns among adults with hearing loss who use hearing aids (e.g., increased need in even mundane situations). We aimed to explore the question of whether evidence of noise exposure is associated with self-reported hours of hearing aid use, after accounting for potential confounders, among older adults who reported hearing aid use at visit 6 (2016-2017) of the Atherosclerosis Risk in Communities (ARIC) study. We hypothesize that those with noise exposure report more hours of hearing aid use compared to those without noise exposure.

Design: ARIC is an ongoing population-based cohort study of community-dwelling adults in 4 US communities - Forsyth County, NC; Jackson, MS; Minneapolis, MN; and Washington County, MD. Data from Visit 6 (2016-2017) of the study (N=1,455) was used. The final analytic sample included 918 participants who reported hearing aid use. Participants were asked whether they currently used a hearing aid in one or both ears (yes/no). If they confirmed that they used an aid, they were asked to report the average number of hours per day they wore the hearing aid(s) over the past month. Noise

exposure was measured using a noise exposure identification algorithm, which detected the presence of noise notches at specific frequencies using the participants' audiometric data and verified with self-report noise exposure questions (occupational and recreational). Multivariable Robust Poisson Regressions were used to estimate the association between the presence of noise notches and the self-reported number of hours using a hearing aid among the analytic sample. Model 1 was unadjusted, Model 2 was adjusted for age, sex, and race, and Model 3 was further adjusted for education, marital status, income, Medicaid use, Veteran status, deprivation index percentile and urbanity.

Results: The study population consisted of older adults aged 79.1 years (62% women, 24% black), of whom 918 reported using hearing aids. After adjusting for all variables, increased hearing aid use was not associated with the presence of a noise notch. Among participants with hearing loss, those with a noise notch were no more likely to use a hearing aid compared to those without a notch (point estimate 0.97, 95% CI:0.74 to 1.28 for those with a notch). Additionally, among hearing aid users, individuals with a noise notch did not report using their hearing aids for more hours than those without a notch (point estimate: 0.95, 95% CI: 0.79-1.15). On average, hearing aid users with noise exposure reported slightly greater hearing difficulties compared to those without noise exposure (point estimate: 1.49, 95% CI: -1.99, 4.97).

Conclusions: In this study sample, evidence of noise exposure was not associated with an increase in self-reported hearing aid use. Those with noise exposure were not more likely to use hearing aids compared to those without noise exposure. In some cases, age-related influences on degree of hearing loss may have already begun, which could mask or obscure the biological marker (notch) of noise exposure on the audiogram. In addition to this, noise exposure may not always present as a noise notch. Further exploration of the association between noise exposure and hearing aid use is needed, using alternative measurements to determine noise exposure. Future planned analyses in the ARIC study include utilizing speech-in-noise data to better understand influences of noise and auditory processing on hearing aid use patterns in a population-based study. Addressing and preventing the negative outcomes of hearing loss is crucial from a public health standpoint, as it helps reduce disparities among groups at risk of underutilizing care.

Category: Hearing Loss / Rehabilitation

Poster #: 177

Communication Choices of Caregivers of Deaf or Hard of Hearing Children

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Objectives: The purpose of this study is to explore the communication choices of caregivers of deaf or hard of hearing children. This study aims to explore what communication options caretakers are presented with, identify what factors may impact a caregiver's decision to pursue spoken language, and identify what barriers exist to learning sign language.

Design: This study consisted of 19 semi-structured interviews of caregivers of deaf or hard of hearing children. Participants were required to be the legal guardian of a deaf or hard of hearing child and have

had decision making power at the time of their child's diagnosis. They also needed to have had a desire to learn sign language to any extent. Participants were recruited from the Early Language and Literacy Acquisition study (R01 DC17173), an ongoing longitudinal study led by Dr. Krystal Werfel and Dr. Emily Lund. Audio of interviews were recorded and transcribed. Data was coded and final codebook developed. The final codebook was shared with participants to ensure accuracy of analyses.

Results: Preliminary data shows that many families reported that minimal to no information was provided about communication options at the time of their child's diagnosis or shortly after. Additionally, the families of children with cochlear implants noted they were discouraged from signing with their children at all. The most commented on factor impacting their decision to pursue spoken language is their wish for their child to have a connection with their hearing family, both immediate and extended members, and to have a connection with the hearing world. Many families reported barriers to learning sign language including a difficulty finding in person courses and difficulty integrating the vocabulary they learned into their everyday communication with their child.

Conclusions: Based on preliminary data, it is clear there is a need for providers to re-evaluate the information they provide caretakers and ensure they are following best practice guidelines to best support the caretakers. Providers should also take into consideration the priorities of the family and provide recommendations that best fit their goals. Additionally, there is a mismatch between what beginner sign language courses offer and the needs of families of deaf or hard of hearing children.

Category: Hearing Loss / Rehabilitation

Poster #: 178

Effects of ACHIEVE Hearing Intervention on Falls in Older Adults

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Objectives: To examine the effect of a hearing intervention on falls over three years among older adults in a secondary analysis of the ACHIEVE study.

Design: The ACHIEVE study is a randomized trial of 977 adults (70-84 years) conducted between 2018-2022 that determined the effect of hearing intervention versus control on the primary outcome of global cognitive decline. Participants were recruited from two distinct study populations at four US community sites: participants from an ongoing observational study of cardiovascular health (ARIC, n=238) who were initially randomly sampled and recruited into ARIC from 1987-89 or de novo healthy volunteers (n=739). Participants were randomized 1:1 to a hearing intervention(n=490) or health education control (n=487). Self-reported falls were assessed at baseline and annually.

Results: Participants were mean age 76.8 (SD=4.0) years, 53.5% female, and 87.8% White. The unadjusted absolute rate of observed falls was 460.2 per 1,000 person-years in the intervention group versus 630.7 falls in the control group. In adjusted analyses, the intervention group had a 27% reduction in falls over the 3-year study period compared to the control group (mean falls per year [95% confidence interval]: intervention: 0.48 [0.43, 0.54], control: 0.66 [0.61, 0.72], difference: -0.18, [-0.26, -0.10]). The 3-

year protective effect of hearing intervention was consistent across both the ARIC and de novo study populations.

Conclusions: In this secondary analysis of the ACHIEVE study, hearing intervention versus control was associated with a reduction in the average number of falls in older adults.

Category: Hearing Loss / Rehabilitation

Poster #: 179

Unrecognized Hearing Impairment among Community-Dwelling Older Korean Americans

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Objectives: Hearing impairment is highly prevalent among older adults, but little is known regarding hearing health among racial and ethnic minority communities in the United States. Older Korean Americans are predominantly monolingual first-generation immigrants, representing one of the fastest-growing aging populations in the country. National cohorts of older adults have primarily focused on English-proficient communities with limited representation of older Korean Americans. Older Korean Americans face multiple barriers seeking hearing care, including issues related to the perception of hearing impairment. Factors including education, income and ethnicity have been associated with differences in the perception of hearing impairment in older adults. This study compares self-reported and audiometric hearing impairment measures within an older Korean American cohort, aiming to identify the prevalence and characteristics associated with unrecognized audiometric hearing impairment. We hypothesized that demographic factors like age, education level, and income are associated with unrecognized hearing impairment.

Design: Participants aged 60 and older were recruited from 18 Korean American churches in partnership with faith-based organizations in the Baltimore-Washington metropolitan area and underwent both a tablet-based automated audiometric screening and staff-administered questionnaires. Audiometric hearing impairment was defined using 1991 World Health Organization criteria. Questionnaires asked respondents to assess their hearing on a scale from "excellent" and "very good" to "a little trouble", "moderate trouble" or "deaf." Participants with audiometric hearing impairment who self-reported their hearing as "excellent" or "good" were categorized as having unrecognized hearing impairment; those

reporting "a little trouble" or worse were categorized as having recognized hearing impairment. A total of 513/575 (89.2%) consented participants completed screenings and questionnaires.

Results: Among those screened, 285/513 (55.6%) had audiometric hearing impairment with 201 (70.5%) who described having "a little trouble" or worse hearing (recognized hearing impairment), and 84 (29.5%) who described their hearing as "excellent" or "good" (unrecognized hearing impairment). In univariate analyses, participants with unrecognized hearing impairment tended to be younger, have a lesser degree of audiometric hearing loss and had lower scores on the screening version of the Hearing Handicap Inventory for the Elderly (HHIE-S) than those with recognized hearing impairment: no differences were found with respect to sex or education. In multivariate analyses, after accounting for differences in audiometric hearing loss, there was no statistically significant association between the odds of recognizing hearing impairment and age, sex, or level of education.

Conclusions: Approximately 30% of participants with audiometric hearing impairment perceive their hearing as "excellent" or "good." Further research is necessary to compare these findings to nationally representative samples. Although limited by sample size, these findings are fundamental for further studies aimed at raising awareness and improving recognition of hearing impairment in this population. Understanding factors related to unrecognized hearing loss can help design targeted public health interventions and enhance hearing care awareness among older Korean American populations.

Category: Hearing Loss / Rehabilitation

Poster #: 180

Noise Exposure and Cognitive Decline in ARIC-NCS

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Objectives: Hearing loss is the most immediate and recognized effect of noise exposure, and is an important modifiable risk factor for dementia. However, in addition to hearing loss, noise may also impact cognitive health through its effects on sleep and cardiometabolic risk factors. There is very limited research in the US examining whether noise exposure is associated with faster rates of cognitive decline. In part, this is due to a lack of quality noise data collected in large population-based studies. To address this gap, we investigated whether noise exposure, defined using a novel algorithm to detect audiometric "noise notch", is associated with cognitive decline over 9 years in older adults. We hypothesized that noise exposure is associated with faster rates of global and domain-specific cognitive decline over time independent of hearing loss and other demographic and clinical factors.

Design: We analyzed data from 3,602 participants who received hearing tests in 2016-2017 from the Atherosclerosis Risk in Communities Neurocognitive Study (ARIC-NCS), a prospective cohort from four U.S. sites. A detailed 10-test neurocognitive battery assessed cognitive function in three domains

(memory, language, and executive function) up to four times between 2011 and 2022. We used a novel algorithm to identify "noise notch" consistent with a history of noise exposure on audiograms, accounting for inter-person biological variability related to the threshold potentially impacted by noise, as well as for age-related changes (presbycusis) expected in a population of older adults. Three survey questions on firearm use, occupational, and non-occupational noise exposure assessed subjective lifetime noise exposure as a comparison. Linear mixed-effects models with random intercepts and slopes estimated differences in rates of cognitive decline by audiometric noise exposure. Models adjusted for pure tone average, age, sex, race-center, education, occupation, area deprivation index national ranking, smoking, body mass index, hypertension, diabetes, and stroke. In a secondary analysis, we jointly modeled hearing loss (4-frequency better-ear pure tone average ≥25 dB HL) and noise to test for effect modification of the impact of hearing loss on cognitive decline by noise exposure using the following 4 exposure categories: no notch, no hearing loss (reference group), no notch with hearing loss, notch without hearing loss, and both notch and hearing loss.

Results: Among 3,602 older adults (mean age 74.5 years), after adjustment for hearing loss and other factors, we did not observe significantly different rates in global or domain-specific cognitive decline by audiometric noise notch status. Similarly, no statistically significant differences were observed using self-reported noise exposure. In our secondary analysis, we found that hearing loss was associated with faster rates of global cognitive decline, irrespective of noise notch. On average, participants with hearing loss but no notch declined 0.03 standard deviations (SD)/year (= -0.03, 95% confidence interval [CI]: –0.04, –0.01) faster than participants with no notch and normal hearing. Participants with both hearing loss and notch (vs. no notch, normal hearing) had, on average, a 0.02 SD/year (95% CI: –0.04, –0.01) faster rate of annual decline. Domain-specific cognitive decline rates showed similar trends.

Conclusions: Our study found no independent association between noise exposure and cognitive decline over 9 years. Hearing loss, with or without noise exposure, was associated with faster cognitive declines in all domains. Despite strong a priori hypotheses that noise exposure could increase cognitive decline risk independent of hearing loss (e.g., via increased cerebrovascular risk, sleep disruption), our findings could suggest that, if noise impacts cognitive decline, the primary mechanistic pathway may be through hearing loss. Alternatively, our algorithm for audiogram-based objective noise exposure may not adequately reflect noise exposure impacting brain health in older adults. Better noise measures are needed to understand the impact of noise exposure on the brain and overall health of older adults.

Category: Hearing Loss / Rehabilitation

Poster #: 181

Audiologic Profile of Normal-Hearing Subjects with Reduced Sound Level Tolerance

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Objectives: Tinnitus, reduced sound-level tolerance (SLT), and difficulties hearing in noisy environments are the most common complaints reported by adult patients with sensorineural hearing loss.

Occasionally, the same issues are reported by patients with normal audiometric thresholds. This study aims to clarify if cochlear neural degeneration (CND) estimated in a large pool of participants with normal audiometric thresholds is associated with reduced SLT.

Design: 206 native speakers of English with normal audiometric thresholds were enrolled. Each participant completed the hyperacusis handicap questionnaire (HHQ) along with a series of self-report questionnaires aimed at documenting demographic informations (age, sex), medical history (including history of concussion, anxiety/depression, misophonia, recreational/occupational noise exposure), tinnitus percept (if any), and self-reported difficulties hearing in noisy environments. Three groups of participants were defined based on participants' HHQ scores and their self-report of tinnitus. The first two groups included those with good (HHQ<11) or poor (HHQ>38) SLT who never experienced tinnitus or occasionally heard phantom sounds that emerged and resolved within minutes. The last group included those with poor SLT and a chronic and constant non-pulsatile tinnitus.An extensive test battery probing the different stages of auditory processing from hair cell responses to auditory brainstem reflexes was also performed on each participant. Hearing sensitivity was measured behaviorally at standard and extended high frequencies (9-16 kHz). Neural responses were assessed using ABRs obtained in response to 100 ¬µs-clicks delivered at 125 dB pSPL in alternating polarity at a rate of 9.1 Hz. ABR waveforms were processed through two bandpass filters to separate the contributions of auditory-nerve spikes from other generators. To assess the middle-ear muscle reflex, changes in ear-canal sound pressure to a probe stimulus (95 dB pSPL click) were evoked by a 500-msec ipsilateral broadband elicitor raised in 5 dB steps from 40 to 95 dB SPL. The medial olivocochlear reflex was measured as the average difference between the 1-2.8 kHz TEOAE spectral band obtained with or without a 60 dB SPL contralateral broadband noise elicitor.

Results: Participants with poor SLT and no tinnitus showed reduced cochlear nerve responses that were not associated with signs of hyperactivity in the brainstem auditory pathways. Consistently, no significant correlation was obtained between the HHQ score and the various metrics of auditory reflexes. On the other hand, participants with poor SLT reporting a chronic and constant tinnitus showed further signs of peripheral neural damage associated with brainstem hyperactivity. The latter participants were older, included more males and had poorer EHF thresholds.Poor SLT in absence of tinnitus was also associated with increased self-report of anxiety/depression, misophonia and increased difficulties hearing in noisy environments. The same symptoms were reported in greater proportions among those with poor SLT and chronic tinnitus.

Conclusions: These results support the idea that poor SLT may arise from decreased peripheral neural activity from a damaged cochlea that is not (yet) associated with signs of hyperactivity in the brainstem.
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Category: Hearing Loss / Rehabilitation

Poster #: 182

Genetic Factors Explain Intersubject Variability in Audiograms Among Young Adults

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Objectives: Age-related hearing loss (ARHL) is a highly prevalent health condition that has been associated with numerous health comorbidities, including dementia, Alzheimer's disease, cognitive decline, and social isolation. Recent genome-wide association studies (GWAS) have uncovered the genetic architecture underlying ARHL. We hypothesized that genetic variations associated with ARHL can also explain subclinical differences in hearing thresholds among healthy young adults with self-reported normal hearing. Early identification of individuals genetically at risk of ARHL before its clinical onset is critical to providing timely interventions to mitigate the negative effects of hearing loss.

Design: We selected 7218 single-nucleotide polymorphisms (SNPs) associated with ARHL in a previous genome-wide association study meta-analysis (meta-GWAS). We performed regression analysis to determine whether these variations could explain differences in pure-tone audiometric hearing thresholds among a sample of 357 healthy young adults with self-reported normal hearing. We employed linear mixed models to identify the SNP effects on hearing thresholds. We then used functional annotation to map SNPs to their gene to quantify gene-specific effects on hearing thresholds.

Results: 2348 SNPs were significantly associated with hearing thresholds in the young adult cohort. Of these, 1642 SNPs demonstrated consistent direction of effect on hearing thresholds compared to what was observed in the meta-GWAS; that is, SNPs that were associated with hearing difficulty in the meta-GWAS were associated with poorer hearing thresholds, and vice versa. 129 of the mapped genes were significantly associated with hearing thresholds and demonstrated consistent direction of effect on hearing thresholds compared to what was observed in the meta-GWAS. Overall, genes explained over 18% of variance in hearing thresholds among young adults.

Conclusions: Individuals with genetic predisposition to ARHL exhibit significantly poorer hearing thresholds, potentially decades before clinical onset of ARHL. Genetic variants associated with ARHL explained a significant proportion of intersubject variability in hearing thresholds. These results emphasize the need for early intervention for high-risk individuals, who may be experiencing a subclinical decline in hearing function well before their age-matched peers. This underscores the necessity of a genotype-first approach, which can identify these individuals before noticeable hearing difficulty emerges and provide clinicians with the chance to perform targeted preventative intervention.

Category: Hearing Loss / Rehabilitation

Poster #: 183

Association of Age-related Hearing Loss with Cognitive Performances in India

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Objectives: Being the world's most populous country, India is undergoing rapid demographic shifts with major growth in older adult population, which shadows the burden of dementia in the next decades. Hearing loss is a prevalent health condition among older adults and is recognized as a key modifiable risk factor for cognitive decline and dementia. Using data from a nationally representative survey, our study aims to estimate the prevalence of age-related hearing loss in India and investigate its association with cognitive performances.

Design: Our study population was derived from the cross-sectional sample of the Longitudinal Aging Study of India - Diagnostic Assessment of Dementia (LASI-DAD), an ongoing, prospective cohort that is representative of the Indian population 60 years and older. In the second study wave (2024), 3,474 LASI-DAD participants received audiometric hearing tests that measured peripheral hearing. Our exposure, hearing loss status, was defined by the four-frequency better-ear Pure-Tone Average (BPTA) categorized by the World Health Organization (WHO) criteria (no hearing loss: ≤25 dB; mild hearing loss: 25-40 dB; and moderate or greater hearing loss: >40 dB). The pre-2021 WHO cut points were used to compare to published literature using population samples. Our primary outcomes of interest, global and domain-specific (memory, executive functioning, language, visuospatial, and orientation) cognitive scores, were derived from LASI-DAD's comprehensive cognitive test battery, which accommodates the cultural and linguistic diversity of the Indian population. To examine the associations of interest, we first profiled the study population regarding the distribution of key sociodemographic and health characteristics across varying severity of hearing loss. We then adopted multivariable linear regression models to examine the associations between hearing loss and cognitive scores. In secondary analyses, we performed stratified analyses by re-fitting our primary models on subgroups of study samples defined by age, sex, urbanicity, and literacy level. LASI-DAD complex analytical weights were applied to all analyses.

Results: In a study sample of 3,474 LASI-DAD participants (mean age: 69.5 years [SD=6.5]; 48% female; 70% rural residents; and 54% illiterate), we observed the prevalence of mild and moderate or greater hearing loss to be 43% and 26%. As compared to participants without hearing loss, those with hearing loss were more likely to be older, widowed, urban residents, and living with cardiovascular risk factors. Results from full-adjusted linear regression models suggested that relative to those without hearing loss, participants with mild hearing loss and moderate or greater hearing loss tended to score 0.02 (95% Confidence Interval [CI]: -0.07, 0.03) and 0.20 (95% CI: -0.25, -0.14) SDs lower on global cognition, and similarly on other cognitive domains. In stratified analyses, potential heterogeneity of associations between hearing loss and global cognition were observed by rural (score differences between participants with moderate or greater hearing loss and no hearing loss [β]=-0.22; 95% CI: -0.29, -0.15) and urban (β=-0.14; 95% CI: -0.25, -0.02) residency.

Conclusions: Using nationally representative survey with valid audiometric hearing test results, our study presented important prevalence statistics that advances the understanding of the disease burden of age-related hearing loss among older adult population in India. We also found that older adults with greater degrees of hearing loss had less ideal performances on cognitive tests. Given the modifiable nature of hearing loss through rehabilitative devices and services, our study highlighted the need of further understanding on hearing health in the Indian context.

Category: Hearing Loss / Rehabilitation

Poster #: 184

Hearing Loss and Dementia: Vulnerabilities of low English Language Acculturation

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Objectives: Hearing loss is a risk factor for dementia amenable to interventions. Among non-native English speaking older U.S. adults, low English language acculturation may be a risk factor for cognitive decline sharing pathways with hearing loss. We aimed to assess the role of language acculturation in moderating the relationship between hearing loss and dementia.

Design: We conducted a cross-sectional analysis of adults aged 65 and older in the U.S. from the 2022 National Health and Aging Trends Study (NHATS), excluding those who only spoke English. The analytical sample included participants who spoke a language other than English or were interviewed in Spanish. We defined hearing loss hearing loss as a better-ear pure tone average >25 dB from a tablet-based audiometric test. English comprehension was assessed using a four-point scale (1 = very well, 4 = not at all). Participants with “not well” or “not at all” comprehension were categorized as low acculturation. Dementia was defined as possible/probable dementia using the NHATS dementia algorithm (reported dementia diagnosis, AD8, and neurocognitive test results). We used survey-weighted Poisson regressions to assess differences in prevalence of dementia by hearing and language acculturation status, as well as potential additive interactions to evaluate whether the combined effect is greater than the sum of the individual effects.

Results: The prevalence of hearing loss was 52.7%, low acculturation 16.6%, and dementia 13.4%. The association between hearing loss and dementia varied by acculturation status. Compared to those with normal hearing and high acculturation, those with low acculturation and hearing loss had a prevalence ratio for dementia of 1.86 (95% CI: 0.96, 3.60), while those with high acculturation and hearing loss had a prevalence ratio of 1.65 (95% CI: 0.95, 2.87). We observed a super-additive interaction with a Synergy Index of 1.3 (95% CI: 0.5, 2.1), suggesting that individuals with low acculturation may be more vulnerable to the harmful effects of hearing loss, although the interaction was not statistically significant.

Conclusions: The association between hearing loss and dementia is more pronounced among individuals with low language acculturation, compared to those of higher acculturation. Hearing interventions may be especially beneficial in reducing dementia risk among older adults with low English acculturation.

HEARING SCIENCE / PSYCHOACOUSTICS

Category: Hearing Science / Psychoacoustics

Poster #: 185

Impact of Reduced Latency on AI-Based Noise Reduction

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Objectives: Difficulty understanding speech in noisy environments represents the primary auditory complaint for listeners with hearing loss. Accordingly, considerable effort has been directed toward developing noise reduction that can improve intelligibility. AI or deep-learning based noise reduction has advanced from initial laboratory proof-of-concept to real-world-capable systems that are beginning to be implemented in commercial devices (e.g., Oticon, Phonak). The aspect currently under study involves the processing latency of the deep-learning algorithm. Although commercial hearing devices often target an ideal overall latency around 10 ms, the literature shows that listeners with hearing loss cannot detect/are undisturbed by latencies up to several times this value. The opportunity then exists to use latency as a tool to improve intelligibility, so long as the appropriate latency constraints are observed. Our previous work has shown that small advantages can be obtained if the algorithm is allowed a small "look ahead," which increases latency. In contrast, latency reduction may be desirable, especially if other aspects of processing introduce delays. The objective of the current study was to examine the effect of reducing the latency of an existing AI-based noise-reduction algorithm. Are intelligibility benefits hindered when the latency of a known model is reduced?

Design: Algorithm latency is determined largely by time-window size. For the current study, the standard version of the Attentive Recurrent Network (ARN), having a window size/latency of 20 ms, was modified to create additional versions having window sizes/latencies of 10 and 5 ms. These three versions of the deep neural network were trained using speech from over 2,000 talkers mixed with 10,000 different noises. The networks were tested by examining their ability to extract standard HINT sentence recordings from a background of multi-talker babble. The speech and noise were mixed and presented diotically, representing a "worst-case" single-microphone situation in which the speech and noise are co-located and binaural cues are absent. Ten listeners with typical (normal) hearing heard these test sentences mixed with babble at -5, -2, and 0 dB SNR. Ten listeners with sensorineural hearing loss of likely cochlear origin heard them at -2, 0, and +3 dB SNR.

Results: Intelligibility benefit resulting from the reduced-latency algorithms was similar to that observed for the standard 20-ms latency model, for both listeners with typical hearing and those with hearing loss.

Conclusions: These data suggest that this state-of-the art deep neural network can retain high effectiveness when modified to operate in situations where very low latency is desired or in situations where other aspects of processing contribute substantially to the overall latency.

Category: Hearing Science / Psychoacoustics

Poster #: 186

Emotional Vocalizations Cause Distraction Affecting Speech Recognition and Listening Effort

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Objectives: Task-irrelevant sounds can be distracting, impairing speech recognition and increasing listening effort. Previous work has demonstrated that the degree to which irrelevant stimuli are distracting is related to stimulus valence; unpleasant and pleasant irrelevant stimuli are more distracting than neutral ones. However, this work is limited to non-speech sounds. The primary purpose of the current study was to evaluate the effect of task-irrelevant, human vocalization on speech recognition performance and behavioral listening effort. In addition, because people can automatically experience the emotion expressed by others, a secondary purpose of this study was to evaluate the effect of interleaving affective vocalizations between words during a listening effort task on a listener's mood.

Design: Sixteen adults with normal hearing participated in a dual-task paradigm where the primary task was word recognition and the secondary task was word categorization speed, with response speed being interpreted as a measure of behavioral listening effort. Immediately prior to 45% of the target words, an irrelevant vocalization was presented. Conditions varied by background noise (present, absent) and by valence of the vocalization (pleasant, unpleasant, neutral). Task relevant and irrelevant sounds were presented at 65 dBA; background noise, when present, was a multitalker babble presented at 65 dBA. After testing in each condition, participants provided ratings of valence and arousal of how they felt. Data were analyzed using linear mixed-effects modeling to evaluate the effect of the presence of a distractor, vocalization valence, and background noise on word recognition performance and behavioral listening effort. Ratings of valence and arousal were analyzed similarly, focusing on the effects of vocalization valence and background noise condition.

Results: Analysis revealed that only background noise, not the presence of task-irrelevant vocalizations, affected word recognition performance (scores were approximately 100 and 94% in quiet and noise, respectively). However, both background noise and the presence of valenced (pleasant and unpleasant) task-irrelevant vocalizations increased behavioral listening effort by 119 ms and 54 ms, respectively. Ratings of valence were higher (more pleasant) following conditions with pleasant, task-irrelevant distractors compared to all other conditions. Ratings of arousal were higher (more exciting) following conditions tested in background noise compared to conditions tested in quiet.

Conclusions: The results of this study demonstrate that pleasant and unpleasant vocalizations increase listening effort in quiet and in noise, despite no changes in word recognition performance. In addition, pleasant task-irrelevant sounds increase subjective ratings of valence measured immediately after testing. That is, pleasant vocalizations are distracting, and increase listener's self-assessments of experienced valence, whereas unpleasant vocalizations are simply distracting. Future work is warranted to disentangle the methodological differences and the differences in effect sizes between the current study and previous work with non-speech sounds. The findings have implications for listening in complex, real world environments, where distraction and emotion are likely to occur.

Category: Hearing Science / Psychoacoustics

Poster #: 187

Age Effects on Binaural Sensitivity and Spatial Release from Masking

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Objectives: This study aimed to investigate the relationship between aging and declines in Interaural Time Difference (ITD) and Interaural Level Difference (ILD) sensitivity and to explore how age-related declines in ITD and ILD sensitivity co-vary with Spatial Release from Masking (SRM). Specifically, we tested the hypotheses that aging affects ILD Sensitivity, ITD Sensitivity, and SRM and that ITD and ILD sensitivity declines will be related to decreases in Spatial Release from Masking.

Design: We conducted an experimental study with 200 adult participants (aged 18-73 years), recruited anonymously via an online platform. Inclusion criteria include no hearing loss or hearing difficulties (confirmed through a validated online speech-based hearing screener), successful completion of an online headphone check, normal vision or corrected to normal vision, no mild cognitive impairment or dementia, English as a primary language, and residency in the US or Canada. Participants completed tasks on an online platform to assess ITD sensitivity (binaural FM task), ILD sensitivity (ILD threshold test), and SRM (Modified Rhyme task). Full psychometric curves were plotted, and the 79.4% correct response rate determined participant ITD and ILD thresholds and SRM performance. Data analysis utilized linear regression models to examine the effects of age on ITD and ILD sensitivity, the relationship between age and SRM, and the relationship between SRM and ITD and ILD sensitivity.

Results: Aging was associated with a significant decrease in ILD sensitivity and SRM Thresholds. However, no age-effects were found with ITD sensitivity in our test population. SRM was significantly associated with ILD sensitivity, indicating that as ILD sensitivity decreases, older adults derive less masking release from spatial separation compared to younger adults. However, no correlations between SRM and ITD sensitivity were observed.

Conclusions: These findings highlight the presence of age-related declines in ILD sensitivity, and how these declines negatively impact SRM. However, contrary to our initial hypothesis, no effects if ITD sensitivity or effects of ITD sensitivity on SRM were found. The absence of age-related declines in ITD sensitivity raise inquiry to whether the speech-based hearing screener may have been a confound for ITD sensitivity by excluding individuals with poorer TFS coding. The relationship between ILD sensitivity and SRM with age opens up future studies that look at enhancing ILD cues to aid in speech perception restoration.

Category: Hearing Science / Psychoacoustics

Poster #: 188

Impact of Working Memory and Attention Demands on Listening Effort

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Objectives: Changes in pupil dilation in response to demanding listening conditions have been used as a measure of listening effort (LE). However, pupil measurements can be affected by attention and working memory (WM) capacity. The literature on the roles of these factors is limited and inconclusive. The current study comprises three specific aims:1) To investigate the impact of increased attentional demand on LE in young versus older-adults. 2) To assess the influence of increased WM demand on LE in young versus older-adults 3) To explore the relationship between attention and WM for LE across the two age groups.

Design: Guided by a medium effect size from pilot data and literature on age differences, an a priori analysis determined a sample size of 18 normal-hearing participants including young (18-35 years) and older-adults (>50). Assessments included behavioral (WM and dichotic-digit scores) and physiological (pupillometry) measurements. The Word Auditory Recognition and Recall Measure (WARRM) protocol assessed WM capacity(n), which formed the reference point for low and high-demand set sizes for WM.Data collection used a Tobii T60-XL eye tracker. Participants engaged in WM-only and attention-only conditions, with attention demand manipulated by requiring repetition of dichotic-digits from only right ear (AttnD-low) or from both ears sequentially (AttnD-high). The WM-only condition involved two levels of WMdemand (WMD-low and WMD-high) at n-1 and n+1, respectively. Participants listened to these words and recalled them after a retention period.Additionally, the study explored WM and attention combinations in low and high-demand scenarios, collecting continuous pupil data across 20 trials/condition. Here, working memory is the initial task, followed by a retention interval with a dichotic test as a distractor. Subsequently, participants had to recall the words heard during the initial part of the trial. It encompassed WMD-Low+AttnD-Low, WMD-Low+AttnD-High, WMD-High+AttnD-Low, and WMD-High+AttnD-High combinations.

Results: Pupillometry data analysis from five young participants revealed notable effects of WMD on LE. Specifically, under WMD-High, MPD is greater than WMD-Low (MPD=0.12, SD=0.23). For the combination conditions, the highest dilation is observed in WMD-Low+AttnD-High condition, (MPD=0.20, SD=0.02), exceeding that of WMD-High. Other conditions show MPD values, including WMD-Low (MPD=0.07, SD=0.23), WMD-Low+AttnD-Low (MPD=0.16, SD=0.02), and WMD-High+AttnD-Low (MPD=0.16, SD=0.02). Behavioral data from nine young participants were analyzed. A repeated measures ANOVA was conducted to answer the research aims. The analysis found no significant main effect/interaction concerning attention demand on WM performance. The analysis showed a significant effect of WM demand on attention performance ($p=0.006$), while attention performance approached significance ($p=0.059$), but not the interaction ($p>0.05$). The difference score was calculated by independently subtracting out the potential effects of attention and WM from the combination conditions, revealing no significant main effects or interactions, though the interaction approached significance ($p=0.053$). Additional data would be required to achieve sufficient power to draw more conclusive results.

Conclusions: Overall, these findings emphasize the importance of considering both WM and attention demands when evaluating LE, especially in complex listening environments, as each factor independently and interactively contributes to increased cognitive load, thus elevating LE. Additional data will be presented later to address our aims concerning older-adults.

Category: Hearing Science / Psychoacoustics

Poster #: 189

The Effects of Interaural Level Differences on Binaural Fusion

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Objectives: Binaural fusion is the perception of a single auditory image when signals are presented to the two ears. Decreasing the interaural coherence of the signals often degrades binaural fusion. However, perception of interaural level differences (ILDs) is minimally affected by decreased interaural coherence. This study aims to determine if ILDs can be used to foster binaural fusion in the presence of reduced interaural coherence and if that binaural fusion is obligatory (i.e., can participants choose to attend to only one ear when the sound is perceived as binaurally fused). Experiment 1 investigated the effects of ILDs on binaural fusion for signals with varying interaural coherences. Experiment 2 investigated if participants can attend to the loudness at one ear for a partially interaurally uncorrelated signal in the presence of a left-biased ILD.

Design: For Experiment 1, vocoded stimuli with envelopes with varying interaural coherences were presented that contained ILDs that ranged from a 16 dB left-biased ILD to a 16 dB right-biased ILD. Participants viewed a graphic of a head with an oval in the center. Following stimulus presentation, participants indicated the perceived size and lateralization of the auditory image using a dial to alter the number and width of the depicted oval(s). For Experiment 2, participants indicated the perceived loudness in their right ear using a visual analog scale. Stimuli was similar to Experiment 1, but were bilaterally roved to allow the separation of the effects of perceived lateralization from those of changes in perceived right ear loudness.

Results: In Experiment 1, participants indicated that stimuli with reduced interaural coherence were binaurally fused when there was a large ILD, even when they indicated that the same stimulus was unfused when there was a 0 dB ILD. For Experiment 2, participants could accurately assess the changes in the right ear loudness levels when the stimulus had right-biased ILDs. However, when the stimulus had left-biased ILDs, participants largely indicated little-to-no sound in their right ear. However, this varied depending on the interaural coherence of the stimulus. When stimuli were completely interaurally correlated, there was no relationship between right-ear stimulus levels and perceived loudness for stimuli with left-biased ILDs, indicating obligatory fusion. In contrast, signals with low interaural coherence had a significant correlation between the right ear stimulus level and perceived loudness for stimuli with left-biased ILDs, despite the sounds still being perceived as quieter than stimuli with the

same right ear intensity but with a right-biased ILD. This suggests a reduced but present ability to attend unilaterally when the interaural coherence was low, and thus that fusion was not completely obligatory.

Conclusions: The results indicate that signals with low interaural coherence can be binaurally fused when the stimulus has large ILDs. Additionally, the ability to choose to attend to one ear in the presence of these ILDs is greatly reduced, but not eliminated, indicating that binaural fusion is such cases is not entirely obligatory, although participants still struggle to attend to one ear.

Category: Hearing Science / Psychoacoustics

Poster #: 190

Validation of A Large Set of Affective Auditory Stimuli

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Objectives: The study of emotion is an emerging area of research in the hearing sciences that has benefitted from the development of standardized stimuli such as the International Affective Digitized Sounds (IADS-2) database. IADS-2 consists of 167 validated emotionally evocative sounds that can be used in studies of auditory emotion. Despite its utility, the small number of stimuli in IADS-2 yields limited distribution of sounds along the affective dimensions of valence and arousal. This complicates the selection of an equal number of sounds across different emotional conditions, making it difficult to create balanced experiments or to evaluate emotional responses longitudinally within the same individuals. In response to these challenges, an expanded version of IADS (IADS-E) with 767 new auditory stimuli was developed and validated in a group of Japanese adults. This expanded set of stimuli holds promise for increasing the number of validated stimuli available to study auditory emotion; however, this dataset has not been validated for English-speaking populations, nor in individuals whose hearing status is known. The primary objective of this study is to establish the reliability and validity of the IADS-E in English-speaking adults who have clinically normal-hearing sensitivity.

Design: Data collection is ongoing, with a planned enrollment total of 200 participants. To date, 16 university students (8 Males, 8 Females) between age of 18-23 years have completed the study. All participants had normal hearing bilaterally. They completed a questionnaire about their demographic details, audiological history, and any associated medical conditions. The 767 IADS-E stimuli were divided into 10 blocks with 75-80 sounds per block. Each participant listened to two random blocks. Stimuli were presented binaurally via circumaural headphones at a calibrated level of 75 dBSPL. Participants rated each sound on three affective dimensions (Valence, Arousal, and Dominance) using Self-Assessment Manikin scale.

Results: The mean valence, arousal, and dominance ratings were 4.48, 5.52, and 4.75, respectively. These results align with the mean ratings provided by the Japanese participants, which were 4.58, 5.53, and 4.82 for valence, arousal, and dominance, respectively. We further analyzed the distribution of sounds

across three levels of affect: low (mean rating< 3), neutral (mean rating between 3 and 6), and high (mean rating > 6). We found 169 sounds with low (i.e., negative) valence, 449 with neutral valence, and 149 with high (i.e., positive) valence. There were 43 sounds with low arousal, 393 with neutral arousal, and 331 with high arousal. There were 53 sounds with low dominance, 573 with neutral dominance, and 141 with high dominance. Subsequent analyses will evaluate correlations between the three affective dimensions and effects of demographic variables (i.e., gender identity) on emotional responses. We will also evaluate cross-cultural differences in emotional responses by comparing ratings for individual sounds from our dataset to those from the Japanese dataset.

Conclusions: The higher number of validated sound stimuli across different affective dimensions will provide researchers with a more diverse stimulus pool, which is crucial when stimulus repetition is not viable. Additionally, this study addresses cultural and linguistic considerations for adapting emotional stimuli for different populations.

Category: Hearing Science / Psychoacoustics

Poster #: 191

Identification of Talker Location Based on Talker Head Orientation Cues

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Objectives: A realistic cocktail party listening scenario involves a target talker facing the listener while masker talkers typically face other directions. The ability to identify the head orientation of a talker could be helpful for inferring whether one is the intended recipient of an utterance. Previous studies conducted in quiet indicate that extended high frequencies (EHFs; > 8kHz) in the speech spectrum contain cues that allow discrimination of talker head orientation relative to 0° (facing the listener). In this study, we investigated listeners' ability to identify the spatial location of a talker based on head orientation. The target talker faced the listener in the presence of two other spatially separated talkers who were not facing the listener. We hypothesized that performance would improve with (a) greater mismatches in talker head orientation angles, (b) access to EHF cues in the speech signal, and (c) a longer stimulus duration.

Design: Listeners performed a three-alternative forced choice task to identify the spatial location of the talker facing the listener. Short segments of narrative speech were presented simultaneously from three loudspeakers located at 0° and ±45° azimuth. There were 24 experimental conditions: two talker sexes (male or female), three head orientation angles for the non-facing talkers (67.5°, 90°, or 112.5°), two filtering bandwidths (full-band, or low-pass filtered at 8 kHz), and two stimulus durations (2s or 4s).

Results: Preliminary analyses indicate that mean performance was above chance level in all conditions. Performance improved with increasing head orientation angles for the non-facing talkers. Performance in full-band conditions tended to be better than in low-pass filtered conditions. For correct responses, response times tended to be shorter in the full-band compared to low-pass filtered conditions. Performance was somewhat better for the longer stimulus duration.

Conclusions: Listeners are sensitive to mismatches in talker head orientation angles and can identify the location of a talker facing them in the presence of interfering talkers facing other directions. The directional nature of EHFs may provide cues that support listeners' ability to localize the talker facing them more accurately and more quickly than spectral cues below 8 kHz. This could have implications for individuals with elevated thresholds in the EHFs, making it harder for them to detect when they are the intended recipient of an utterance. [Supported by NIH R01-DC019745 (BBM)]

Category: Hearing Science / Psychoacoustics

Poster #: 192

Developmental Trajectory of Sound Localization Precision and Localization Abilities

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Objectives: A cross-sectional study was designed to track the maturation of accuracy in sound localization using a multi-loudspeaker array, and right/left discrimination, without and with a simulated echo. This robust study will not only inform the maturation of auditory spatial hearing, but will also provide a benchmark for the maturation of auditory function in individuals with hearing loss and with intellectual and developmental disabilities.

Design: The Right/Left discrimination experiment included 79 Typically Developing (TD) participants: 39 children (5-18 years) and 40 adults (18-24 years). Two conditions were tested: Single-Source (SS) and echoed (4ms lead-lag delay). Pink noise was presented at 65dB SPL, and participants were selected between two loudspeakers located to the right or left at ±10°, ±5°, or ±2.5°. The localization experiment included 76 TD participants in the same age ranges. Only SS stimuli were used. The testing apparatus was a semi-circular arc consisting of 15 loudspeakers, spaced 10° apart spanning -70° to +70°. On each trial, a spondee word was presented from one of the loudspeakers at 60dB SPL with a ±4 dB rove. Participants selected a loudspeaker to indicate the perceived sound location. For statistical analyses, we considered age as either a continuous variable or categorical (5-8, 9-12, 13-18 and 18-23 years, with slightly varying group sizes.

Results: D' from right/left discrimination data were first analyzed using linear mixed-effects models with age (continuous variable), condition (SS vs echoed), and interaction. A significant effect of age on d' was seen at 5° and 2.5° for SS and echoed conditions. Age was not significant at 10°, where most participants performed at ceiling level. Interaction effects indicate lower d' values in the echoed vs the SS condition, and better performance in the echoed condition with increased age. With age as a categorical variable

(two-way mixed-effect ANOVA), significant age-related group differences were found, for both SS and echoed conditions, particularly in the two smaller angular separation conditions. Analyses of Root Mean Square (RMS) errors for sound localization with age as a continuous variable showed a significant negative correlation between age and RMS error, indicating reduced errors with increased age. With age as a categorical variable (one-way ANOVA), RMS errors were higher in the two younger groups than the older children and adults [means: 7.66° (±3.51), 6.87° (±1.41), 4.5° (±1.92), and 4.44° (±1.45), for ages 5-8, 9-12, 13-17, and adults, respectively.

Conclusions: Spatial hearing abilities, consisting of discrimination and RMS errors undergo maturation through adolescence. Right/left discrimination reaches adult-like d' values approximately by 8 years of age, whereas localization accuracy may not reach adult-like performance until age 13. The presence of echoes renders right-left discrimination more challenging, with a more protracted period of maturation for suppression of directional information from the lagging source, perhaps reflecting ongoing central auditory maturation.

Category: Hearing Science / Psychoacoustics

Poster #: 193

Space Party Rescue: A Gamified Virtual Reality Cocktail Party Experience

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Objectives: Previous work has explored the addition of game elements into experimental tasks, or "gamification," as a means of increasing participant engagement, enjoyment, and performance with speech-in-noise testing. An alternative approach is to design new experimental speech-in-noise tasks using game design concepts as guiding principles in development. The current study evaluated a virtual reality game, Space Party Rescue, and its potential utility as a game-based assessment of communication abilities in noise. Performance and subjective impressions of the testing experience in Space Party Rescue were compared to those obtained from a more traditional "gamified" test, Pipes Puzzle, to determine the extent to which Space Party Rescue yielded meaningful clinical data and greater subjective ratings of engagement and enjoyment.

Design: Twenty adults aged 19-37 years with normal hearing completed Pipes Puzzle and Space Party Rescue. Pipes Puzzle was run on an iPad with calibrated headphones. Participants responded to stimuli from the Coordinate Response Measure Corpus with colocated or spatially separated maskers. Their responses revealed pipe fittings that were pieced together into a visual puzzle. The outcome data from Pipe Puzzle were 50% correct thresholds for colocated and separated maskers and spatial release from masking, expressed as the difference between these thresholds. Space Party Rescue was run on a Meta Quest 2 virtual reality headset with calibrated headphones. Participants navigated a virtual party on a spaceship, with seven talkers distributed across three conversation groups. Participants were tasked with finding specific talkers at the party, based on the topic of that talker's monologue. The number of

seconds required for the participant to locate the correct talker was recorded as the primary data from Space Party Rescue. After each game, participants completed a questionnaire to evaluate their subjective impressions of the test, including ratings of mental demand, perceived success, frustration, and enjoyment.

Results: The average time required to find a given talker in Space Party Rescue was moderately correlated with threshold on Pipes Puzzle with colocated maskers ($r = 0.459$). This result indicates some shared variance between the games in assessing speech recognition at a positive target-to-masker ratio without spatial cues. Participants reported significantly greater enjoyment and perceived success in Space Party Rescue compared to Pipes Puzzle. Additional results will be reported to explain stimulus factors that contributed to the time required to find a given talker in Space Party Rescue.

Conclusions: A novel form quantifying performance on a gamified test (time required to find a talker) showed a promising association with speech recognition performance on a more traditional speech-in-noise task. Interestingly, this association was observed with speech recognition thresholds with colocated maskers, despite the fact that all stimuli in Space Party Rescue had spatial cues simulated by the Oculus spatializer. This finding suggests that listeners were navigating to positions with favorable signal-to-noise ratios to locate the target talker, rather than scanning the scene from a fixed position using spatial cues. Subjective reports of enjoyment and success suggest a better overall testing experience with Space Party Rescue compared to Pipes Puzzle.

HEARING TECHNOLOGY / AMPLIFICATION

Category: Hearing Technology / Amplification

Poster #: 194

Hearing Aids and Neuropsychiatric Symptoms in NACC

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Objectives: Hearing loss is a common comorbidity among persons living with dementia (PLWD), with prevalence estimates >90%. Such sensory impairments have been associated with an increased risk of neuropsychiatric symptoms (NPS), which can greatly increase the burden and cost of caring for PLWD. Use of hearing aids among PLWD may be protective and is associated with reduced risk of NPS. To explore the potential relationship between hearing loss and NPS, we sought to employ a larger dataset than previously employed, analyzing data from the National Alzheimer's Coordinating Center's (NACC) uniform dataset. We explored the following questions: (1) is there an association between hearing loss and the number and severity of NPS? (2) is hearing aid use protective against NPS? We hypothesized that hearing loss is associated with increased number and severity of NPS and the use of hearing aids as potentially protective against NPS among PLWD.

Design: We analyzed data from the NACC uniform dataset. The study was restricted to the first assessment of adults ages 60+ with dementia, with complete information about self-reported hearing status (normal vs. functional loss) and the Neuropsychiatric Inventory Questionnaire (NPI-Q). We estimated the association between functional hearing loss and number and severity of NPS using a negative binomial regression model adjusting for demographic and clinical characteristics. We estimated the association between hearing aid use and number and severity of NPS among participants with hearing loss. Selection bias was addressed using nearest neighbor matching between hearing aid users and non-users based on respondent's demographic characteristics.

Results: In a sample of 10,054 participants (mean age 75.2 years, 51.1% female, 78.1% White) a total of 2,416 (24.0%) participants were identified as having functional hearing loss, while 7,638 (76.0%) were classified as having no hearing loss. Compared to participants without hearing loss, participants with hearing loss were older (78.2 years vs. 74.2 years), more likely to identify as White (82.6% vs. 76.7%), male (62.0% vs 44.7%), and reported a slightly higher education level (65.9% vs. 63.5% said they more than a high school education). Participants with hearing loss experienced slightly less severe (5.1 vs. 5.4), but a similar number (3.3 vs.3.4) of NPS than study subjects without hearing loss. In adjusted models, we estimated that self-reported functional hearing loss was associated with higher (IRR: 1.03; 95% CI: 0.98, 1.08) and more severe (IRR: 1.05; 95% CI: 0.99, 1.11) NPS, however the confidence intervals for these associations included the null hypothesis. Further investigation showed that hearing aid use was statistically significantly associated with fewer (IRR: 0.93; 95% CI: 0.88, 0.99) and less severe (IRR: 0.90; 95% CI: 0.84, 0.97) NPS. These results suggest that hearing aid use may be a protective against NPS.

Conclusions: We find that hearing aid use among PLWD and concurrent functional hearing loss may have a protective effect on the management of NPS. While limited by a functional measure of hearing status, our study emphasizes the importance of continuing to explore the importance of identifying and addressing hearing loss in a rigorous fashion among PLWD.

Category: Hearing Technology / Amplification

Poster #: 195

Phonak Sphere Infinio is Preferred by Clients during Real-World Use

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Objectives: 1. Better speech Understanding in a "real-world" scenario (via Guided Field Trip) is better with Phonak's new Spheric Noise Program compared to two competitor speech-in-noise programs for adults with moderate to moderately severe hearing loss. 2. Less listening effort (Via subjective questionnaire based on the real-world scenario) with Phonak Spheric Noise Program than without for adults with moderate to moderately severe hearing loss.3. Phonak Infinio Sphere will be more preferred compared to two competitor hearing aids when adults with moderate to moderately severe hearing loss have completed a "real world" situation (s).

Design: This investigation is an interventional study with a confirmatory design. The investigation model is a single-blinded, cross-over design. 26 participants met the investigator 3 times during an approximate 2-month study. 1 visit was in lab; the remaining 2 visits were conducted inside a loud, local café. The participants were experienced adult hearing aid users with moderate to moderately severe bilateral hearing loss aged 58 to 93 years.

Results: Speech was better rated with Phonak Infinio Sphere than with compared to competitors, participants rated less listening effort with the Infinio Sphere, and the Phonak Infinio Sphere was more preferred than competitors in a loud café setting.

Conclusions: Data from the café visits closely resemble the data obtained in the more controllable lab setting. Additionally, data support two processors working in parallel indeed enhance speech and suppress noise, achieving outstanding results on real people in a real-world noisy café, even as compared to other premium level hearing instruments. Participants indicated that they usually would avoid such noisy places as the café we chose for testing due to the typical conversation difficulty, but with the new DNN-based hearing aids, they were able to communicate. With the introduction of Phonak Sphere Infinio, it may be important to encourage the hearing aid wearer to re-explore environments.

Category: Hearing Technology / Amplification

Poster #: 196

Sound Quality Outcomes with a Novel Source-Based Compression Approach

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Objectives: Real-world listening environments, especially challenging ones like restaurants and social events, include multiple overlapping sound sources. Conventional hearing aids apply dynamic range compression to the mixture signal captured by the microphone, which can result in reduced performance in multiple-source listening tasks. For example, fast-acting compression improves audibility of soft speech, but it can interfere with the temporal dynamics of music, for which slow-acting compression is generally preferred. Furthermore, joint compression of multiple sounds is known to produce nonlinear distortion artifacts in which the level of one sound affects the gain applied to the others. To avoid these tradeoffs, we evaluate a novel approach known as source-based compression, where each sound source

is processed individually before they are mixed and delivered to the listener. In this study, we focus on the specific use case of speech and music. The objective is to determine whether source-based compression can provide better sound quality than conventional (mixture-based) compression. It is expected that source-based compression will better preserve the sound quality of each signal by maximizing the benefits of different compression parameters for each signal and reducing nonlinear distortion effects.

Design: Listeners with normal hearing and hearing loss (mild to moderately severe sensorineural loss) rate the sound quality for spontaneous speech spoken by a female talker mixed with classical music (Beethoven). A hearing aid simulator is used to apply gain across frequencies for a standard mild to moderate hearing loss (normal hearing group) or the listener's hearing level (hearing loss group). For mixture-based compression, speech and music are processed with fast compression after the signals are mixed to simulate a conventional hearing aid. For source-based compression, speech is processed with fast compression and music is processed with slow compression, and the signals are mixed after the compression parameters are applied. The speech level is always 65 dBA and the music level is varied to achieve three speech-to-music ratios (SMRs; -10, 0, +10 dB). Listeners rate sound quality across four dimensions: overall impression, speech clarity, speech naturalness, and music naturalness.

Results: Results from the normal hearing group (N=15) show that the effects of source-based compression varied by relative signal level. Specifically, at -10 dB SMR, source-based compression resulted in higher ratings than mixture-based compression for overall impression ($p=0.021$) and speech clarity ($p<0.001$). As the SMR increased, the differences in sound quality ratings between the two compression methods decreased for these two scales. When the SMR increased, the ratings for overall impression ($p<0.001$) and speech clarity ($p<0.001$) increased, whereas music naturalness decreased ($p<0.001$). Results from the hearing loss group and statistical analyses from the complete dataset will be presented.

Conclusions: This study is a proof-of-concept to show the benefits of source-based compression for sound quality outcomes. Source-based compression can provide better overall sound quality and speech clarity when music levels are higher than speech which is often the case in restaurants and social gatherings. The results provide a baseline for future work involving innovative source-based compression design in hearing aids.

Category: Hearing Technology / Amplification

Poster #: 197

Hearing Aids Beneficial for Normal Hearing Individuals with Auditory Injuries

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Objectives: Recent evidence suggests that individuals with a history of blast exposure and/or a history of noticeable temporary threshold shifts (TTSs) after noise exposure frequently report chronic hearing difficulties even when their thresholds fall within the normal range. There is also evidence that low-gain

hearing aids can provide substantial benefits for many Service Members (SMs) with normal hearing thresholds who report chronic hearing difficulties. However, to this point, no effort has been made to directly determine if individuals with a history of blast exposure or TTS are more likely to obtain benefits from hearing aids than individuals who do not. The main objective of this retrospective study was to quantify the relationship between TTS history, blast history, hearing complaint and hearing aid benefit based on a survey administered to Service Members in conjunction with their required annual hearing tests.

Design: Active-duty United States (US) Service members (SMs) volunteered to participate in research following their annual hearing screening at hearing conservation clinics across the US. Participants completed a short battery of surveys and tests, including hearing thresholds, the Hearing subscale of the Tinnitus and Hearing Survey, a hearing aid questionnaire, and questionnaires asking about blast exposure and TTS history. Data were analyzed using a pair of linear models with blast exposure and TTS history categories as predictors and hearing aid benefit and subjective hearing difficulty as measured by the Hearing subscale of the Tinnitus and Hearing Survey as outcomes.

Results: Preliminary results show that overall subjective hearing difficulty increased with both blast exposure and TTS. The preliminary results also show that SMs with normal hearing thresholds obtained a much greater benefit from hearing aid use when they had a history of both blast exposure and TTS, and that blast-exposed individuals with thresholds within the normal range who reported frequent TTS reported hearing aid benefits similar to those obtained by individuals with elevated hearing thresholds. Individuals who reported that they had never experienced TTS received minimal benefits from hearing aids regardless of their hearing thresholds.

Conclusions: Low-gain hearing aids can provide benefits to individuals with normal- hearing thresholds, but these benefits do not seem to occur for all listeners with thresholds within the normal range wearing hearing aids. A previous study indicated that hearing aid benefits only occurred for individuals with hearing complaints that placed them in the bottom 5 percent of NH listeners. These results suggest that hearing aid benefits may also be related to blast exposure and post-exposure hearing symptoms. More research is needed to explore this in more detail. Disclaimer: The views expressed in this abstract are those of the authors and do not necessarily reflect the official policy of the Department of Defense or the U.S. Government.

Category: Hearing Technology / Amplification

Poster #: 198

Vocal Emotion Recognition in Adults: Insights from Acoustics and Behavior

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Objectives: Hearing loss disrupts the perception of emotion. Currently, there is limited evidence demonstrating the benefits of hearing aids in this domain. This study investigated the effects of hearing loss and hearing aids on vocal emotion recognition through two components, 1) behavioral testing on participant's emotional recognition and 2) analysis of acoustic cues that differentiate emotions with and without hearing aids.

Design: The targeted study enrollment includes 20 listeners with normal hearing and 20 listeners with hearing loss aged 55 to 80 years. Participants completed behavioral testing in the laboratory using a previously validated corpus of emotional stimuli and a closed-set recognition task. They were asked to identify the emotion type and rate their confidence in the judgment. The emotions portrayed included anger, happy, sad, fear, disgust, and neutral. Participants with normal hearing completed the testing with no hearing aids. Participants with hearing loss completed the testing with and without commercially available study hearing aids, which were fit and verified in the laboratory. The test order was counter-balanced. Stimulus modality was manipulated such that the emotion stimuli were presented as auditory-only (sound) or audiovisual (sound plus video). Prior to behavioral tasks, participants with hearing loss wore the study hearing aids for approximately three weeks. To analyze acoustic differences between portrayed emotions, test stimuli were recorded through an acoustic manikin with and without hearing aids. Different hearing aid fitting parameters were also explored. The recordings were submitted to acoustic analyses, which included evaluation of overall level, crest factor, pitch, spectral shaping, and amplitude modulation

Results: Preliminary analyses of the acoustic data indicate that hearing aids improve the audibility of the test stimuli, especially at high frequencies. However, hearing aids also alter the cues that might differentiate emotion, specifically dynamic cues like crest factor and amplitude modulation. Behavioral data collection is ongoing, but preliminary results show that listeners with hearing loss were overall less confident and less accurate in the emotion recognition task than their normal hearing peers, especially when visual information was not available. Amplification improves their confidence but has mixed effects on recognition accuracy. Some of these behavioral findings may relate to acoustic findings.

Conclusions: The results of this study provide insight into the possible reason for previous mixed results demonstrating hearing aid benefit for emotion recognition by linking behavioral data and acoustic parameters related to recognition of vocal emotion. Specifically, the study hearing aids improved audibility of high-frequency content, but also altered dynamic cues that might be important for the ability to recognize emotions. The implications of these findings will be discussed.

Category: Hearing Technology / Amplification

Poster #: 199

Characteristics of Hearing Aid Fittings in Adolescents

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Objectives: Hearing aids (HAs) play a crucial role in providing auditory access and supporting appropriate speech and language development among children who are hard of hearing. While past research studies have characterized standard clinical practice for hearing aid fittings in infants and children, the specific characteristics of hearing aid fittings in adolescents remain largely unknown, as this age group is often understudied. This presentation has three research questions - 1) What is the proximity of HA fittings to prescriptive targets among adolescent HA users? 2) What percentage of participants have aided audibility values outside of the DSL normative range? 3) What factors predict aided audibility? We hypothesized that 1) as the deviation from prescriptive target increases, the aided audibility will decrease, and 2) aided audibility will be related to severity of hearing loss and deviation from prescriptive target.

Design: We analyzed HA fitting data from 165 adolescents (ages 12 to 20) with mild to profound hearing loss. Proximity of fitting to prescriptive targets was quantified by calculating the average root-mean-square (RMS) error of the fitting compared with Desired Sensation Level (DSL) prescriptive targets for 500, 1000, 2000, and 4000 Hz. Aided audibility was quantified using the Speech Intelligibility Index (SII) at 65 dB SPL (average speech). We conducted a regression analysis to examine the associations between aided audibility (dependent variable) and RMS error and PTA (predictor variables), while controlling for age.

Results: Sixteen percent of fittings from both left and right ears combined had an RMS error less than 3 dB, 25% had an RMS error between 3 dB to 5 dB, and 60% had at least 1 ear that deviated from prescriptive targets by more than 5 dB RMS.Aided audibility for the right ear was significantly predicted by RMS error ($B = -0.264$, $p<0.001$) and right PTA ($B = -0.795$, $p<0.001$). The same model for the left ear showed similar statistical patterns with RMS error ($B = -0.305$, $p<0.001$) and PTA ($B = -0.782$, $p<0.001$). Overall, the models used for both ears accounted for approximately 82% of the variance.

Conclusions: Adolescents in the study had a wide range of fitting outcomes in terms of proximity to prescriptive targets (RMS error) and aided speech audibility (SII). The current study highlights the importance for clinical audiologists in achieving optimal audibility outcomes for adolescents with hearing aids, particularly to identify impact of deviations from prescriptive targets on speech audibility.

Category: Hearing Technology / Amplification

Poster #: 200

Perceived Sound Quality and Mood in Established Hearing Aid Users

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Objectives: Hearing aid sound quality is an important contributor to hearing aid outcomes, such as use, benefit, and satisfaction. Considerable research efforts have focused on the factors that improve sound quality, such as hearing aid bandwidth, frequency response, and compression parameters. Results of such

studies demonstrate that differences in these acoustic characteristics can result in differences in sound quality, sometimes without affecting speech intelligibility. Yet, little is known about more holistic effects of hearing aid sound quality on hearing aid wearers' daily lives. The purpose of this study was to evaluate the difference between good and poor, but tolerable, hearing aid sound quality on ratings of well-being and end-of-day mood.

Design: Thirty adult hearing aid users were fit with commercially available, research hearing aids. The participants adjusted their hearing aids to have two programs, one with 'good' and one with 'poor, but tolerable' sound quality. After a cooling-off period, participants wore one of the two programs home for approximately 1 week and rated their mood at the end of the day using a validated mood questionnaire. Participants then returned to the lab, completed a validated quality-of-life questionnaire. They then commenced a second home trial with the other hearing aid program, again completing end-of-day mood questionnaires each day and a well-being questionnaire at the end of the week. Participants were blinded to the programs and program order was randomized across participants. Data were analyzed using linear mixed-effects modeling with quality-of-life or end-of-day mood ratings as the dependent variable, program as the independent variable, and participant as a random factor. Additional analyses were used to evaluate differences between the programs in terms of hearing aid frequency response and laboratory-based speech-in-noise performance.

Results: On average, participants programmed their 'poor, but tolerable' sound quality program to be approximately 5 dB lower than the 'good' sound quality program from 1000-4000 Hz. Speech-in-noise scores were not significantly different in the two programs. Ratings of wellbeing after each one-week trial were also not significantly different from each other. However, self-reported mood at the end of the day was better as measured with the mood questionnaire, indicating participants felt more vigor, less fatigue, and more esteem at the end of the day when using their 'good' sound quality program compared to the 'poor, but tolerable' sound quality program.

Conclusions: Hearing aid sound quality plays an important role in feelings of fatigue, vigor, and esteem at the end of the day. This finding is important because participants were blinded to the programs during the home trial when they rated their mood. In addition, the differences in gain settings were relatively small and did not affect speech intelligibility. These findings add further support to the growing body of literature demonstrating the importance of hearing aid sound quality. Future work is warranted to translate the self-adjustment hearing aid programs into clinical practice.

Category: Hearing Technology / Amplification

Poster #: 201

Patient Experience and Preferences for One or Two Hearing Aids

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Objectives: Our aim was to explore patient experiences with assigned unilateral or bilateral hearing aid fittings in a randomized controlled clinical trial (RCT), and perspectives on patient preferences in regards to their choice of final hearing aid configuration at the conclusion of their three-month trial.

Design: All study participants who completed the parent RCT intervention comparing the benefits of unilateral and bilateral hearing aid fittings for the treatment of mild-to-moderate age-related hearing loss in individuals aged 50+ years responded to patient experience questions at the 3-month follow-up evaluation. Adapted from Credibility/Expectation Questionnaire, study participants were asked: On a 10-point scale, how likely are you to recommend (hearing aid assignment) to a friend or family member in need hearing aids? (1 = not all; 10 is very highly likely/full recommendation). This "Net Promoter Score" (NPS) is categorized into 'promoters' for people with a positive experience (ratings of 9 or 10), 'passives' (rating as a 7 or 8), and 'detractors' for people with a negative experience. (ratings<= 6). Participants were then asked the primary reason supporting their score, their choice for final configuration and reason for their choice. Purposive sampling based on hearing aid assignment and NPS was used to invite participation in one of three semi-structured focus groups: unilateral fittings, bilateral fittings, or mix of unilateral/bilateral. Focus groups were held via zoom and recorded. The recordings were transcribed verbatim and validated by a second study team member. The transcripts and text responses to experience and preference questions were inductively coded, and themes generated in Dedoose but have yet to be validated by persons with hearing loss.

Results: Among 136 study participants assigned for unilateral fittings, 39.0% had a positive experience and would recommend the same configuration to others. For 139 participants with a bilateral fitting, 66% had a positive experience. A sub-optimal experience was reported by 20.6% and 7.9% of those in unilateral and bilateral fitting groups, respectively. The most prominent experience was noticeable improvement: "I didn't know how much I was missing." The second most frequent theme that emerged on experience was, high tech with some rewards. Time to adjust to the app, in ear sound and intersection of sounds from different smartphone functions was favored by some people and a challenge for others. One theme developed to describe both experience and preference: context matters. Participants reported that satisfaction with their experience using one vs two hearing aids varied by situation-noise level, number of people, task-and preference for whether to ultimately choose to have two, or choose to even wear both after being fitted for bilateral aids also varied by situation-employment, grandchildren, social participation. Financial stability was commonly reported as factor influencing choice. Although there were more "promoters" in the bilateral group, they reported more challenges adjusting than those who began with one and "built up the stamina" and technologic understanding before choosing a final configuration.

Conclusions: Findings suggest both hearing aid configurations were perceived as beneficial. Financial stability, daily activities and lifestyle could be considered important factors to inform patients' choices regarding purchase of unilateral or bilateral hearing aids.

Category: Hearing Technology / Amplification

Poster #: 202

Modeling Decision-Making Strategies Among Prospective Hearing Aid Buyers

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Objectives: With the growing availability of diverse hearing aid (HA) service delivery models-ranging from prescription HAs fitted at clinics, hospitals, and retail settings like Costco, to over-the-counter HAs available in grocery stores, pharmacies, and online-prospective buyers now have more options than ever. However, how HA buyers evaluate the attributes of different service models (e.g., cost, availability of in-person support) and make purchasing decisions is not well understood. This study aimed to determine whether the decision-making strategies of prospective HA buyers can be modeled using the Equal Weighting (EQW), Weighted Additive (WADD), or Take-The-Best (TTB) strategies. The EQW and WADD strategies involve considering all attributes and assigning equal (EQW) or different (WADD) weights based on perceived importance. In contrast, the TTB strategy is a less cognitively demanding approach that focuses on choosing the option with the highest score on the most important attribute.

Design: Three groups of participants were recruited: experienced HA users, non-HA users, and adult children of parents with hearing loss. In a lab-based experiment, participants completed 45 decision-making trials, each involving a choice between two hypothetical HA service options. Each option was characterized by eight attributes, and each attribute has either a positive or negative value (e.g., "full in-person support" vs. "limited in-person support"). A side-by-side comparison of the two HA services across the eight attributes was presented to participants in each decision. The attribute values were systematically manipulated, allowing participants with different decision-making strategies to prefer different options. Following the decision-making tasks, participants ranked and rated the attributes by importance.

Results: Ninety participants completed the study (43 females, mean age = 56.5 years), with 30 in each participant group. Before analysis, decisions predicted by the EQW, WADD, and TTB strategies for each of the 45 trials were generated for each participant based on their individual attribute importance rankings and ratings. Three multilevel logistic regressions-one for each strategy-were conducted, with predicted decisions as the independent variable and observed decisions as the dependent variable. The results showed that only the regression models of WADD and TTB were statistically significant, with TTB being much more likely to account for the observed data than WADD. The statistical models further suggested that most participants were classified as using TTB (60.7%), followed by WADD (39.3%), and none using EQW (0%). Although more experienced HA users employed the TTB strategy (75.9%) compared to non-users (56.7%) and adult children of parents with hearing loss (50.0%), the difference was not statistically significant. HA warranty length, out-of-pocket cost, and support provider (hearing care professional vs. customer service representative) were ranked as the most important attributes when making decisions.

Conclusions: Most participants employed the TTB strategy when selecting service delivery models, followed by the WADD strategy. This indicates that prospective HA buyers tend to base their decisions on a limited number of key attributes they deem most important. Leveraging decision-making framework theories, the findings of this study could inform the design of HA service delivery models that are more appealing to prospective HA buyers.

SPEECH PERCEPTION

Category: Speech Perception

Poster #: 203

Cochlear Implant Listeners' Perception of Trust/Doubt in the Voice

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Objectives: Prosodic features like intonation and speaking rate communicate key information about the meaning, emotion, and attitudes that shape a given utterance. Although prosody is sometimes considered secondary to word-level intelligibility, it can be socially significant in building and maintaining relationships. For example, if patients perceive a clinician's trusting or neutral tone as disbelieving, this may weaken the rapport the clinician has with the patient, impacting the patient's willingness to receive care.Extending previous work on perception of basic emotions from vocal cues, the goal of the current study is to understand perception of doubt and trust. We hypothesized weak or inconsistent perception of trusting/doubting prosody by cochlear implant (CI) listeners because of their limited access to fundamental frequency (F0) and compensatory weighting of other cues like duration and intensity.

Design: Participants rated perception of trust and doubt in response to words that were manipulated to contain acoustic cues to these attitudes. Stimuli were 64 unique spoken renditions of the word "okay" derived from one natural trusting token and one natural doubting token (endpoints that could be written as "okay!" or "okay?" respectively). Stimulus acoustic parameters included F0 contour (doubt: low-rising, trust: high-falling), vowel duration (prolonged vowel duration for doubt), closure duration and intensity of the /k/ (longer and louder respectively for doubt), and vowel quality (more diphthongized vowels for doubt). These tokens were presented to typical hearing (TH) listeners and CI listeners who were told to determine based on the talker's tone of voice whether the talker trusted or doubted a hypothetical statement made by the participant. Responses were continuous ratings given on a visual analog scale. Listeners heard all 64 tokens four times in four blocks, with each token presented in random order once per block, for a total of 320 trials. Response slope and variability were analyzed in a linear mixed effects model, with listener response predicted by fixed effects of listener hearing status, the four manipulated acoustic variables, and interactions between these variables.

Results: Prolonged vowel duration and increased /k/ intensity and closure duration led to stronger percepts of doubt in both CI and TH listeners. Falling F0 contour significantly predicted TH perception of trust but did not affect CI listeners' perceptions. CI listeners rated stimuli where F0 and duration represented trust as less trusting than did TH listeners.

Conclusions: TH and CI listeners can differentiate between durational cues to trust and doubt but rely on different auditory information to render this judgment. CI listeners do not reliably perceive trust from a high-falling intonation pattern on its own without accompanying durational cues. When building rapport with CI patients, clinicians should consider how simple responses like "okay" may be perceived as disbelieving, especially if spoken slowly, even if the clinician intends to convey trust or support through their intonation. Future study should consider alternative strategies for conveying trust (e.g., vocal intensity cues or facial expressions) that increase CI listeners' access to a talker's expression of trust.

Category: Speech Perception

Poster #: 204

Spatial Separation, Head Orientation, and Extended-High-Frequency Cues for Speech Recognition

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Objectives: Talker head orientation cues support masked speech recognition. Due to the directional nature of high and extended high frequencies (EHFs; >8 kHz) in speech, EHFs provide some of these head orientation cues. In real-world multi-talker settings, a combination of spatial cues, including spatial separation and mismatched head orientations, likely contribute to the human ability to recognize target speech. In the present study, we investigated the interaction between spatial separation, head orientation, and audibility of extended high frequencies for male speech recognition. We hypothesized that the availability of head orientation cues would reduce the importance of spatial separation, and vice versa. We also hypothesized that loss of audible EHFs, either by low-pass filtering or by having elevated EHF thresholds, would lead to poorer speech recognition and loss of head orientation cues.

Design: Subjects were young, normal-hearing adults (≤20 dB HL at 500-8000 Hz, bilaterally). Listeners were split into two groups, EHF-NH (≤20 dB HL at 9-16 kHz, bilaterally) and EHF-HI (at least one frequency between 9-16 kHz >20 dB HL, in either ear). Speech recognition thresholds (SRTs) for sentences were measured using an adaptive procedure with a male target talker and a male two-talker masker. The target talker always faced the listener, and experimental manipulations included facing (0°) versus non-facing (90°) maskers, co-located versus spatially separated maskers (±45° symmetric separation), and full-band speech versus speech low-pass filtered at 8 kHz.

Results: The talker head orientation related (THOR) benefit was approximately 5 dB for full-band speech, whereas the spatial separation benefit was approximately 8 dB, with a total benefit of approximately 10.5 dB when cues were combined. Listeners in the EHF-HI group exhibited poorer performance compared to the EHF-NH group in the co-located, non-facing condition. However, this EHF-HI group effect disappeared when talkers were spatially separated. Similarly, there was an effect of low-pass filtering for co-located, non-facing maskers that was reduced when talkers were spatially separated. When speech was low-pass

filtered, the THOR benefit was reduced, whereas the spatial separation benefit was enhanced, potentially due to the loss of head orientation cues associated with directional EHFs. The presence of head orientation cues reduced the spatial separation benefit, and vice versa.

Conclusions: Spatial separation and mismatched head orientation both provide salient cues for male speech-in-speech recognition. There is a complex interaction between spatial separation, head orientation, and audibility of EHF cues for speech recognition. There was a clear trend for an EHF benefit for male speech-in-speech recognition across all conditions. This was somewhat surprising, given that male talkers tend to have lower spectral levels at EHFs. Elevated EHF thresholds were associated with poorer speech recognition in some, but not all, listening conditions. [Supported by NIH R01-DC019745 (BBM)]

Category: Speech Perception

Poster #: 205

Association of Attention and Memory on Speech Segregation in Children

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Objectives: Children's ability to segregate speech from background talkers (interferers) is highly variable. The sources of variability are not well understood, and likely determined by a complex interaction of auditory and non-auditory processes; the latter are likely to be cognitive abilities involving attention and working memory. This study focused on the extent to which cognitive processes contribute to individual variability in the magnitude of benefit from spatial separation between target speech and interferes termed as spatial release from masking (SRM). While this study focuses on typically developing (TD) children, it was designed to serve as a benchmark for examining maturation in children with intellectual and developmental disability or hearing loss.

Design: TD children aged 5 to 17 years (N=37) and TD adults aged 18-24 years (N=39) participated. Target stimuli were spondaic words and interfering sentences were two-talker 'babble' from the Harvard IEEE corpus. Participants identified a picture on a screen that matched the heard target word in a four-alternative-forced-choice task. Speech reception thresholds (SRTs) were assessed with target stimuli at 0-deg, in quiet, and with interferes co-located (front), or spatially separated (90-deg to the right or left). Auditory attention and working memory were assessed in children using the forward and backward digit span (Wechsler Intelligence Scale for Children).

Results: Pearson correlation showed significant associations between age and SRTs. When grouped into age groups, analysis of variance (ANOVA) tests showed a significant main effect of age on each SRT condition tested (quiet: $F(3,72) = 10.87$, $p<.001$; co-located: $F(3, 72) = 13.81$, $p<.001$; asymmetric right: $F(3, 72) = 32.51$, $p<.001$; asymmetric left: $F(3,72) = 31.75$, $p<.001$). Bonferroni-corrected post hoc two-

tailed paired t-tests revealed significant maturational effects progressing with age when comparing age groups (5-8, 9-12, and 13-17, and 18-24 yrs), for all conditions tested. The exception was lack of difference between 13-17- and 18-24-year-olds. Within each age group, Bonferroni-corrected post hoc paired t-tests revealed significant differences in SRTs between quiet and all interferer conditions (i.e., masking), and between co-located and separated (i.e., SRM), with no differences for interferers on right vs left. Pearson correlation revealed significant associations between SRTs in quiet or asymmetric left with both the digit span forward and digit span backward. SRM with interferers on the left (when a right-ear advantage occurs) was correlated with working memory.

Conclusions: This study provides insight into age effects associated with segregation of speech from interferers throughout childhood. Preliminary findings suggest that cognitive processes such as auditory attention and working memory may contribute to this ability in TD listeners, with benchmarked data that can serve as the basis for understanding communication abilities of individuals with intellectual and developmental disability or hearing loss.

Category: Speech Perception

Poster #: 206

Relationship Between Extended High Frequency Hearing Thresholds and Talker and Spatial Advantage in Children

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Objectives: The understanding of extended high frequencies (EHFs; > 8 kHz) in human hearing has significantly evolved over the past two decades, particularly regarding their role in auditory perception and communication. This study investigates the importance of EHF hearing in children, who typically demonstrate enhanced sensitivity to EHFs compared to young adults. A listening scenario where EHF hearing may be crucial is in complex listening situations, such as multitalker environments, where effective speech comprehension and communication relies on the ability to distinguish target speech from competing auditory signals. Adult listeners employ various cues for this segregation, including differences in talker-sex and spatial separation between the target and masking speech sources. In environments with competing sounds, like classrooms or noisy playgrounds, the ability to segregate and comprehend speech is vital for children. Understanding how EHF hearing facilitate in these scenarios can inform strategies to support communication abilities in children. While previous research has primarily focused on the effects of talker sex and spatial cues in isolation, the potential benefits of combining these cues have been less explored. The objective of this study was to examine the relationship between EHF hearing and utilization of talker-sex, spatial, and combined sex and spatial cues for segregation of competing speech. We hypothesize that children with better EHF hearing will perform better in challenging listening conditions (low cue scenarios) compared to conditions where both talker sex and spatial cues are available. A related goal was to test the feasibility of using digit triplets to assess speech stream segregation.

Design: This study employed a case-control design involving children aged 4 to 14 years, all of whom had clinically normal audiograms but exhibited varying degrees of EHF thresholds (n=81). This approach allowed for the comparison of speech recognition abilities across different levels of EHF sensitivity, speech recognition thresholds (SRTs) were measured using an adaptive approach. The stimuli were digit triplets. The major advantages of using digits are that it overcomes the challenge of test administration, and digits are among the few first words children learn. The testing included four conditions, analogous to the Listening in Spatialized Noise- Sentences test: (1) Low cues: The target (male talker) and two male maskers were presented from the front. (2) Talker advantage: The target and two female maskers were presented from the front. (3) Spatial advantage: The target was presented from the front, while two male maskers were presented from +90 and -90 degrees. (4) Combined spatial and talker advantage: The target was presented from the front, with two female maskers presented from +90 and -90 degrees.

Results: There was a trend indicating that poorer EHF thresholds were associated with increasing age, whereas standard frequency thresholds did not show a similar pattern. SRTs could be measured in 79 to 80 children, depending on the listening condition, and significant improvements in SRTs were observed with age. Initial regression analyses revealed that, after adjusting for age and standard frequency threshold effects, EHF hearing sensitivity had a significant impact on SRTs in low-cue and talker-sex conditions, but not in spatial or high-cue conditions, with SRTs worsening as EHF thresholds decreased. Additionally, while release from masking for talker, spatial, and combined conditions improved with age, there was no significant effect of EHF thresholds on this improvement. Final analysis will be presented.

Conclusions: Findings indicate that poorer EHF thresholds correlate with increasing age in children, while standard frequency thresholds remain stable. Utilizing digit triplets enabled testing of children as young as four years old. EHF hearing sensitivity significantly affects SRTs in low-cue and talker-sex listening conditions, underscoring its importance in specific complex auditory environments. Despite improvements in masking release with age, EHF thresholds did not significantly influence these changes, suggesting that other factors may contribute. Overall, this study emphasizes the critical role of EHF hearing in speech stream segregation.

Category: Speech Perception

Poster #: 207

Exploring Listening Effort and Affective Processing Using Pupillometry

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Objectives: The objective of this preliminary study was to determine whether pupillometric indices of listening effort and affective auditory and visual processing differed among adults with normal hearing and hearing loss. The main hypothesis was that participants with hearing loss would demonstrate increased listening effort and diminished affective processing responses compared to the adults with normal hearing. The long-term goal of this project is to use these measures to quantify the listening

deficits experienced by Veterans with bothersome tinnitus, blast exposure, traumatic brain injury, and posttraumatic stress disorder.

Design: Twenty-one adults with normal hearing and nine adults with hearing loss participated in this study. Participants with hearing loss had no greater than a moderately-severe sensorineural hearing loss and wore their own hearing aids during testing, if applicable. Participants listened to AzBio sentences, viewed affective images, and listened to affective sounds while their pupil size was measured. Baseline pupil size, peak pupil dilation, and growth curve analyses (GCA) were used to analyze the responses.

Results: Baseline pupil size did not change significantly across condition or modality for participants with hearing loss. Baseline pupil size was significantly smaller for the affective visual stimuli for participants with normal hearing. All participants showed greater task-evoked pupil responses to AzBio sentences in noise than in quiet. Participants with hearing loss exhibited smaller peak pupil dilation to affective sounds and images than the participants with normal hearing. GCA showed that participants with hearing loss exhibited a faster change in pupil dilation than participants with normal hearing during both AzBio sentence conditions; similar or slower change in pupil dilation for the affective sounds; and much slower or similar change in dilation to affective images. An exploratory analysis of seven patients with greater than a mild Tinnitus Handicap Inventory score revealed that baseline pupil size, not peak or growth curve measures, was associated with subjective tinnitus handicap.

Conclusions: The preliminary results from this study suggest that hearing loss affects listening effort and the processing of affective sounds and images differently. Importantly, baseline pupil size may be a better metric for quantifying bothersome tinnitus than either traditional measures of pupil dilation or growth curve analysis.

Category: Speech Perception

Poster #: 208

Effects of Position, Age, and Hearing Status on Speech-in-Noise Recognition

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Objectives: Difficulty understanding speech in noisy environments is a common challenge for individuals with varying degrees of hearing across the lifespan. These difficulties not only hinder effective communication but also negatively impact individuals' daily lives and social interactions. While amplification devices are widely utilized to improve speech comprehension, they often do not adequately address the challenges posed by background noise and may not be appropriate or desired by everyone seeking support. Listener positioning strategies offer a potential solution, or complementary addition, that can be applied effectively across different age groups and hearing statuses. Though listener positioning strategies are frequently suggested in traditional aural rehabilitation, their effectiveness has not been thoroughly supported by empirical evidence. Understanding how listener position interacts

with age and hearing status is crucial for developing more effective and personalized aural rehabilitation strategies. The purpose of this study was to evaluate the effects of listener position, age, and hearing status on speech recognition within a simulated, real-world auditory environment.

Design: 64 participants were tested, ranging in age from 18-83 years and in hearing status from normal hearing to moderately-severe sensorineural hearing loss. Speech recognition was measured across twelve different listening positions (four tables, each with three seats) in a simulated restaurant presented under headphones. Ten competing talkers (maskers) were individually rendered for spatial cues and changes in intensity with distance associated with their simulated position relative to the listener. The target talker was processed similarly for a position 1 meter away from the listener at a 0-degree azimuth. Maskers were normalized for similar vocal effort, but each voice varied in intensity based on distance from each position, producing nominal differences in overall noise level across positions. The intensity of the target speech adapted based on performance to estimate a psychometric function for each listener in each position.

Results: Analysis using linear mixed-effects modeling revealed significant effects of age, hearing status, and listener position on speech recognition. Predictable effects of age and hearing status were observed, with younger adults generally out-performing older adults, and normal-hearing listeners outperforming hearing-impaired listeners. Differences were also observed across tables and among seats within tables. Some, but not all, of these position effects could be explained by differences in the overall noise level. Similar trends in table effects were found across participants, but seat position effects were more sensitive to age and hearing status, particularly at the most advantageous table. Some seat positions appear to offer better high-frequency acoustic cues than others, enhancing speech recognition specifically for normal-hearing listeners. These effects demonstrate that speech recognition is influenced by both spatial and individual factors.

Conclusions: Findings underscore the importance of considering listener position, age, and hearing status in aural rehabilitation counseling. By understanding how these factors interact, clinicians can provide more personalized counseling and develop more effective interventions for all individuals facing difficulties in complex auditory environments. Additionally, this study highlights the need for empirical evidence to guide positioning recommendations, ensuring that aural rehabilitation strategies are based on validated practices rather than acoustic principles alone.

Category: Speech Perception

Poster #: 209

Hearing Aid Use Improves Vocal Emotion Recognition in Adult Listeners

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Objectives: This research aimed to assess the impact of hearing aids on the ability to classify vocally expressed emotion by older adults with moderate to severe hearing loss. Using a completely-within-subject design, the study tested the hypothesis that hearing aid use would improve emotion classification performance of individual participants, relative to the unaided performance of each individual tested. Additionally, the study assessed the impact of two different hearing devices in achieving these improvements.

Design: A group of 21 adult participants aged 50 to 85 years were tested on their ability to classify brief speech stimuli representing the following classes of vocally expressed emotion: amusement, anger, sadness, fear, relief, and surprise. The speech stimuli were digit-triplet utterances that were presented in a 6-alternative forced choice task, which task had been previously validated as providing a sensitive measure of emotion recognition differences that could be associated with moderate to severe hearing loss. The 21 participants completed multiple runs of the emotion classification task on two separate days under three conditions. After an initial test under unaided listening conditions, each participant completed, in a counterbalanced order, two aided conditions: one using newly-fit hearing aids and the other using custom-fit over-the-counter (OTC) devices. Participants underwent tests under all three conditions twice, both before and after a hearing-aid acclimatization period. Home trial results were collected using a mobile-phone based ecological momentary assessment.

Results: For the test group of 21 experienced hearing aid users, emotion classification performance was improved both by the use of hearing aids and by the use of over-the-counter devices. A period of hearing aid acclimatization was not associated with any further improvement in emotion classification performance. There was evidence of consistency between home-collected ecological momentary assessments and retrospective responses collected via pre- and post-test administration of the "Emotional Communication in Hearing Questionnaire." The majority (69%) of momentary assessments reported some level of difficulty in recognizing emotions when listening in noisy situations.

Conclusions: This study has provided a compelling demonstration that hearing aids improve the recognition of emotions in older adults. The study also demonstrated that OTC-style devices can also provide benefits to emotion recognition. Variation in emotion classification was well predicted by measured individual differences in spectrotemporal modulation detection, in speech understanding, and in forward digit span. Both self-report questionnaire data and momentary assessment data supported the assumption that people are experiencing difficulties with emotion recognition in everyday, real-world listening situations.

Category: Speech Perception

Poster #: 210

Measuring Lexical Competition in Spoken Language Using Webcam-Based Eye-Tracking

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Objectives: Listeners show lexical competition within milliseconds to spoken words that share phonemic overlap which can be assessed with eye-tracking using a visual world paradigm. In this paradigm, listeners hear a spoken target word (e.g., "dollar") while viewing a screen of four pictures that share word onset (e.g., "dolphin"), word offset (e.g., "collar"), or a word that is phonemically unrelated (e.g., "lipstick"). Previous research using the visual world paradigm has reliably demonstrated that normal hearing listeners show competitive looks to pictures that share phonemes early in spoken language processing, with increasing looks to target items as more of the word unfolds over time. Growing research using the visual world paradigm has demonstrated delays in lexical competition among individuals with hearing loss, which may reflect the quality of the acoustic input. Critically, visual world eye-tracking research focused on single word spoken recognition has largely been limited to the laboratory setting with research-grade eye-trackers. Research-grade eye-trackers can be costly, thereby limiting access to many researchers. The goal of the current work was to (1) validate the use of webcam-based eye-tracking to lay a foundation for studying spoken language processing outside of the formal laboratory in a variety of patient populations and (2) provide instructional resources for researchers interested in exploring webcam eye-tracking methods.

Design: Normal hearing monolingual participants (n=23) completed a visual world eye-tracking task using webcam methods. For visual world eye-tracking, we used word sets containing a base word (e.g., "dollar") along with three competitor items (e.g., "dolphin", "collar", "lipstick") creating trials with different types of lexical competition. We created custom instructional videos to optimize calibration and audio performance of participants computer at home. On each trial, participants heard a spoken word and clicked on the picture representing the word while viewing an array of four pictures on screen. The experiment was hosted in Gorilla Experimental Builder and participants were recruited from Prolific.

Results: We used the browser plugin, Webgazer.js, to control users' webcams and collect eye gaze coordinates using a machine learning algorithm based on features of the participant's eyes and face, as implemented in Gorilla Experiment Builder's eye-tracking zone. We created a custom R package called webgazeR to pre-process the eye-tracking files and plot the time course of eye movements during the task. Preliminary findings suggest close performance of the webcam visual world paradigm to traditional lab-based visual world studies. Namely, listeners showed increased lexical competition, indexed as proportion looks, to items that share phonemic overlap early in word onset. Competition was weaker as more of the word unfolded over time, consistent with listeners updating lexical expectations with more of the spoken word available.

Conclusions: Preliminary findings suggest that webcam-based eye-tracking may offer a novel approach to measuring spoken language access in listeners with normal hearing, which opens research avenues to examine lexical competition in patient populations, including listeners with hearing loss. Challenges relating to the use of webcam methods in spoken language research include calibration, attentional requirements of the task, and data preprocessing are ongoing.

Category: Speech Perception

Poster #: 211

Sleep Proximity on Speech Learning Outcomes for Degraded Speech

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Objectives: Sleep-mediated memory consolidation has been suggested to play a role in promoting learning and generalization of acoustically degraded speech (e.g., noise-vocoded speech). Previous research has found that in normal hearing listeners, training in the evening hours resulted in heightened speech recognition performance relative to listeners trained in the morning, suggesting a role of sleep in stabilizing speech learning. This work suggests that the time of day may differentially promote learning outcomes. Critically, it is currently unknown whether time of day or the proximity of training to sleep plays a greater role in learning outcomes. The current study explicitly investigated how training in proximity to a period of sleep influences learning outcomes for degraded speech. We hypothesized that if sleep-mediated consolidation is a driving factor in stabilizing perceptual learning of speech, participants who undergo speech training just before an interval of sleep will show improved speech recognition performance relative to training completed after a period of sleep. This research has implications for improving rehabilitation recommendations in individuals with hearing loss adapting to hearing assistive devices.

Design: We recruited normal hearing adults with no known sleep disorders from the university setting. To date we have collected data on 17 participants, with a planned sample size of 40. Participants were randomly assigned to a sleep (n = 8) or wake (n = 9) training group. Participants passed an in-lab hearing screening, completed standardized questionnaires of sleep, and were fitted with an actigraph sleep-wake tracking watch. The experimental portion of the study took place over 7 days and was completed remotely to minimize interference with participants typical sleep/wake patterns. During this period, participants wore an actigraph watch, maintained a sleep log, and completed specific training/test tasks to improve recognition of noise-vocoded speech. The at-home training session consisted of noise-vocoded sentences paired with transcription feedback. The at-home testing involved transcribing noise-vocoded sentences without feedback and occurred before training (baseline), immediately after training (Test 1), 12-hours after training (Test 2), 24 hours after training (Test 3), and 7 days after training (Test 4). These time intervals were selected to isolate the proximity of sleep intervals on testing outcomes. Testing involved generalization to novel sentences, talkers, degradation level. Critically, participants assigned to the sleep training group began the study immediately prior to a period of overnight sleep, while the wake training group began the study immediately after a period of overnight sleep.

Results: Performance during training and at test were scored for proportion correct word accuracy. Preliminary data analysis indicates no statistically significant differences in training performance between groups. At test, both groups of listeners show reliable improvement from baseline to Test 1 and stable performance across the one-week period. To date, statistical testing reveals no statistically reliable differences in test accuracy between the sleep and wake groups, suggesting the training promoted equivalent gains at each testing point. With respect to generalization, preliminary analyses suggest similar generalization performance across tasks for both groups of listeners.

Conclusions: Preliminary findings suggest that training promotes adaptation to noise vocoded speech, regardless of the proximity of training to a sleep interval. Future analyses are aimed at examining individual differences in speech learning (e.g., working memory) and the influence of sleep quality and quantity on outcomes to better characterize the role of memory consolidation on speech learning.

Category: Speech Perception

Poster #: 212

How Imperfect Captions Impact Listening-Related Fatigue in Noise

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Objectives: Listening-related fatigue can be a significant problem for some people with hearing loss. Research indicates that hearing aids and cochlear implants can help alleviate, but not fully resolve, listening-related fatigue. One potential intervention could be live captioning, which has become increasingly accessible, can improve speech understanding, and might reduce listening effort in some settings. Such benefits might lead to reduced listening-related fatigue. However, live captions are "imperfect"; they are time-delayed and can contain inaccuracies, potentially negating fatigue benefits. Supporting this concern, previous work demonstrated that pairing imperfect captions with audiovisual speech improved speech recognition but actually increased fatigue. Anecdotal reports from participants suggested that trying to integrate the imperfect captions with auditory and visual speech cues was cognitively challenging. The current study investigates whether this negative effect persists when we reduce the cognitive challenge by presenting captions in an auditory-only condition (no visual cues). We hypothesize that in this test condition, imperfect captions will reduce listening-related fatigue.

Design: Participants included 16 adults (ages 24-62) with normal hearing who were randomly assigned into a caption or no-caption group. To induce fatigue, participants completed a sustained (~50 minutes) dual-task. The primary task involved sentence recognition in multi-talker babble noise (60 dBA). The speech level was individually adjusted to achieve ~70% accuracy without captions. The secondary task was a reaction time task where participants pressed a button whenever a "topic" word was presented during the primary task. Subjective ratings of fatigue were obtained before, during, and after dual-task testing. Fatigue was also quantified objectively via changes in topic-word response times throughout the dual-task and via changes in Psychomotor Vigilance Task visual response times obtained before and after the dual task. Increases in response times over time were considered indicative of increased fatigue.

Results: As anticipated, the group who had access to captions had speech recognition scores that were ~18% better than the group who did not have access to captions. The study task was effective at inducing fatigue, with subjective fatigue ratings increasing ~50% over time in both groups. In contrast to previous work in quiet with audiovisual stimuli, the increase in fatigue scores was similar for both groups (with and without captions). In addition, there were no significant changes in response times for either the psychomotor vigilance task or the secondary task response times for either group, suggesting changes in behaviorally measured fatigue were small for both groups.

Conclusions: Access to captions improved speech understanding as expected. Also as expected, the dual-task paradigm was fatiguing, as evidenced by changes in subjective ratings of fatigue. Unlike previous work with audiovisual stimuli, we did not observe a pattern of increased fatigue in the group who had access to captions compared to the group that did not have access to the captions. Further research is needed to explore the reasons why captions increase listening-related fatigue in some circumstances and

to discover circumstances under which captions can both improve speech recognition performance and reduce listening-related fatigue. [Supported by NIH-NIDCD T35 DC008763]

Category: Speech Perception

Poster #: 213

The Influence of Momentary Listening Effort on Accumulated Fatigue

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Objectives: People with hearing impairment report listening effort and fatigue as a major barrier to successful social communication. Although numerous studies have been done on short-term listening effort, little is known about the mechanistic connection between momentary effort and the accumulation of fatigue. The goal of this study is to determine how differences in momentary listening effort accumulate and directly lead to differences in listening fatigue. We hypothesize that repeatedly needing to mentally repair missing words will lead to greater levels of fatigue compared to hearing fully intact sentences, with fatiguing being captured by a combination of subjective, behavioral, and physiological measures.

Design: To establish this fatigue measurement paradigm, typical-hearing listeners completed a sentence-repetition task that featured two parallel conditions that were previously established to elicit different amounts of effort on a momentary level, now extended to a sustained 60-minute task to see if differences in effort accumulate to differences in fatigue. One condition included intact sentences while the other condition involved sentences where a missing word needed to be repaired using later context. Pre- versus post-listening tasks were used to measure fatigue, including: 1) reaction times measured for an inhibition task involving visual judgments, 2) divergent creativity as measured by semantic distance between words, and 3) subjective report of task difficulty. During the listening task, tonic changes in pupil dilation and pupillary oscillations were also used as signatures of fatigue as it builds over time. In addition, intelligibility scores and the sequence of verbal reaction times of participant responses are used to provide insights into the time course of fatigue. Recruitment of 20 listeners is scheduled.

Results: The group of 20 listeners should enable power to detect 90ms increases in reaction time during the rapid inhibition task, to detect 2 TLX rating points that indicate increased subjective report, and 12 points (out of 100) of decreased divergent creativity as evidence of mental fatigue after continually repairing missing words. Based on previous differences in pupil size elicited by this mental-repair design and previous studies of sustained effortful listening, the sample is expected to show slower decay of pupil size over time when needing to mentally repair a missing word compared to intact sentences. Listeners who heard only fully intact sentences are expected to have statistically indistinguishable post-test scores compared to the pre-test phase, as the cognitive resources to successfully perceive the sentences should be negligible and brief. However, if no differences are observed between listening groups, then this would establish that fatigue is not a linear product of repeated moments of elevated effort.

Conclusions: The mechanisms of how effortful listening builds into fatigue can be clarified using the design in the current study, which provides a novel approach that capitalizes on tightly controlled

comparison of listening conditions and a variety of outcome measures. While the anticipated effect sizes for changes in reaction time and creativity are small, these changes are potentially meaningful when interpreting the impact of fatigue on other concurrent abilities beyond speech perception.

Category: Speech Perception

Poster #: 214

Hearing in Noise and Dual-Task Performance in Bilingual Older Adults

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Objectives: The objective of this study to learn about how language experience contributes to hearing in noise for older adults. We hypothesize that bilingual older adults will perform similarly to monolingual older adults for speech-in-noise testing in their preferred language, but that in a dual-task condition designed to increase listening effort, the bilingual participants will experience more dual-task cost due to the increased cognitive load associated with bilingual language processing.

Design: The study includes a sample of Spanish/English bilingual adults and a comparison group of monolingual, English-speaking adults. All participants are 55 years or older. Baseline data includes auditory thresholds, the Montral Cognitive Assessment (MoCA) Screener, the Hearing Handicap Inventory for the Elderly - Screener (HHIE-S), and (for the bilingual participants only) the Language Experience And Proficiency Questionnaire (LEAP-Q). Participants also complete a Corsi Block visuo-spatial working memory task. During the experimental conditions, participants hear AZ Bio Sentences in the sound field at a +4 dB signal-to-noise ratio (SNR) and repeat aloud what they hear. They complete two sentence lists while listening only and two sentence lists while completing a Corsi block memory sequence between hearing the sentence and repeating what they heard aloud. The bilingual group completes all tasks in English and in Spanish.Analysis will include between group comparisons for speech-in-noise performance, visuo-spatial working memory performance, and dual-task cost of completing both tasks. Analysis will also include within-subject comparisons for the bilingual group who will complete the conditions in both languages. Dual task cost will be analyzed for change in speech-in-noise performance and for change in visuo-spatial working memory performance.

Results: Data collection is on-going. To date, four older monolingual adults (age-range = 57 - 70 years; mean age= 66.3; SD = 6.2) have completed the experimental tasks. The mean four-frequency (500-4000 Hz) pure tone average in the better hearing ear is 9.7 dB HL (SD = 1.6) and the average HHIE-S score is 6 (SD = 4.3); both of which indicate the sample has clinically normal hearing. The sample also has normal cognition with a mean MoCA score of 27.8 (SD = 2.6). The average percent correct performance for listening to sentences in background babble is 88.7% (SD = 2.7) in the sentences alone condition and 85.8% (SD = 4.1) during the dual task condition. This reduction in performance reflects an increase in the amount of listening effort required to perform the listening and memory tasks at the same time.

Conclusions: Preliminary data suggests that this dual-task experiment induces a small reduction in performance for speech understanding (and recall) in a noisy background. The main objective of the study will be to compare performance between the monolingual English-speaking participants and the bilingual participants (in their preferred language). In addition, we will analyze within subject

performance for the bilingual participants to understand if they experience listening effort differently in their dominant versus less dominant language. Findings from this study will improve our understanding of how to interpret speech-in-noise testing for multilingual patients during audiology evaluations.

Category: Speech Perception

Poster #: 215

Genetic Comorbidities of Speech-in-Noise Deficits Using Polygenic Risk Score Analysis

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Objectives: Speech-in-noise (SIN) deficits refer to difficulties understanding speech against background noise. A recent genome-wide association study (GWAS) revealed polygenic architecture underlying SIN deficits in individuals with self-reported normal hearing. The objective of the present study was to investigate the genetic comorbidities of SIN deficits. We employed a polygenic risk score (PRS)-based association analysis to identify genetic comorbidities of SIN deficits across the health phenome. PRS can quantify the risk of complex health traits based on the genetic predisposition to disease-associated variants

Design: The PRS-based association analysis of SIN deficits was conducted on the UK Biobank cohort, followed by a replication analysis using clinical measures of SIN deficits in a cohort of healthy young adults with normal audiograms. The UK Biobank sample included 279,911 participants with 58,847 cases reporting SIN deficits with self-reported normal hearing in quiet and 221,067 controls without SIN deficits and reporting normal hearing in quiet. The replication sample included 300 healthy young adults (18-37 years) with self-reported normal hearing. Self-reported SIN deficits were assessed by the Speech, Spatial and Qualities of Hearing Scale (SSQ12). QuickSIN and Dichotic Digit Test (DDT) were performed to evaluate SIN processing. DNA samples from the saliva were subjected to low-pass whole genome sequencing. PRS calculation was performed using a custom PRS calculator. Around 2600 PRS models were derived from an open-access Polygenic Risk Score catalog. A logistic regression model was used to identify the PRS predictors associated with SIN deficits in the UK Biobank cohort. A linear mixed model was utilized to identify PRS predictors of SSQ12, QuickSIN, and DDT in the replication cohort

Results: The regression analysis identified PRS predictors across the health spectrum associated with SIN deficits in the UK Biobank. PRS of sensory traits, such as acquired hearing loss and tinnitus, revealed significant associations with SIN deficits. PRS of neuropsychiatric conditions, including schizophrenia, major depression disorder, self-reported depression, anxiety, and risk-taking tendency, revealed robust associations with SIN deficits. Several PRS across the health spectrum, including autism spectrum disorder, alcohol consumption, body mass index, cholesterol, and lung cancer revealed significant associations with SIN deficits. PRS associated with SIN deficits were enriched (overexpressed) in several trait categories, including neuropsychiatric, mental health, and endocrine/metabolic. The replication analysis using SSQ12, QuickSIN, and DDT revealed complementary results.

Conclusions: The present study identified genetic comorbidities associated with SIN deficits in individuals with self-reported normal hearing in two independent cohorts. The results indicate that genetic predisposition to certain health traits can explain intersubject variability in SIN deficits. The results are consistent with the polygenic inheritance of SIN deficits. We posit that efficient communication of the genetic risk of SIN deficits at younger ages can help prevent or delay the onset of clinical representation of SIN deficits

Category: Speech Perception

Poster #: 216

Word Learning in 4-to-6-Year-Old Children When Talkers Use Face Masks

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Objectives: Face masks create barriers to high-quality speech from which children need to learn language. Different types of face masks, however, variably alter the acoustics of the speech signal and access to the talker's face. For example, the ClearMask® provides access to the talker's face but is made of a hard plastic material that filters acoustic speech more than other face masks. In contrast, disposable masks have less acoustic filtering than other masks but conceal the talker's face. The objective of this study was to test the effects of different face masks on novel word learning in preschool-aged children. We asked the specific questions: (1) What is the effect of acoustic filtering on novel word learning? (2) What is the effect of visual speech cues on novel word learning? (3) What is the effect of mask type on novel word learning?

Design: Fifty-six children between 48 and 78 months (mean ± SD: 57.6 ± 7.1 months) participated in the study. Children were taught five novel disyllabic words through an interactive computer program in one of four conditions that vary on the spectral fidelity of speech and access to the talker's face: Auditory-only (AO) without mask filtering; AO with ClearMask® filtering, Audiovisual (AV) with ClearMask® filtering, and AV with disposable mask filtering. In each condition, children were taught novel word forms linked to unfamiliar objects during a retrieval-based training protocol. Children were asked to name all trained objects immediately after training to capture encoding and after a 5-minute delay to capture retention. All productions of words were coded as the proportion of phonological features correctly produced relative to the target word form. Separate mixed-effect beta regression models were used to predict children's production of novel words to address each of our research questions. Covariates in all the models included participants' age, sex (male vs. female), standardized receptive vocabulary scores, and time interval (immediate vs. 5-minute delay). Odds ratios and 95% confidence intervals were estimated, with statistical significance determined at a p-value<= .05.

Results: At the conclusion of one training session, children correctly recalled a proportion of phonological features of the novel word forms across all conditions. Phonological precision varied across words within

a child and across children. The mixed-effect beta regression models suggest the following: (1) Acoustic filtering associated with face masks did not alter children's word learning. (2) The addition of visual speech cues did not alter children's word learning. (3) Children had greater odds of recalling phonological features of novel words in the AV disposable mask condition versus the AV ClearMask® condition immediately after training, but there was no difference across conditions after a 5-minute delay. Children's receptive vocabulary positively predicted word learning outcomes.

Conclusions: Children recalled novel words somewhat equivalently across various mask conditions at the conclusion of one training session. These data suggest that face masks may not disrupt language learning in young children, particularly children with strong receptive vocabulary. The discussion will include considerations for future research.

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Poster #: 217

Assessing Effects of Cognitive Load on Sentence Recognition: A Concurrent fNIRS and Behavioral Study

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Objectives: This study aims to investigate how cognitive load - manipulated by varying stimulus length (i.e., 1 sentence vs 2 sentences) and speed (i.e., normal vs time-compressed) - affects sentence-recognition accuracy and brain activation, using concurrent functional near-infrared spectroscopy (fNIRS). We hypothesized that increased cognitive load would lead to reduced sentence recall accuracy, potentially driven by working memory deficits or temporal processing limitations, depending on the load type. Additionally, we expected that these behavioral outcomes would correlate with participants' cognitive scores on the Wechsler Adult Intelligence Scale (WAIS) test. We further anticipated that fNIRS measurements would reveal increased activation in regions associated with working memory and executive function, such as the pre-motor cortex and middle frontal gyrus (MFG), as cognitive load increases.

Design: The study employed a randomized block design in which participants were presented with 1-sentence or 2-sentence stimuli, across two sessions with varied stimulus speed (0% or 50% time compression). To date, data has been collected from a group of younger adults with normal hearing (YNH), and recruitment is underway for an additional group of older adults with normal hearing (ONH). Behavioral performance was assessed through delayed recall accuracy (percent of correct keywords) under different cognitive load conditions, while brain activation was measured using fNIRS. Additional cognitive measures from the WAIS were collected to assess individual differences in working memory and processing speed.

Results: Preliminary results from eight YNH adults showed a substantial decrease in sentence recognition as cognitive load increased, consistent with our hypothesis. Behavioral results revealed two distinct

patterns: some participants experienced greater difficulty with increased stimulus length while others had greater difficulty with increased stimulus speed. Neuroimaging data indicated greater activation in pre-motor cortex and MFG with increased stimulus speed. However, in the most demanding condition (i.e., 2-sentences, time-compressed), activation dropped below those observed in the easiest condition (i.e., 1-sentence, normal speed). This result suggests that participants may have deployed less cognitive resources and reduced their cognitive engagement in the most difficult condition - possibly demonstrating the participants' tendency to "give up" as cognitive demand increased. This trend aligns with the observed 26% decrease in sentence-recognition accuracy from the easiest to the most difficult condition. We plan to extend this paradigm to ONH adults, predicting overall poorer performance under high cognitive load compared to the younger group. We also expect that individual differences in WAIS cognitive scores will influence behavioral outcomes in the older group, with those showing stronger working memory to be more resilient to increase in stimulus length, while those with greater temporal processing may adapt more effectively to time-compressed speech.

Conclusions: These findings indicate that distinct cognitive load types - stimulus length and stimulus speed - affect sentence recall accuracy and engage separate neural mechanisms, namely working memory and temporal processing speed, respectively. This nuanced understanding of cognitive load in language processing suggests potential for tailored approaches in cognitive training and listening strategies, which could prove particularly beneficial for individuals who may experience greater cognitive demands in complex auditory environments.

VESTIBULAR

Category: Vestibular

Poster #: 218

Treating Imbalance with Augmented Reality: a Proof of Concept Study

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Objectives: Virtual reality games have been used in clinic spaces to improve the perceived benefit and enjoyment of physical therapy based rehabilitation exercises for balance disorders. However, augmented reality (AR) -in which graphics are superimposed over a view of the real world-has been less well explored. Visual reference points are critical contributors to maintaining balance and are naturally given more weight in patients with balance-related deficits from other sensory or even central deficits. Here, we tested if augmented-reality visual cues could be used to improve posture and gait in patients with balance disorders.

Design: Three participants with known balances disorders were recruited. Their postural sway was recorded using body-worn inertial measurement units (APDM, Portland, OR). These measured body sway during quiet stance. Participants wore a MagicLeap AR headset running software custom-programmed in Unity. The visual montage consisted of an "artificial horizon" that remained stable in the earth frame of reference, providing roll, pitch, and yaw information to the user. We tested two ambient visual conditions (obscured vs illuminated room); two AR conditions (visual montage present vs absent);

and two surface conditions (firm vs foam substrate). completed questionnaires relating to their imbalance and dizziness before and after the experiment, as well as their perception of ease of use of the system.

Results: Diagnoses included partial long-term unilateral vestibular loss, acute labyrinthitis, and subacute recovery after vestibular schwannoma resection. In all cases, addition of the artificial horizon improved balance in the obscured room condition. This improvement was even more dramatic when standing on foam. The addition of the artificial horizon improved performance into the normal range even in participants in the most challenging conditions (obscured room, standing on foam).

Conclusions: Augmented reality offers a promising new modality for treating people with imbalance. It promises to serve as a prosthesis that could be worn during daily life, providing veridical visual cues to improve balance performance.

Category: Vestibular

Poster #: 219

Quantifying Vestibular Perception in Vestibular Loss and Pediatric Populations

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Objectives: The aim of this study was to determine whether vestibular perception could be reliably measured using a clinical rotational chair with minimal modification. It was hypothesized that: (1) individuals with vestibular loss would show worse vestibular perception, and (2) vestibular perception could identify sub-clinical vestibular loss in individuals who had "normal" vestibular function but exhibited functional deficits. Additionally, we sought to explore whether vestibular perception could be measured in children. We hypothesized that vestibular perception testing would be feasible in children aged 9 and older, though results would likely be more variable due to attentional differences.

Design: This study included 44 participants: 24 age-matched controls (mean age: 16.8, range: 9 to 45 years, 9 males) and 20 individuals with hearing and/or vestibular loss that were separated into the following two sub-groups: 1) hearing loss and normal vestibular function (n = 11; mean age: 14.4, range 9 - 23 years), and 2) hearing and vestibular loss (n = 9; mean age: 22, range 8 - 47 years). Of those with vestibular loss, 4 had unilateral vestibular loss (1 right, 3 left) and 5 had bilateral vestibular loss. Participants were recruited from the Human Research Subjects Core database at Boys Town National Research Hospital (BTNRH). Informed consent was obtained from all participants under a protocol approved by the Institutional Review Board at BTNRH (protocol 12-13-XP).

Results: Preliminary findings suggest that both functional outcomes and vestibular perception were poorer in participants with vestibular loss. Participants with vestibular loss required higher chair velocities to accurately detect the direction of yaw rotation. Interestingly, individuals with hearing loss

but normal vestibular function also needed higher velocities for accurate detection compared to controls, suggesting possible sub-clinical vestibular loss. Additionally, the vestibular perception task was feasible in children aged 9 years and older, though their performance was more variable than that of adults.

Conclusions: All individuals with hearing loss, regardless of vestibular status needed higher chair velocities to accurately discriminate the direction of yaw rotation compared to typical controls. This finding in individuals with hearing loss and normal vestibular function suggests that vestibular perception testing may be more sensitive for identifying vestibular loss compared to standard vestibular assessments. The study also confirmed that vestibular perception testing is possible in children aged 9 and older, though results were more variable than in adults. Overall, vestibular perception testing using a clinical rotational chair could be a useful tool for detecting vestibular loss, including sub-clinical vestibular loss, and complement traditional vestibular function tests in both adults and children.

Category: Vestibular

Poster #: 220

Ototoxicity at Work: Considerations from the International Ototoxicity Management Group

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Objectives: Exposure to ototoxic chemicals in the workplace can damage the neural processes that underly the hearing and balance functions of workers. This presentation evaluates and prioritizes evidence-based practices for managing individuals exposed to these chemicals in occupational settings. Our objective is to provide considerations regarding hearing conservation delivery to improve hearing and balance outcomes and prevent hazardous exposures from occurring.

Design: This project was conducted by the International Ototoxicity Management Group (IOMG), a consortium formed to address a global gap in ototoxicity management. The IOMG includes experts from professional societies, government agencies, universities, task forces, health foundations, and healthcare users. The "Environmental and Occupational Focus Area" task force was established in February 2021 to tackle research and practice gaps in non-clinical settings. A core group of 6 subject matter experts distilled and drafted a document of considerations from the larger group. Development of these considerations included a mixed methods review which evaluated audiological tests for detecting occupational ototoxicity. A combination of experimental, observational, and expert opinion data was used to prioritize steps to prevent negative hearing and vestibular outcomes. A peer review survey facilitated the tracking of invitations and contributions.

Results: Thirty-one subject matter experts were invited to review the document; 21 completed the review and provided input which was incorporated into the authors' considerations. Invitational emails failed to reach seven experts, and three were unavailable to review it. Current standard pure-tone

audiometric monitoring protocols alone are considered insufficient for early detection of ototoxicity. We identified six steps for the management of workers at risk of ototoxic chemical exposure in the workplace. These steps can be carried out in occupational health programs and were organized into a basic protocol for situations where ototoxic risk exists, with or without concurrent noise exposure, and minimal resources are available. Early identification strategies are considered crucial to identify ototoxic health impacts and include self-report questionnaires, baseline and annual auditory tests, vestibular screening, referrals for diagnosis, case management, and monitoring of exposure scenarios to prevent further cases.

Conclusions: These considerations for management strategies encompass prevention, diagnosis, and treatment of auditory and vestibular dysfunctions that may arise from exposure to ototoxic chemicals in the workplace.