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PODIUM PRESENTATIONS

Toward Cognitive Status as a Predictor of Hearing Aid Success

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Starkey Hearing Technologies

Potential real or perceived conflicts of interest: The study was conducted at Starkey Hearing Technologies.

Objectives: This study aimed to examine how cognitive status, demographic, and audiological factors contribute to speech recognition in noise and overall hearing aid satisfaction.

Background: Hearing aid outcomes appear to be linked to individuals' cognitive status. Improvements in speech recognition ability as a result of amplification are generally well-documented; however, significant individual variability requires further exploration. Cognitive status may account for a proportion of the individual variability observed in hearing aid outcomes.

Methods

Results: Correlation analysis revealed significant correlations between MoCA scores and each of the variables. A regression model that included HINT scores, age, and gender, accounted for the largest proportion of variance (approximately 44%) with the fewest number of factors. Overall hearing aid satisfaction scores increased with increasing MoCA scores.

Conclusions: The results of this study point toward a future in which measures of cognitive status can clinically predict a patient's ability to manage challenging listening situations. For instance, an audiologist may use an observation of mild cognitive impairment as a prospective indicator of poor speech recognition in noise ability, prompting selection of appropriate counseling strategies and technologies.

Effectiveness of Frequency-Lowering Hearing Aids and Electric Acoustic Stimulation (EAS) Cochlear Implant for Treating People with a Severe-To-Profound High-Frequency Hearing Loss

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Potential real or perceived conflicts of interest: The trial hearing aids were graciously provided by Phonak Canada and Widex Canada. First author received doctoral training awards from Fonds de recherche du Québec en santé, Centre Intégré universitaire de santé et de services sociaux de la Capitale-Nationale, and Center for Interdisciplinary Research in Rehabilitation and Social Integration. The first author also received research fundings from Centre Intégré universitaire de santé et de services sociaux de la Capitale-Nationale, and Center for Interdisciplinary Research in Rehabilitation and Social Integration. No other source of potential, real, or perceived conflicts of interest exists.

Background: The effectiveness of hearing aids (HA) for treating people with severe-to-profound sensorineural high-frequency hearing losses (HFHL) is known to be limited. Technological alternatives have been developed to meet the needs of these individuals, such as frequency-lowering (FL) HA or electric acoustic stimulation (EAS) implants. To date, no study has shown which of these alternatives is the most effective to improve hearing abilities for this population.

Objectives: Compare the effectiveness of frequency-compression and frequency-transposition HA, and of EAS cochlear implant on speech perception for people with a severe-to-profound sensorineural HFHL.

Methods: Ten adults tested frequency-compression and frequency-transposition HA following an ABAC single-subject design; four weeks baselines were completed with own HA, followed by 8-week trials with each device. One participant also received an EAS implant. Follow-up time ranged from 16 to 32 weeks. Speech recognition was measured each week using HINT and monosyllable tests. GHABP and APHAB questionnaires and semi-structured interviews were also used to collect participants' perspectives on the benefits of each technology.

Results: FL HA improved speech recognition up to 10% compared to conventional HA in 5/10 subjects. Others experienced either no gain or a degradation (from ?9 to ?22%) in speech recognition when using a FL algorithm. Most participants reported better speech perception and listening comfort in everyday noisy situations, and improvement in environmental sound detection with FL HA. The participant who received an EAS implant obtained a gain ranging from +17 to +41 % compared to conventional or FL HA.

Conclusions: An EAS implant appears as the first indication for treating people with a severe-to-profound sensorineural HFHL; it is also the most costly, invasive, and risky alternative. Thus, and considering the significant benefits some patients can obtain from FL HA, trials using these technologies should be considered on an individual basis prior to implantation.

Where Does a Hearing Aid Prescription Begin and End?

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Potential real or perceived conflicts of interest: None

Objectives: To determine if CASLPO's current definition of *hearing aid prescription* is legally defensible, in keeping with the intention of the Regulated Health Professions Act (RHPA) and consistent with definitions used in other professions and in other jurisdictions in Canada.

Background: Under the RHPA it is a controlled act in Ontario to prescribe a hearing aid for a hearing impaired person. The words "prescribing" and "prescription" as they relate to hearing aids are not defined in the RHPA. The college's current definition of hearing aid prescription is quite broad, encompassing activities usually thought of as part of dispensing. CASLPO defines hearing aid prescription in its *Preferred Practice Guidelines for the Prescription of Hearing Aids to Adults* as: "the process of selecting the device, including the verification and validation of the selection."

The college requested a legal review and opinion of its definition of hearing aid prescription. This stems from concern that if challenged legally, the college may not have reasonable grounds for the broad definition it currently applies.

Methods: CASLPO tasked an external legal firm with reviewing the definitions of hearing aid prescription as used in other provinces in Canada and the definition of prescription and prescribing as used by other health professions (e.g., optometrists) in order to provide an opinion on CASLPO's definition of hearing aid prescription. This was then applied to the current practice environment and practice standards.

Results: The legal opinion provided was that CASLPO's definition of hearing aid prescription is too broad, encompassing certain acts of dispensing, and not in keeping with the intent of "prescribing" and "hearing aid prescription" as contemplated in the RHPA.

Conclusions: In order to create a legally defensible definition of hearing aid prescription, the definition must leave out any elements of dispensing. Clarification of standards related to both prescribing and dispensing developed from this revised definition.

Residual Hearing Helps Children with Cochlear Implants Rely Less on Tempo Cues to Judge Emotion in Music

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Potential real or perceived conflicts of interest: None

Objectives: To determine how judgments of emotional content of music are shaped by the type of hearing experience in early auditory development.

Background: Children with bilateral deafness who listen with one cochlear implant were previously shown to abnormally rely on tempo rather than mode cues to distinguish happy from sad music. Such children are increasingly being provided with bilateral input either through implantation of the contralateral ear (bilateral) or use of a hearing aid when sufficient residual hearing in that ear exists (bimodal). We hypothesized that bilateral implants would not provide additional pitch information thus resulting in a reliance on tempo to judge emotion in music. By contrast, bimodal users' better access to pitch would increase their use of mode cues on this task.

Methods: Fifty-eight children aged 6.5 to 14 years completed the Montreal Emotion Identification Test. Sixteen children had normal hearing, 31 wore bilateral implants and 11 were bimodal users. Reaction time and accuracy were measured and analyzed using repeated measures analysis of variance and Bonferroni corrections in pairwise comparisons. Linear regressions were used to determine associations between opinion changes opinion and measures of experience.

Results: Children using implants in both the bilateral and bimodal groups identified emotion in music less accurately than their normal hearing peers, although they performed significantly better than chance (86.3±1.4%, $p<0.0001$) and required similar times to respond (3.8±0.2s versus 3.9±0.4s, $p=0.88$). Both the bilateral ($p=0.01$) and bimodal ($p=0.04$) groups relied on tempo cues more than their normal hearing peers to judge emotion in music. This abnormal reliance on tempo

remained constant across duration of bilateral use (R=0.11, *p*=0.48), but decreased with duration (R=?0.65, *p*=0.03) and degree of residual acoustic hearing (R=0.30, *p*=0.05) in bimodal users.

Conclusions: Normal reliance on mode cues is altered when access to pitch cues is deprived by deafness and CI use. Improving access to acoustic hearing through bimodal hearing reduces the abnormal switch to reliance on tempo to judge emotion in music.

Effects of a Personalized Music-Based Sound Therapy for Treating Tinnitus: A Randomized, Blinded, Placebo-Controlled Trial

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Potential real or perceived conflicts of interest: Dr. Michael Chrostowski has developed the computational model of the music-based sound therapy software. He was only involved in obtaining baseline audiogram and tinnitus characteristics from participants of the trial, and was not involved in any analysis or follow-up questionnaire administration for the trial. He was blinded from the group allocation of participants.

Objective: To investigate the treatment effects of a personalized music-based sound therapy compared to placebo controls among chronic tinnitus sufferers.

Background: Subjective tinnitus has been a distressing and debilitating audiological problem affecting up to 15% of adults worldwide.[1] Currently, there is no cure for tinnitus; existing therapies primarily focus on reducing subjective tinnitus to ultimately improve patient's quality of life. The approach investigated here uses an embedded computational model of the central auditory system to create an optimal music-based sound therapy according to each participant's audiogram and tinnitus characteristics. To our knowledge this is the first randomized placebo-controlled trial to test the effectiveness of a music-based sound therapy for tinnitus.

Methods: Fifty participants were randomly assigned to the treatment (*n*=25) and placebo (*n*=25) groups. Both groups received music for daily listening; only the treatment group's music was customized. Tinnitus Handicap Inventory (THI) and Tinnitus Functional Index (TFI), measurements of subjective tinnitus, were administered during baseline and follow-up (3, 6, and 12-months following treatment). Effects of the treatment were analyzed at each follow-up using general linear regression. The progression of participants' condition over the 12-month period was examined by random intercept models for the two groups separately.

Results: Treatment group had significantly lower THI scores at each follow-up wave than at initial testing ($p<.001$). Treatment group's overall TFI scores also decreased significantly 6 months after the initial testing ($p<.001$). Within the treatment group, decrease in THI and TFI scores was significant at 3 and 6 months ($p<.005$), but not at 12 months.

Conclusions: The personalized music-based sound therapy reduced subjective tinnitus significantly after 3 months of usage, and continued to offer lasting effects at 12-month follow-up. Future research should examine the neurological pathways of the treatment effects for this sound therapy. Clinical implications will be discussed.

References

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Functional Deficits in Auditory Nerve Developed in Noise-Induced Hidden Hearing Loss: Indications of Unhealthy Synaptic Repair and Auditory Perception Difficulty in Presbycusis

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Potential real or perceived conflicts of interest: None

Objectives: To investigate functional changes in single auditory nerve fibers (ANFs) during cochlear ribbon synapse repair following noise-induced hidden hearing loss.

Background: The synapse between inner hair cells (IHCs) and spiral ganglion neurons (SGNs) in the cochlea has been identified as a new locus of noise induced cochlear lesions. Massive damage to this synapse may occur after noise exposures insufficient to cause permanent threshold shifts, resulting in many SGNs losing their connections to IHCs. Those SGNs will slowly degenerate if the connection cannot be re-established. Evidence also suggests that (1) damaged synapses can be partially repaired naturally, and (2) some functional abnormality may occur during the repair.

Methods: Single unit recording from ANFs was done in guinea pigs at 3 different time points after a brief noise exposure (105 dB SPL, broad band noise, 2 h) and compared with the control group.

Results: A transient change in the distribution of low- and high-spontaneous rate (SR) ANFs suggested disproportionate damage to low-SR units. Coding functions were found to be changed in many aspects including: (1) a reduction in driven spike rate, (2) an elongation in response latency, (3) a reduction in peak/sustained spike ratio, (4) poorer recovery of spike rate to the second click in a paired click paradigm. Those changes were more severe in the low-SR units and appeared with a later onset.

Conclusions: Low SR synapses are more vulnerable to noise. The repaired synapses (mostly the low-SR units) are not functionally healthy and show deficits in both intensity and temporal coding.

POSTER PRESENTATIONS

Analysis of Auditory Brainstem Responses in Children with Auditory Processing Disorders

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Potential real or perceived conflicts of interest: None

Background: It is important to have good measures of auditory system integrity when evaluating children suspected of having an APD. Professional guidelines suggest the inclusion of auditory electrophysiology in a comprehensive assessment battery but the use of such has not been widely accepted in clinical practice (Emanuel, Ficca, & Korczak, 2011). In this study an evaluation of multiple aspects of the ABR to supra-threshold click stimuli was conducted in children referred for

APD assessment.

Objectives: To better evaluate auditory system neural integrity in children with auditory processing disorder (APD) as evidenced by the auditory brainstem response.

Methods: Eight normal hearing adults and ninety four children with listening difficulties were recruited for the study. A standardized battery of auditory processing tests were administered to the children and based on their performance they were classified as APD (*n*=59) or non-APD (*n*=35). Ipsilateral and contralateral ABRs to monaural stimulation at 13.3 clicks/sec and 57.7 clicks/sec were recorded using two channel evoked potential instrument. The electrodes were placed on the vertex, and on both ear lobes with a ground on forehead.

Results: Analysis included measures of absolute and inter-wave latencies and wave amplitudes measured on both ipsilateral and contralateral recordings. Data from the two groups of clinically referred children were compared and both were evaluated relative to that obtained from the adults. Results showed differences in the 3 groups that will be discussed according to auditory system models that evaluate both axonal conduction times and synaptic delays (Ponton, Moore and Eggermont, 1996). In general, greatest differences were seen in the children with an APD diagnosis and these differences were most likely to occur in the region of waves II and III.

Conclusions: Analysis of ABRs may help in detecting subtle issues of auditory system neural integrity that may be important in understanding children's difficulties with many listening tasks.

Do Characteristics of the Binaural Interaction Component Evoked By Lateralized Chirp Stimuli Remain Persistent Over Time In Normal Hearing Listeners?

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Entry into the Outstanding Student Research Award: Yes

Potential real or perceived conflicts of interest: None

Background: In single session recording of normal auditory brainstem responses (ABR) previous studies indicated that the amplitude of the binaural interaction component (BIC) decreases and its latency increases as the centrally perceived stimuli become more lateralized. Whether these findings remain stable across multi-session recordings is unclear.

Objective: The goal of this study is to investigate the BICs of the ABR elicited by processing binaural stimuli varying in interaural time difference (ITD) in the normal auditory brainstem in multisession recordings.

Methods:
Recording: Multi channel ABRs in unilateral, diotic and dichotic stimulus conditions.
Stimuli: Bilateral chirps with interaural time delays (ITDs) of 0, ±300, and ±600 ?s delivered through insert earphones.
Analyses: BIC waveforms established in off-line analysis by subtracting the bilaterally evoked potentials from the summed unilateral responses. The amplitude and latency of BIC were measured for each channel.

Results: Consistency of ITD-related changes in BIC waveforms across all channels and recording sessions was assessed. Characteristics of the BIC waveforms from diotic stimuli (0-ITD) were compared with those obtained with lateralized bilateral stimuli. As the magnitude of the ITD increases toward either ear, amplitude and latency changes in the BIC occur.

Conclusions: The results of the current study will provide valuable information about the processing of lateralized stimuli at the level of the brainstem via the BIC. We will use this method to determine within and between subject variability in normal-hearing subjects, and changes in the binaural brainstem processing of individuals who have experienced a temporary unilateral hearing loss.

Do Multilingualism and Bilingualism enhance Neural Speech Encoding at Subcortical Level?

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Potential real or perceived conflicts of interest: None

Background: Bilingualism confers certain advantages at a cognitive level, affecting both language processing and executive functions. It is presumed that, in bilinguals, these enhanced cognitive functions may in return have an impact on auditory processing through top down mechanisms. Multilingualism, being proficient in more than two languages, provides individuals with a richer linguistic environment and is purported to confer the same cognitive advantages as bilingualism.

Objective: The aim of the study is to use Speech Brainstem Evoked Response (Speech ABR) to explore the way the central auditory systems of monolinguals, bilinguals and multilinguals react to auditory stimulation in favourable (quiet) and non-favorable (noise) listening conditions.

Method: A total of 50 young adults aged between 18?25 years have been invited to participate in this study. 10 monolinguals (anglophones or francophones), 20 bilinguals as well as 20 multilinguals participated in this study. Speech-ABR was recorded using verbal stimuli, (da), in quiet and noise.

Results and Discussion: In all three groups, auditory processing abilities were considerably reduced in noise than in quiet. The Speech-ABR latencies were reduced in quiet and in noise in bilinguals and multilinguals relative to monolinguals. Our results suggest that auditory processing is faster and/or more efficient in bilinguals and multilinguals in different listening conditions in comparison to monolingual. However, speaking three or more languages does not appear to confer additional advantages in comparison to speaking only two languages.

Conclusion: Speech-ABR could be considered as a neurophysiological marker identifying central auditory processing efficiency in participants having different language experiences.

The effects of Musical Training on Cortical Auditory Evoked Responses in Children with Hearing Loss

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Potential real or perceived conflicts of interest: None

Background & Objectives: The main objective of present study was to explorer the effect of piano lessons on the Cortical Auditory Evoked Potentials (CAEP) in children with normal and abnormal auditory function. It has been documented that special auditory training and the quality of acoustic

environments have complex impacts on the neural auditory system. On the other hand, the absence of early acoustic stimulation during optimum periods of central auditory system plasticity may prevent the normal maturation of the central auditory system.

Method: Twenty 4 to 9 year-old children with normal hearing (NH) and with hearing loss, HL (users of Cochlear Implant, CI, and/or Hearing aids) participated in the study. CAEP were recorded in a passive oddball paradigm. Cortical auditory evoked responses, P1, N1, P2, N2, and MMN were measured before and after six months of intensive piano training.

Results: Different pattern of results have been found; N1 and P2 deflection were absent in more children with CI compared to children with NH. Moreover, the N2 and MMN latency and/or amplitude values were different between the groups of participants. Larger N2 amplitude was found only in NH after the musical training.

Conclusion: Findings indicated different patterns of cortical responses in children with CI and/or with hearing aid before and after musical training. Findings suggest that musical experience may have advanced the developmental trajectory only in children with NH. Results suggest that 6 months of musical training may not be sufficient to compensate for the maturational delays in children with HL.

Investigation of Encoding of Reverberated Speech Using Auditory Brainstem Response

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Potential real or perceived conflicts of interest: None

Objective: This study investigated how reverberated speech is encoded in the auditory system using the speech-evoked ABR.

Background: Reverberation has been mainly associated with degradation of speech signals, through effects such as temporal smearing, filling dips and gaps in the temporal envelope, increasing the prominence of low-frequency energy, and flattening of formant transitions. On the other hand, reverberation amplifies the speech signal level. Such amplification can assist with speech perception particularly with dominance of early reflections.

Methods: Twelve subjects with normal hearing participated in this study. Speech-evoked ABRs were recorded using reverberant stimuli created by convolving a 2-s synthetic vowel /a/ and each of the following room impulse response (RIR) components: direct sound, early reflections, late reflections, and full reverberation.

Results: For waves V and A amplitudes, a significant difference or trend towards significance was found between direct and late, between direct and full, and between early and late. For waves V and latencies, significant differences were found between direct and late, between direct and full, between early and late, and between early and full. For Envelope Frequency Response and Fine Structure Frequency amplitudes, a significant difference or trend towards significance was found between direct and late, and between early and late. Moreover, our results showed that moderate reverberation increases waves V and A amplitudes, decreases waves V and A latencies, and increases Envelope Frequency Response and Fine Structure amplitudes.

Conclusions: Our results support the notion that the direct wave and early reflections constitute

useful energy, while the late reflections constitute detrimental energy. Overall, this study shows that effects of reverberation can be studied electrophysiologically, thereby providing another means than perceptual studies to investigate the effects of room acoustics on auditory processing.

Central Auditory Processing of Speech Sounds in Hearing-Impaired Children

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Entry into the Outstanding Student Research Award: Yes.

Potential real or perceived conflict of interest: The authors declare that they have no potential real or perceived conflict of interest.

Background: The impact of the lack of auditory stimuli on the development of central auditory abilities in hearing-impaired children is currently not well understood, and the majority of the clinical audiologic tests do not allow their accurate evaluation. Some markers demonstrating anomalies in the central auditory nervous system of hearing-impaired children translate in a malfunctioning at the brain's level, but may be also uphill at the brainstem's level. Experimentally, the use of speech-evoked auditory brainstem responses (ABRs) measurements has been clinically proven in many populations for the assessment of the signal transmission in the brainstem's auditory nerve tracts, and could allow a better sensitivity than the click-evoked ABRs to identify auditory processing problems at the brainstem's level.

Objectives: The objective of the present study was to explore the consequences of peripheral hearing losses on auditory processing of speech sounds at the brainstem's level in children.

Methods: A total of 22 children aged between 6 and 14 years old and divided into two different groups, 11 hearing-impaired children with a bilateral symmetric sensorineural hearing loss paired with 11 children with normal hearing, were assessed following the recording of click-evoked ABRs and speech-evoked ABRs.

Results: No significant differences in the latencies of the ABRs waves between the group of normal hearing children and the group of hearing-impaired children were noted when click-evoked ABRs were used. However, significant differences were obtained for C, D, and E waves when speech-evoked ABRs were used. These results suggest an abnormal representation of the specific neuronal activity in hearing-impaired children, rather than a global deficit of the neuronal synchronization at the brainstem's level.

Conclusion: This study could help allowing the development of a clinical tool to assess the incapacities of auditory processing in hearing-impaired children, which could lead to an earlier clinical diagnosis and therefore to a faster and more specific intervention.

Children's Complex Listening and Understanding in Auditory Distraction

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Potential real or perceived conflicts of interest: None

Background: Children spend much of their lives in noisy environments (e.g., classroom, cafeteria, playground). Studies have indicated regular classroom noise levels range from ?7 to +4 dBSNR.

While audiologic evaluations provide information on a child's lower-level skills: detection of pulsed puretones and recognition of isolated familiar speech, they do not assess the full range of auditory and cognitive demands placed on a child in the classroom. Osman & Sullivan (2014) evaluated the effect of 4-talker babble on working memory (WM) performance in 8–10 year old children. Background noise was detrimental to WM performance; this is thought to be due to the fact that children require explicit processing to hear the target stimuli in noise, leaving fewer resources for interpretation and storage of information. These results suggest background noise contributes to a child's failure to cope with simultaneous processing and storage demands of complex listening activities and can have negative consequences for speech understanding in noise. The present study investigated the effects of noise across a range of signal-to-noise ratios on classroom-relevant tasks: working memory and auditory comprehension.

Objectives: (1) To determine whether WM and auditory comprehension performance decrease by the same degree, as a function of SNR. (2) To determine whether response-time increases as a function of SNR.

Methods: Thirty 8–9 year old children with normal hearing participated. Backward digit-recall, letter number sequencing and auditorilly-presented stories were administered in quiet and 4-talker babble at +15, +5, 0, and -5 dB SNRs.

Results: Main effect of listening condition: performance accuracy of working memory and comprehension were not significantly affected in favorable SNRs (i.e., +15) but a noticeable effect of noise was present at +5 onwards. Interaction between listening condition and task complexity: as SNR became more adverse, there were greater differences in observed for each task compared to favorable conditions, where little to no differences between task performance occurs. While performance accuracy was essentially unaffected in favorable listening conditions, response-time was significantly increased even in favorable conditions across tasks.

Conclusions: These results provide information on the listening and cognitive effort involved with understanding complex information in noise.

Interaction of Air and Bone Conduction in Speech Production During Altered Auditory Feedback

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Potential Real or Perceived Conflicts of Interests: No

Background: Auditory feedback, the sound of our voice, plays an important role in speech error detection and the regulation of speech production. The hearing of our own voice occurs through air and bone conduction where the cochlea responds to the linear sum of voice signals arriving through the two routes. When the signal delivered by headphones (i.e., air conduction) is altered in real-time, talkers compensate for the perturbation by changing their speech production. These production changes may depend on the ability of the person to detect errors in their speech: if the level of the altered air conduction signal relative to the unaffected bone conduction signal is favourable then compensation can occur.

Objective: The purpose of this study was to identify differences in speech compensation behaviours at different headphone sound pressure levels with the altered auditory feedback task.

Methods: By altering the level of the headphone signal, the relative level between the altered speech in the headphone and the unaffected bone conduction signal at the cochlea was modulated. The headphone feedback of the first formant of /?/ was manipulated during speech production at

50, 60, 70, and 80 dBA SPL in young adults with normal hearing.

Results: Results found speech compensation did not occur or was minimal at lower headphone stimulus levels. This result suggested that altered auditory feedback was inadequate to mask the unaffected bone conduction feedback at lower headphone levels. In comparison, at higher headphone levels speech compensation occurred, which suggested the altered air conduction signal was adequate to affect the feedback system and likely masked the bone conduction signal.

Conclusions: Overall, these results suggested auditory feedback is affected by an interaction of air and bone conduction and this interaction influenced the ability of the person to detect speech errors.

Speech Regulation through Altered Auditory Feedback in Normal and Hearing-Impaired Adults

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Entry into the Outstanding Student Research Award: Yes

Potential Real or Perceived Conflicts of Interests: No

Background: The human auditory feedback system uses a combination of somatosensory and auditory cues in the detection of speech errors and the regulation of speech production. The use of auditory information in the ongoing control of speech production can be most effectively studied by perturbing feedback using real-time signal processing (e.g., the altered auditory feedback paradigm). The limited auditory cues available with a hearing loss can reduce speech perception and production abilities of individuals with hearing impairments. Hearing aids are a common assistive device that amplifies inaudible sounds for patients with hearing loss.

Objective: The purpose of the study is to identify differences in the use of auditory feedback between individuals with normal hearing and hearing loss. We are investigating how hearing aids affect the use of auditory feedback to reveal information about the maintenance of speech production and perception.

Methods: Outcomes are measured in three groups: young (18–35 years) adults with normal hearing and older adults (55–80 years) with normal hearing and hearing loss. Our test battery includes the altered auditory feedback paradigm with participants wearing laboratory hearing aids to evaluate the impact of hearing loss and hearing aid use on the perception and production of speech sounds. Acoustic characteristics of sibilant fricatives, intensity of vowels, and F1/F2 vowel qualities will be analyzed for changes as a result of hearing aid use and degree of hearing loss.

Expected results: It is expected that individuals with normal hearing or different degrees of hearing loss will have different speech production and perception patterns.

A Conceptual Framework of Parent-To?Parent Support for Parents of Children Who Are Deaf or Hard of Hearing

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Potential real or perceived conflicts of interest: None

Background: A scoping review of the literature was conducted resulting in the development of a structured conceptual framework of parent-to?parent support for parents with children who are deaf or hard of hearing (D/HH). This is a dual-stage scoping review. The second stage in the review process was to obtain input/feedback on the theoretical conceptual from experts in parent?to-parent support with an aim to reach consensus on a proposed framework.

Purpose: This study sought stakeholder involvement with an aim to achieve consensus on the constructs, components and design of the initial conceptual framework, or obtain feedback to direct revisions.

Research Design: A modified electronic Delphi (eDelphi) study was completed with 21 hand-picked experts from 7 countries who have experience in provision, research or experience in the area of parent-to-parent support. Participants completed an online questionnaire using a 10 point Likert scale (strongly disagree to strongly agree) and answered various questions related to the descriptor terms, definitions, constructs, components and overall design of the framework. Each question provided space for textual input to obtain written feedback and opinion from respondents.

Results: Participant responses led to the revision of the original conceptual framework.

Conclusions: The findings from this dual-stage scoping review and eDelphi study provide an important conceptual framework that defines the vital contribution of parents in Early Hearing Detection and Intervention (EHDI) programs. Through consensus we have developed a conceptual framework of Parent-to-Parent support for parents with children who are Deaf or Hard of Hearing that will be a useful addition to EHDI programs.

A Scoping Review Examining the Quality Criteria Framework of Decision Aids for Patients with Chronic Conditions: Application to Audiology Practice

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Potential real or perceived conflicts of interest: None.

Background: Patients often have a difficult time making a decision in regards to their treatment when there are several treatment options available. According to the International Patient Decision Aids Standards (IPDAS) Collaboration, decision aids are tools that can be used to aid patients and their health care practitioners in the complex decision-making process when there is no clear advantage of a treatment option over another. They provide evidence-based information about the available options, including the possible benefits and harms, and also help patients communicate personal values they associate with varying aspects of the treatment to help them reach an informed, value-based decision. They are intended to supplement rather than replace patient-practitioner interaction. The field of audiology currently does not have many decision aids that have been evaluated to international standards to facilitate the decision-making process for those with hearing/balance difficulties.

Objectives: By reviewing the evidence in the chronic disease/disability literature of allied health professions, this scoping review aimed to understand: (1) the effectiveness of decision aids in goal-setting/decision-making; (2) important components of effective decision aids; (3) how decision aids might benefit the profession of audiology.

Results and Conclusion: Evidence in the literature suggests that the use of decision aids improved

the quality of the decision-making process and facilitated more effective goal-setting and shared decision-making with a health care practitioner than when they used it on their own. Patients that used decision aids also demonstrated improved knowledge, realistic expectations of benefits/harms, an improved congruence in their decision and personal values.[1,2] However, patient decision aids are of little value if they are not used in practice. Considering the breadth of an audiologist's role in counselling/education of various treatment/communication strategies we should consider development and implementation of reliable, quality decision aids in audiological practice.

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Comparison of RECD Measurements Taken with 2 cc and 0.4 cc Couplers

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Potential real or perceived conflicts of interest: None. The project was designed and completed for partial fulfillment of coursework for Communication Science 9529T, Calibration & Instrumentation.

Background: Individual ear canal acoustics are considered when estimating a threshold in dB SPL by taking a real-ear-to-coupler-difference (RECD) measurement using a 2 cc coupler. The Verifit 2 system has introduced a 0.4 cc wideband coupler that results in different RECD values.

Objective: Our objective was to determine the difference between the RECD measurements of the two couplers.

Methods: RECDs were measured for eight normal hearing ears on a Verifit 1 using a 2cc coupler and on a Verifit 2 using a 0.4 cc coupler in the Starkey Teaching lab at Western University. The same probe module set-up was used for all measurements. As a measurement of predictable difference, we compared the absolute differences of the two RECD measurements to the absolute differences of the two couplers' response to a wideband noise signal. The primary outcome was a judgment of whether or not the comparative differences across frequencies fell within tolerance of test, re-test reliability.

Results: The average difference between the couplers was 15.33 dB, and between RECDs, 10.86 dB (difference of 4.47 dB). After applying a correction to account for the use of an HA-2 coupler on the Verifit 1 system the average difference across frequencies was 2.25 dB (SD=1.66 dB). The difference across all frequencies fell within the tolerance of two standard deviations with the exception of 1000 and 3000 Hz. The differences between RECDs and noise response were 4.38, and 5.73 dB at 1000 and 3000Hz respectively. This anomaly has not yet been accounted for.

Conclusions: However, it is concluded by the investigators that there is a predictable difference between RECDs measured with a 2 cc coupler and a 0.4 cc coupler. Failure to correct for the use of a 0.4 cc coupler could lead to over-amplification of approximately 15 dB.

Perception of Emotional Speech by Listeners with Hearing Aids

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Potential real or perceived conflicts of interest: None

Objectives: This study investigated the effects of hearing aid use on the perception of emotion in speech and on the recognition of speech spoken with emotion.

Background: One important type of information carried in the speech signal is the talker's emotional state, which is conveyed in part by pitch and loudness contours. While the frequency and amplitude compression performed by hearing aids may make speech easier to understand, little is known about how such processing affects users' perception of emotion in speech.

Methods: Experienced hearing aid users (aged 69–94 years) were tested without their hearing aids and with their hearing aids in two different sessions. Participants listened to sentences spoken by a young female actor who portrayed six different vocal emotions and one neutral condition. Listeners reported keywords from these sentences, identified which vocal emotion was portrayed, and reported the perceived intensity of the portrayed emotion. In addition, participants underwent audiometric testing, Verifit testing and cognitive assessments, and filled out questionnaires on hearing and on emotion.

Results: The use of hearing aids improved the word recognition performance of listeners from an average of 43% correct (unaided) to an average of 68% correct (aided). In contrast, hearing aids did not improve listeners' emotion identification (an average of 38% correct identification unaided, compared to 40% aided). The specific emotion portrayed affected listeners' performance on both word recognition and emotion identification, but the emotions that were the most easily identified were not necessarily the same emotions that led to better word recognition.

Conclusions: The types of information carried by the speech signal are differentially affected by hearing aids; in this case, hearing aids improved the recognition of what was spoken but not the identification of vocal emotion.

High-Frequency Measurement Repeatability Using the Probe Tube Method

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Potential real or perceived conflicts of interest: None.

Objectives: This study aims to measure high frequency measurement reliability using the probe tube method. Clinicians tend to place the probe tube 28 mm and 30 mm from the intertragal notch towards the tympanic membrane for women and men, respectively. These insertion depths allow clinicians to measure up to 4–6kHz in the ear canal with validity and reliability. The reliability and validity across insertion depths and varying analyzer settings is less well understood. This project aims to evaluate high frequency measurement accuracy and reliability, as well as the impact of varying analyzer settings, on extended bandwidth verification.

Background: Probe tube measurement is an essential step in the hearing aid fitting process. By

measuring real ear spectral responses, audiologists are capable of verifying hearing aid performance in the ear or coupler following real-ear to coupler difference measurements. Unfortunately, the probe tube method measures frequencies above 4 kHz with poorer accuracy than frequencies below. However, when using extended bandwidth amplification, hearing-impaired listeners may perceive auditory information with better signal-to-noise ratios and improved speech. Additionally, children with hearing loss may exhibit faster short-term word-learning. Manufacturers are developing commercially available hearing aids and fitting products with extended bandwidth amplification. In order to maximize these benefits using new technologies, it is necessary to fit with precision and reliability at high frequencies.

Methods: Probe tube measurements were made using female left ears. White noise stimuli were presented to each participant through foam insert transducers. Real ear measurements were taken at 4 insertion depths with 2 repetitions each. Clinically shallow depths were measured at 24 mm and 26 mm, preferred-practice depths were measured at 28 mm, and experimental depths were measured at 30 mm, all from the intertragal notch. Sound spectra were recorded using 1/3rd and 1/24th octave band analyses.

Results: Data is currently being analyzed to determine the effects of insertion depth and analysis bandwidth.

Acclimatation aux aides auditives par les personnes âgées ayant une déficience auditive: l'effet des algorithms de reduction de bruit des appareils auditifs sur l'effort déployé pour reconnaître la parole dans le bruit

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Potential real or perceived conflicts of interest: Il n'y a aucun conflit d'intérêts

Ce projet sera réalisé dans le but de mesurer de manière comportementale l'acclimatation des personnes aînées avec une déficience auditive aux appareils auditifs par rapport à l'effort déployé pour reconnaître la parole dans le bruit et l'effet des algorithms de reduction de bruit des appareils auditifs sur cette acclimatation.

Le paradigm de double tâche a été utilise afin de mesurer l'effort déployé pour percevoir la parole dans le bruit de façon efficace auparavant dans plusieurs études.(Desjardins & Doherty, 2013; Gosselin & Gagne, 2011). Dans notre étude, la tâche principale est le HINT (Hearing In Noise Test) et la tâche secondaire est le DPRT (Digital Pursuit Rotor Tracking). Le HINT est un test de perception de la parole dans le bruit adaptatif qui permet d'identifier le RSB (Rapport Signal?sur-Bruit) necessaire pour une performance de 50%. Le DPRT consiste à suivre un point qui suit un cercle à l'aide d'une souris d'ordinateur. Il y aura 8 séances d'évaluation sur une période de 18 mois afin de mesurer l'effet d'acclimatation. Il y aura 45 participants âgés entre 65 et 75 ans ayant une hypoacousie neurosensorielle de degré léger à moderement?sévère bilatéralement. 30 participants seront des nouveaux utilisateurs d'appareils auditifs (sous?divisé en deux groups: avec ARB et sans ARB) et les 15 autres seront des utilisateurs expérimentés d'appareils auditifs qui constituera notre groupe contrôle. Les habiletés cognitives, notamment la mémoire de travail ainsi que la vitesse de traitement d'information, seront évaluer grâce au RST (Reading Span Test) et au DSST (Digit Symbol Substitution Test).

Nos hypotheses sont que l'acclimatation sera notable pour tous les nouveaux utilisateurs d'appareils auditifs et que cette dernière sera corrélée avec les habiletés cognitives des participants. De plus, nous croyons que la presence d'algorithmes de reduction de bruit prolongera la période

d’acclimatation puisque ce dernier crée une distorsion du signal auditif.

Références
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Current Phenotyping of Otosclerosis in an Ontario Population

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Potential real or perceived conflicts of interest: None

Background: Otosclerosis is a disorder involving abnormal bone growth in the middle ear. The typical hearing profile of otosclerosis is a low-frequency conductive hearing loss usually progressing to a mixed hearing loss. The aim of the current study is to identify the current phenotype of otosclerosis in an Ontario population using commercially available equipment including audiometry, acoustic immittance and distortion product otoacoustic emissions (dpOAEs).

Method: Thirty-five participants diagnosed with otosclerosis were recruited for the study. Thirty-three of the participants underwent corrective surgery for otosclerosis, while two were diagnosed clinically. Ear status was identified as ‘surgical,’ ‘normal,’ or ‘suspected otosclerosis.’ Family history questionnaires were also collected to identify cases with a family history of hearing loss or otosclerosis specifically.

Results: A one-way ANOVA was conducted to determine that resonance frequency measured using multifrequency tympanometry was higher in otosclerotic ears compared to normal ears and surgical ears ($p<0.001$). All surgical ears and suspected otosclerotic ears had absent dpOAEs, as well as absent acoustic reflexes. Family history questionnaires revealed that of 35 otosclerotic participants, 17 participants reported at least one family member with a hearing loss developing between the ages of 20 and 60 years of age. Nine of the 17 participants with a family history of hearing loss reported at least one other family member being diagnosed with otosclerosis specifically.

Conclusion: This study demonstrates the current clinical phenotype of otosclerosis. Clinically, patients’ ears with otosclerosis demonstrate a hearing loss, either conductive or mixed, absent dpOAEs, absent acoustic reflexes, and approximately half of the cases had a family member with a late onset hearing loss.

Advancing the Use of Genetic Testing for Hearing Loss: Canadian Perspective on Ethical Challenges

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Potential real or perceived conflicts of interest: None

Objective: The objective of this study is to review the ethical issues surrounding genetic testing for hearing loss in Canada with the goal of informing clinical practitioners and researchers in this field

and identifying gaps in the existing literature.

Background: Advances in genetic technology have reduced the cost of genetic testing and Canadians are rapidly gaining greater access to their genetic information. There are currently many benefits for the inclusion of genetic tests in clinical practise and great promise for the future. However, there are numerous ethical concerns for genetic testing for medical conditions in general and also the additional concerns of the Deaf community specific to hearing loss.

Method: A scoping review of literature is in progress. We will review of the ethics of genetic testing for hearing loss genes in Canada using the scoping review framework proposed by Arksey and O'Malley (2005). The literature search was conducted with keyword strategy for publications in English since 1990 using PubMed, CINAHL, and EMBASE.

Expected results: Initial thematic analysis identified many recurrent themes. These themes can be separated into general concerns about genetic testing and hearing specific concerns. General concerns include: genetic discrimination, insurance loss, privacy concerns, and barriers to participation in research and treatment. Themes specific to hearing loss include Deaf culture, genetics knowledge of practitioners, genetic heterogeneity of hearing loss, and patient benefit.

Conclusion: As genetic testing becomes more prevalent so does the call for specific policy to regulate the use of genetic data. In the void of policy to protect participants and patients it is important that practitioners and researchers be aware of the risks and benefits of genetic testing and ensure families and individuals have enough information to make informed decisions about participation in genetic testing.

Barriers and Facilitators to Hearing Health Care for Older Adults

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Entry into the Outstanding Student Research Award: Yes

Potential Real or Perceived Conflicts of Interest: There are no potential real or perceived conflicts of interest involved in this study.

Objective: The purpose of this study is to investigate the perceptions of health care professionals regarding the barriers and facilitators that older adults may experience when seeking hearing health care.

Background: Age-related hearing loss is an increasingly prevalent health problem for older adults. It is assumed that early intervention would be beneficial, but individuals often delay help-seeking for hearing problems for a decade or more. Possible explanations for such delays include difficulties adjusting to hearing loss, stigmatization, poor knowledge of or accessibility to services, and lack of referral for hearing problems by health care professionals (e.g., physicians).

Method: Seven health care professionals (5 females, 2 males) who were not experts on hearing participated in a focus group to provide their perspectives on factors that might be barriers or facilitators to seeking hearing health care. Using the Delphi nominal group method, all participants were asked the same question, "*For older adults, what are barriers and facilitators to seeking, taking and benefitting from hearing health care?*" Their responses were assessed and compared

with what is found in literature.

Results: Results demonstrated major themes: public awareness or education about hearing loss, stigmatization associated with hearing loss, accessibility to information and services for hearing, individuals motivation to seek help, and the amount of attention given to hearing and communication from both the health care professional and patient perspective. All of these factors may have an influence on a patient's help seeking behaviour when it comes to hearing healthcare.

Conclusion: Based upon the participant's responses, patterns about accessibility, education and acknowledgement about hearing loss, level of self-motivation, stigmatization, and patient/health care professional miscommunication should all be addressed to facilitate help-seeking and decrease the number of barriers.

Troubleshooting Workplace Hearing Difficulties: A Workplace Wellness Program for Hearing Impairment

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Potential real or perceived conflicts of interest: None

Objectives: The objective of this investigation is to evaluate the feasibility and effectiveness of providing a workplace wellness program for hearing impairment (HI). We hypothesize that this program will reduce hearing handicap for workers with HI while providing a positive return-on-investment (ROI) for the organization.

Background: Working with a HI is linked with more fatigue and stress-related illness (Danermark & Gellerstedt, 2004), as well as lower annual earnings (Kochkin, 2010). Past support programs for workers with HI have included recommendations for employees and their employers based on multidisciplinary expert assessments (Gussenhoven et al., 2015) as well as community based psychoeducational groups addressing assistive technologies and strategies for the workplace (for e.g., Getty et al., 1991; Williams et al., 2014; Habanec et al., 2015). However, as the workforce ages, supports for employees with disabilities, like HI, should be implemented directly within the workplace. Workplace health promotion programming, known as *workplace wellness*, has grown over the last two decades and holds promise for improved health and quality of working life for employees coupled with a positive ROI for employers. To date, HI has not been a focus in these programs but as the workforce ages we have a unique opportunity to meet the hearing health-care needs of working adults.

Methods: We will use a repeated-measures controlled design to evaluate workplace wellness programs for HI in call centers. Ambient noise reduction strategies will be implemented and communication strategies will be taught. Changes in employee well-being, performance and engagement will be compared with a matched call center. Savings, as calculated by these metrics, will be compared to direct program costs in order to measure ROI.

Results: We hypothesize that this program will reduce hearing handicap for workers with HI while providing a positive return-on-investment (ROI) for the organization.

Conclusions: Workplace wellness programs for HI, by supporting the employee and reducing barriers in environment, hold promise for improved health and quality of working life for employees coupled with a positive ROI for employers