

Hearing Review™

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Issue 13 – 2009

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Welcome to the thirteenth issue of Hearing Review.

The authors of the first study presented in this edition (an investigation into the effects of training on naïve listeners' judgements of the speech intelligibility of children with severe-to-profound hearing loss) comment that their results may have raised as many questions as they have helped to answer. They suggest that *"further research is needed to enhance our understanding of listeners' performance on intelligibility tasks, in general, and for tasks involving speech of hard-of-hearing or deaf talkers, in particular"*. The authors of a noteworthy study that examined the effect of variations in hearing-aid frequency response on real-life functional performance of children with severe-to-profound hearing loss recommend using the NAL response for initial fitting, and evaluating children's amplification needs through parents' and teachers' observations.

I hope you enjoy the latest edition and welcome your comments and feedback.

Kind regards,

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Effects of training on naïve listeners' judgments of the speech intelligibility of children with severe-to-profound hearing loss

Authors: Ellis LW and Belyukova SA

Summary: This study examined the effects of two methods of training (feedback and familiarization) and no training on naïve listeners' word identification (WI) and magnitude estimation scaling (MES) judgements of the speech intelligibility of children with severe-to-profound hearing impairments. Depending on the training group, listeners received a pretest, an immediate post-test, and/or a delayed post-test. Overall, repeated exposure – with or without training – led to improved WI scores and perception scores. WI scores increased significantly immediately after training in which listeners received feedback regarding the accuracy of their WI responses. An interesting relationship was observed between WI and MES measures; whereas listeners in the feedback group perceived speech samples as less intelligible after the training, perceptions of speech intelligibility stayed almost the same for the familiarisation training group, and participants in the control group perceived speech samples as more intelligible at the post-test. For the training groups that were not pretested, perceptions improved from the immediate to delayed post-test.

Comment: The speech of those with significant hearing impairments (HIs) may be hard for the unaccustomed ear to understand. Research suggests that training may help individuals to better understand the speech of those with an HI, and this article compares 2 different approaches to training for improving both identification and subjective intelligibility. Successful training would benefit both the listener as well as the person with an HI. Interestingly, the study also found that improved ability to identify words didn't consistently parallel the trainee's subjective rating of intelligibility. For example, although the trainee was able to identify more words, they didn't necessarily rate the speech to sound as more intelligible.

Reference: *J Speech Lang Hear Res.* 2008;51(5):1114-23

<http://jslhr.asha.org/cgi/content/abstract/51/5/1114>



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Selective attention in normal and impaired hearing

Authors: Shinn-Cunningham BG and Best V

Summary: This review discusses the multiple factors that conspire to interfere with the ability of hearing loss listeners to communicate in social settings requiring selective attention and how normal-hearing listeners cope in such settings.

Comment: This review covers how both individuals analyse and selectively attend to auditory information. It details how much more difficult auditory streaming is for those with a hearing impairment, with factors such as poor frequency resolution consequential of wider auditory filter bandwidths, diminished temporal and spectral acuity, and physiological changes being inherent to a cochlear hearing loss. With difficulty communicating in noise being one of the most common issues, this article discusses a host of factors that could be mentioned to clients in counselling to assure them that it is common and quite 'normal' to have difficulty in noisy environments. Although noise suppression algorithms and directional microphones in hearing aids attempt to address this, effective communication usually requires the listener to maintain awareness of the entire auditory scene, as opposed to focusing on a single target at the expense of all other auditory input.

Reference: *Trends Amplif.* 2008;12(4):283-99

<http://tia.sagepub.com/cgi/content/abstract/12/4/283>

Evaluating the benefit of hearing aids in solving the cocktail party problem

Authors: Marrone N et al

Summary: These researchers examined whether the benefit of spatial separation between talkers while using amplification would be affected by an increase in room reverberation. They also compared conditions of bilateral amplification to unilateral amplification, using both younger and older listeners with hearing loss to examine the effect of age. Overall, with or without hearing aids, hearing-impaired listeners showed much less spatial release from masking (SRM) than age-matched normal-hearing listeners. Single hearing aid users experienced reduced SRM in relation to the level of the stimulus in the unaided ear. Increased reverberation reduced SRM in all listening conditions.

Comment: The preceding article in this issue of HRR discusses how hearing aids (HAs) do not fully remediate difficulties related to understanding speech in multi-talker environments. This article further delves into this issue, discussing the two components of speech-on-speech masking (informational masking, and energy masking from sound being in the same frequency region), and aims to evaluate the effects of spatial separation and reverberation for HA users. The findings confirm that those with a hearing loss are poorer at using spatial separation cues, and that bilateral HAs are better than a unilateral HA. The degree of benefit obtained from a unilateral HA depends on the level of loss, as a milder loss predictably allows more binaural information to be received by the unaided ear.

Reference: *Trends Amplif.* 2008;12(4):300-15

<http://tia.sagepub.com/cgi/content/abstract/12/4/300>

Independent commentary by Dr Valerie Looi, a Lecturer in Audiology for the Department of Communication Disorders at the University of Canterbury. Her primary areas of research are in the field of cochlear implants, along with the music perception of those with a hearing impairment. She is particularly interested in developing a music training programme for cochlear implant users.

Auditory steady-state responses in normal hearing adults: A test-retest reliability study

Authors: D'haenens W et al

Summary: This study assessed the test-retest reliability of an 80-Hz multiple-auditory steady-state response (ASSR) technique in 29 normal-hearing adults, who participated in two sessions (test-retest) with a descending search protocol using a 10-dB precision. The Pearson product-moment correlation coefficient revealed poor correlation for ASSR thresholds (0.34) with 500 Hz CF and moderate correlation (0.55) with 1000, 2000, and 4000 Hz CF. A two-way ANOVA analysis of the difference scores (ASSR threshold minus behavioural threshold) revealed no significant difference between test and retest. The standard error of measurement (SEM) determined the normal tolerance for clinical error of repeated thresholds and the ASSR SEM values fell well within ± 10 dB HL.

Comment: Objective methods of assessing hearing, especially for infants, are a valuable tool for audiologists, even more so now with Universal Newborn Hearing Screening. In addition to determining the severity of a hearing loss, accurate, frequency-specific estimations of hearing thresholds assist with amplification fittings. At present, tone-burst ABR may be considered the 'gold standard' for infant threshold testing. The ASSR allows for higher stimulus presentation levels, and multi-frequency stimulation; however, there are questions over its accuracy with lesser levels of loss, and its retest reliability. With regard to the former, although the results suggest some discrepancy to actual hearing thresholds for normally-hearing listeners, previous research suggests better accuracy with increasing levels of loss. Retest reliability still requires further consideration, though.

Reference: *Int J Audiol.* 2008;47(8):489-98

<http://tinyurl.com/dgnp5z>

Effect of variations in hearing-aid frequency response on real-life functional performance of children with severe or profound hearing loss

Authors: Ching TY et al

Summary: The effect of variations in hearing aid frequency response was examined on the functional performance of 30 children aged 7 months to 16 years with severe-to-profound hearing loss. In a cross-over design, the children's hearing aids were adjusted to the NAL prescription and alternatives that produced either a BOOST or a CUT (6dB/octave from 0.5 to 2kHz), relative to the NAL response. Each response was assessed over two to four weeks using parents' and teachers' observations (PEACH and TEACH scales). Intelligibility judgements and self-reports were also obtained from school-aged children. Results indicated that on average, variations in frequency response produced differences in functional performance. Significant correlations were observed between PEACH and TEACH, and also between children's intelligibility judgements and subjective reports from children and their parents and teachers.

Comment: The results of studies like this have implications for clinical practice. For example, what degree of accuracy is required in matching hearing aid targets, does it matter which prescription is selected, are real-ear measures necessary, or are simulated (or automated) responses from the fitting software sufficient? Although the answers may seem obvious, in clinical work, time vs cost vs benefit are always pertinent issues. How much time should be spent to match the targets precisely? In children, the time issue is even more critical. In addition to the finding that the frequency response slope between 0.5–2kHz is vital to the functional auditory performance for children in everyday life, the authors also discuss the need to verify hearing aid fittings with parents' and teachers' observations.

Reference: *Int J Audiol.* 2008;47(8):461-75

<http://tinyurl.com/arh7u9>

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Balance and otitis media with effusion

Authors: Casselbrant ML et al

Summary: This review discusses eustachian tube dysfunction with and without middle-ear effusion and balance disturbances in young children. It recommends that clinicians consider not only the adverse effect on hearing in the management of a child with otitis media, but also the child's balance.

Comment: The association between otitis media (OM) and hearing loss is well known, but its impact on balance is less recognised. This could impede a child's motor development, which in turn increases their risk of falling over or having an accident. In addition to discussing the mechanisms by which OM causes balance difficulties and reviewing 4 current methods used to test balance in children, the article also reviews recent research that has utilised these balance tests in the paediatric population. Overall, evidence suggests that balance and OM are closely related, and as such, balance assessments for children with a history of OM may be warranted. For example, it seems that children with OM tend to rely more heavily on visual cues for monitoring balance, and demonstrate similar behaviours to adult patients with confirmed vestibular disorders.

Reference: *Int J Audiol.* 2008;47(9):584-9

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Personality and perception of tinnitus

Authors: Welch D and Dawes PJ

Summary: The role of personality in the perception of tinnitus in the general population was investigated in this study by using information from interviews with a birth cohort of 970 people aged 32 years sampled from the general population. Participants were divided into three groups; those without tinnitus, those with occasional tinnitus – including those with transient tinnitus of very brief duration (38.2%), and those who experienced tinnitus $\geq 50\%$ of the time (6.8%). The amount of tinnitus reported did not differ by gender, but women were more likely to find it annoying. People from lower socioeconomic backgrounds were more likely to report tinnitus. According to Multidimensional Personality Questionnaire results, tinnitus sufferers were more socially withdrawn, reactive to stress, alienated, and had less self control. People who were more annoyed by tinnitus were more socially withdrawn, and men were more stress reactive and alienated.

Comment: As tinnitus is a percept, personality traits (in addition to the physiological or pathological factors) would contribute to the effect of the condition on the patient. This study actually originates from Dunedin, as part of a larger-scale longitudinal Health and Development study. Unlike many other tinnitus studies, this one focuses on a non-clinical group of young adults. Hence it should be kept in mind that the personality effects found would be less than for clinical populations (i.e. studies involving only tinnitus patients). The overall finding that there exists a pattern of personality traits associated with tinnitus would impact on factors such as: a person's likelihood of reporting the condition and/or seeking treatment; the severity of the symptoms reported; the response to and impact of the treatment; and the effectiveness of counselling, psychological and/or behavioural interventions.

Reference: *Ear Hear.* 2008;29(5):684-92

<http://tinyurl.com/cpoays>

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Cross-sectional age-changes of hearing in the elderly

Authors: Gates GA et al

Summary: Measures of central auditory function were determined in 241 members of a dementia surveillance cohort aged 71 to 96 years who had sufficient and symmetric auditory function to perform central auditory tests. The mean distortion product otoacoustic emission thresholds at 1, 2, and 3 kHz (Distortion Product Otoacoustic Emissions) increased 0.34 dB/yr or 0.45 standard deviations (S.D.)/decade, while the pure-tone threshold average of 1, 2, and 3 kHz (PTA) increased by 0.5 dB/yr or 0.59 S.D./decade. The auditory-evoked potential latencies for wave V of the Auditory Brain Stem Response, Pa of the middle latency response, and P2 of the late latency response did not vary by age. The mean Synthetic Sentence Identification test with ipsilateral competing message scores dropped 1.7 percentage points per year or 0.78 S.D./decade (significant versus the drop with age in both the Distortion Product Otoacoustic Emissions and the PTA). After an age-adjusted analysis of the drop in hearing threshold level, the decline in Synthetic Sentence Identification test with ipsilateral competing message remained significant and averaged 1.1 percentage points per year.

Comment: Current clinical audiology testing related to presbycusis focuses on the periphery, even though it is well acknowledged that central auditory processing (CAP) also declines with age. Assessing CAP performance would provide a more holistic and true clinical picture, particularly given that amplification is often less effective, with lower satisfaction rates amongst those with CAP dysfunction. This would be important for both selecting rehabilitation options, and in counselling the patient. The study found that in the 7th decade of life and beyond, it is CAP skills that decline the most, followed by puretone hearing thresholds, outer hair cell function, and lastly 8th nerve/central pathway function. This suggests that the rate of decline of auditory function is not uniform across the auditory system, and assessing CAP skills using a speech-in-noise or dichotic listening task should be performed on a more routine basis.

Reference: Ear Hear. 2008;29(6):865-74
<http://tinyurl.com/b268tc>

Factors affecting sensitivity of distortion-product otoacoustic emissions to ototoxic hearing loss

Authors: Reavis KM et al

Summary: This study describes the relationship between ototoxic-induced behavioural threshold and distortion-product otoacoustic emission (DPOAE) changes in patients with pre-existing hearing loss. Of 90 ears examined, 82 (91%) had DPOAEs that could be monitored for changes. Sixty-four of these 82 ears (78%) had DPOAEs that were reduced or absent following drug treatment. DPOAE sensitivity to ototoxicity did not correlate with the type of ototoxic drug administered but depended on the magnitude of postexposure hearing changes and on variables related to pre-exposure audiogram and DPOAE measurements. Behavioural hearing changes not detected by DPOAEs were small on average (<7 dB). DPOAE sensitivity was reduced in ears with poorer pre-exposure hearing, and in ears with measurable DPOAE frequencies limited to f_2 's below 2.5 kHz or >1 octave from the frequency region where hearing change occurred. Logistic regression analysis revealed that DPOAEs present at f_2 's greater than 2.5 kHz were associated with the eventual success of ototoxicity monitoring with DPOAEs. However, independent variables examined could not explain differences in the relative timing of behavioural and DPOAE changes. A roughly equivalent proportion of ears experienced DPOAE changes before, during, or after behavioural hearing changes.

Comment: With individual susceptibility of ototoxic hearing loss (HL) being influenced by a multitude of biochemical, physiological, genetic, medical, and pharmaceutical factors, predicting HL from ototoxic drug administration is extremely complex. The use of DPOAEs to screen and monitor HL has been discussed in previous issues of HRR. This article examines factors that could impact on the sensitivity of using DPOAEs as a screening tool. Its findings suggest that although DPOAEs are less sensitive than behavioural testing that incorporates very high frequencies extending to the limit of a patient's audible frequency range (~16–20 kHz), one must be mindful that such high-frequency audiometry is time consuming, which in itself could impact on reliability, particularly for children. The results also suggest that DPOAEs may be more useful for those with a pre-exposure HL, with greater sensitivity noted for these patients.

Reference: Ear Hear. 2008;29(6):875-93

<http://www.ear-hearing.com/pt/re/earhearing/abstract.00003446-200812000-00006.htm>

Educational attainment, labour force status and injury: a comparison of Canadians with and without deafness and hearing loss

Authors: Woodcock K and Pole JD

Summary: This study reports the educational attainment, labour force status and injury profile of deaf and hard-of-hearing Canadians in relation to the population as a whole, using data from the Canada Community Health Survey 1.1 and involving a total of 131,535 respondents. Approximately 4% of the respondents were classified as having a hearing problem. The prevalence of hearing problems increased with age and was slightly higher among men than among women (4.52% vs 3.53%). Respondents classified as having a hearing problem, whether hearing loss or deafness, were more likely to have achieved less education, less likely to be working and experience higher rates of injury and work-related injury compared with hearing respondents.

Comment: Many of the findings from this large-scale Canadian population study would be generalisable to NZ. They highlight the need for more equal access to education and employment opportunities for those with a hearing loss (HL). Although employers, educationalists, policy makers etc. may be more aware of the impact of an HL compared to 2 or 3 decades ago, results from this and other studies still suggest that those with an HL are still not on an equal playing field. They tend to be less likely to complete tertiary education, have lower employment rates, earn less money, are less likely to hold managerial or professional positions, are less satisfied in their jobs, are more likely to report poorer general health, have higher rates of depression and stress, are more likely to have sustained a workplace injury, and are associated with more negative or lower employer expectations. This is exacerbated with greater degrees of HL.

Reference: Int J Rehabil Res. 2008;31(4):297-304

<http://www.intjrehabilres.com/pt/re/intjrr/abstract.00004356-200812000-00006.htm>

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