Hearing Review™

Making Education Easy

Issue 17 – 2009

In this issue:

Welcome to the seventeenth issue of Hearing Review.

This edition includes a study reporting that some middle-aged women with little or no hearing loss experience listening difficulty in complex environments, with even only a very slight hearing loss negatively affecting speech understanding in the presence of noise. The researchers suggest that the auditory temporal processing deficits that have been well-documented in older listeners may actually begin at a younger age.

Our remaining studies cover a range of subjects, including the conversational abilities of teenagers with cochlear implants, the role of speech-read information for speech perception, the outcome of stapes surgery in patients with osteogenesis imperfecta, and the successful outcomes of cochlear implantation in very elderly patients.

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

Kind regards,

Valerie Looi
Lecturer in Audiology, University of Canterbury
valerielooi@researchreview.co.nz

Speech recognition and temporal processing in middle-aged women

Authors: Helfer KS and Vargo M

Summary: Speech understanding, temporal processing ability, and self-assessed hearing were measured in 12 younger (19–22 years) and 12 middle-aged (45–54 years) women with normal hearing sensitivity or no more than a mild high-frequency sensorineural hearing loss. Middle-aged subjects performed significantly worse than the younger participants in the presence of a spatially coincident speech masker. Although performance in this listening condition was not significantly correlated with degree of hearing loss in the middle-aged women, it was associated with scores on a clinical measure of gap detection. Speech understanding performance in the presence of a steady-state masker was related to high-frequency pure-tone thresholds.

Comment: Research has shown that older adults, even those with normal hearing (NH) have difficulty understanding speech in adverse environments. The question therefore arises as to whether these age-related changes in auditory processing begin in middle age? Studies suggest that skills related to binaural processing, lipreading, and temporal processing, begin their decline in middle age.

The results of this study showed that factors other than just a peripheral hearing loss contribute to the increased communication difficulty in adverse environments associated with increased age. The NH middle-aged subjects in this study had more difficulty with speech understanding in adverse environments than the younger listeners. Additionally, even a slight degree of high frequency hearing loss (mild at 6 or 8kHz) was shown to have further negative impact. This is something for audiologists to be mindful of when counselling patients who report difficulties in noisy environments; such difficulties occur even if pure-tone hearing thresholds are within normal limits.

Reference: J Am Acad Audiol. 2009;20(4):264-71.
http://www.ingentaconnect.com/content/aaa/jaaa/2009/00000020/00000004/art00008

Infant air and bone conduction tone burst auditory brain stem responses for classification of hearing loss and the relationship to behavioral thresholds

Authors: Vander Werff KR et al

Summary: This study tested a clinical protocol including air conduction (AC)- and bone conduction (BC)-frequency-specific tone burst auditory brain stem response (TBABR) for classification of type and severity of hearing loss (HL) in 81 infants targeted for early identification and intervention. The researchers found that AC- and BC-TBABR results can be readily obtained in young infants (mean age, <3 months) under natural sleep and can classify the type of HL based on the absolute threshold and the size of the air-bone gap (ABG). They also report that differences in wave V latency functions for TBABR by AC and BC and wave I and V latencies of the high-level click ABR distinguished between infants with and without TBABR ABGs. Ear-specific behavioural responses were successfully obtained at levels under 20 dBHL in normal-hearing infants aged <1 year using visual reinforcement audiometry (VRA), and these behavioural thresholds correlated strongly with TBABR thresholds obtained previously in the same infants at a mean age of 3 months.

Comment: Both the Joint Committee on Infant Hearing, and the American Speech-Language-Hearing Association advocated the use of frequency-specific ABR testing for infants <6mths of age, to obtain both AC and BC thresholds. This allows for better identification of mild-moderate losses, and conductive losses. The UNHSEIP protocols for NZ also specify the need to obtain frequency-specific AC and BC thresholds (preferably – Air: 2, 0.5, 4 & 1kHz; Bone: 2 & 0.5kHz).

This paper would be of interest to anyone involved with the UNHSEIP and/or paediatric audiology testing, as it provides useful information on the parameters used for ABR and VRA testing, the equivalency of tone-burst to click-evoked ABR thresholds, the equivalency of TB ABR thresholds to VRA thresholds, and correction factors to use if estimating behavioural thresholds from ABR data. Also of interest is that the researchers were able to obtain ear-specific VRA thresholds, using insert earphones, to levels less than 15dBHL in more than half of the infants. Two sessions were required to obtain thresholds for both ears though.

Reference: Ear Hear. 2009;30(3):350-68.

http://tinyurl.com/ykh8vu5

Test-retest reliability of the acoustic stapedial reflex test in healthy neonates

Authors: Mazlan R et al

Summary: These researchers evaluated the test-retest reliability of the acoustic stapedial reflex (ASR) test in healthy neonates aged between 24 and 192 hours who showed a single-peaked configuration in the high-frequency tympanometry test and had previously passed an automated auditory brain stem response test and transient-evoked otoacoustic emission (TEOAE) tests. Ipsilateral ASRs were elicited in 91.3% (200/219) of neonates, whereas the remaining 8.7% (19/219) exhibited flat tympanograms (no identifiable peak) and absent reflexes with a refer outcome in the TEOAE test. In test-retest reliability analyses, the mean ASR threshold (ASRT) for a 2-kHz pure tone stimulus (averaged over 194 test ears) was 76.2 dB HL, exceeding that for the broadband noise (BBN) stimulus (64.9 dB HL averaged over 123 ears). According to a repeated measures analysis of variance, the ASRTs were not significantly different across the test-retest conditions. The ASR test also showed high test-retest reliability; intracorrelation coefficients across the test-retest conditions were 0.83 for the 2 kHz pure tone and 0.76 for the BBN stimulus.

Comment: The clinical use of the ASR test for adults is well known, including estimation of hearing levels, differential determination of site-of-lesion, evaluation of facial nerve dysfunction, assessment of functional hearing loss, and as a cross-checking tool. However, its use with neonates is substantially less, despite research suggesting that it could be used as part of a hearing screening tool. One of the reasons for its limited use is the previously reported inconsistency in obtaining reliable ASRs in all healthy infants. However, many of these studies used a low-frequency probe tone (~200Hz); it is now accepted that high probe tone frequencies (>1000Hz) are necessary for immitance testing with neonates.

The results of this study, which used a 1000Hz probe tone, demonstrated that the ASR test has high test-retest reliability, and the reflex was elicited in 91% of the neonates. Those with no ASR demonstrated signs of middle ear pathology. Also, there was no age affect for the neonates in this study, aged up to 8 days old.

Reference: Ear Hear. 2009;30(3):295-301.

http://journals.lww.com/ear-hearing/Abstract/2009/06000/Test_Retest_Reliability_of_the_Acoustic_Stapedial.1.aspx

Deaf teenagers with cochlear implants in conversation with hearing peers

Authors: Ibertsson T et al

Summary: These researchers investigated the use of requests for clarification in conversations between 16 teenagers. There were 8 pairs consisting of a child with a cochlear implant (CI) older than seven years and his/her hearing conversational partner (CIP) who were compared to 8 'hearing' pairs who consisted of a hearing child (HC) and a conversational partner (HCP). The conversational pairs were videotaped while carrying out a referential communication task requiring the description of two sets of pictures depicting faces. Each conversation was analysed regarding different types of requests for clarification and information. The teenagers with CI produced significantly more requests for clarification than the HCs. The most frequently used type of request for clarification in all dialogues was request for confirmation of new information, with the teenagers with CI tending to make this type of request more often than the HC. In contrast, the teenagers with CI made significantly fewer requests for confirmation of already given information and fewer requests for elaboration than the HC.

Comment: Current research into the speech and language development of children with CIs tends to investigate younger children, the effect of cognition, and/or focus on certain structural aspects of language. How older children (teenagers) cope in everyday verbal exchanges is less well known. This study's findings suggest that teenagers with CIs can be effective, contributory conversational partners. It should be noted that the situation used in this study was a referential task, where the speaker described an item for the listener to identify, which was conducted in a quiet environment with a friend (i.e. a known communication partner). However, some of the findings reported would be useful tips for CI recipients and/or their communication partners to consider. Also, teachers may need to be aware that students with CIs may need extra time to get their message across, and/or undertake a collaborative task.

Reference: Int J Lang Commun Disord. 2009;44(3):319-37.

http://www.informaworld.com/smpp/content~content=a903052523~db=all~jumptype=rss

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.

Research Review publications are intended for NZ Medical Professionals.

Review of visual speech perception by hearing and hearing-impaired people: clinical implications

Authors: Woodhouse L et al

Summary: These researchers evaluated evidence on speech-read information for speech perception among hearing infants and adults, people with speech disorders, and those born profoundly hearing impaired. The article discusses five key pieces of evidence in support of speech-reading as part of multi-modal speech processing. Hearing people's perception of speech is influenced by speech-read cues. Hearing infants are aware of congruent lip movements and match speech sounds from soon after birth. Studies of brain activity show that the brain processes speech-read and heard speech similarly. Some children and adults with speech disorders are reported to rely less on speech-read cues than people without speech disorders, and children who are profoundly hearing impaired from birth have concepts of rhyme, can match homophones, and can repeat and spell nonsense words. These behavioural observations are supported by neurophysiological data showing that heard and seen speech show similar brain activity.

Comment: Speech reading is an integral part of speech perception for both normally hearing (NH) and hearing-impaired individuals, and the processing of speech-read information is automatic. This paper covers topics including The McGurk Effect*, speech-reading development in children, neurophysiological evidence of multi-modality, speech reading for those with developmental communication disorders, and factors impacting on speech-reading skills. Five key pieces of evidence are discussed that support the multi-modality of speech perception. This multi-modality is important to consider in assessments, habilitation/rehabilitation programs, and counseling. For example, auditory-alone speech-perception assessments, be it in quiet or noise, may not be a good indicator of real-life abilities.

** The McGurk effect is where conflicting auditory and visual speech stimuli are integrated to form a different percept (e.g. many NH adults who see lip movements for "ga", but hear "ba", will report to have heard "da").*

Reference: Int J Lang Commun Disord. 2009;44(3):253-70.

http://tinyurl.com/yknq55x

Audiometric, surgical, and genetic findings in 15 ears of patients with osteogenesis imperfecta

Authors: Swinnen FK et al

Summary: In this retrospective analysis regarding the outcome of stapes surgery in 12 patients with genetically confirmed osteogenesis imperfecta (OI), audiometric results are described for 15 operated ears. The identified mutation was located in the *COL1A1* gene in all patients. Outcome for hearing in 13 primary operated ears was good because at short-term follow-up (at 6 weeks) the air-bone gap was reduced in all cases. Similarly, at long-term follow-up (>12 months), there were significant improvements in mean air conduction thresholds and significantly improved air bone gaps compared with preoperative measurements, except for one ear, in which some progression of the sensorineural component was detected shortly after the operation. Two additional ears with revision surgeries achieved a good initial postoperative result, but this was maintained in the long-term in only one ear.

Comment: OI is a hereditary condition with an autosomal dominance pattern. It is a connective tissue disorder, and symptoms include bone fragility; blue sclerae; dental, cardiovascular & skin abnormalities; hypermobile joints; lax ligaments; and hearing loss (HL). It has an incidence rate of 1 in 20,000–30,000 newborns, with the reported prevalence of HL varying between 26–78%. The HL usually appears in the late teens to early 20s. Due to the mixed nature of most of the HLs, the effectiveness of stapes surgery has been questioned, particularly over the longer term, as OI-related HL deteriorates with age.

The findings of this study, and other similar studies, suggest that the short-term hearing gain provided by stapes surgery is maintained over a longer term for many patients, irrespective of the presence of a sensorineural component to the HL.

Reference: Laryngoscope. 2009;119(6):1171-9.

http://www3.interscience.wiley.com/journal/122312928/abstract

The relationship of audiometric thresholds elicited with pulsed, warbled, and pulsed-warbled tones in adults with normal hearing

Authors: Franklin C et al

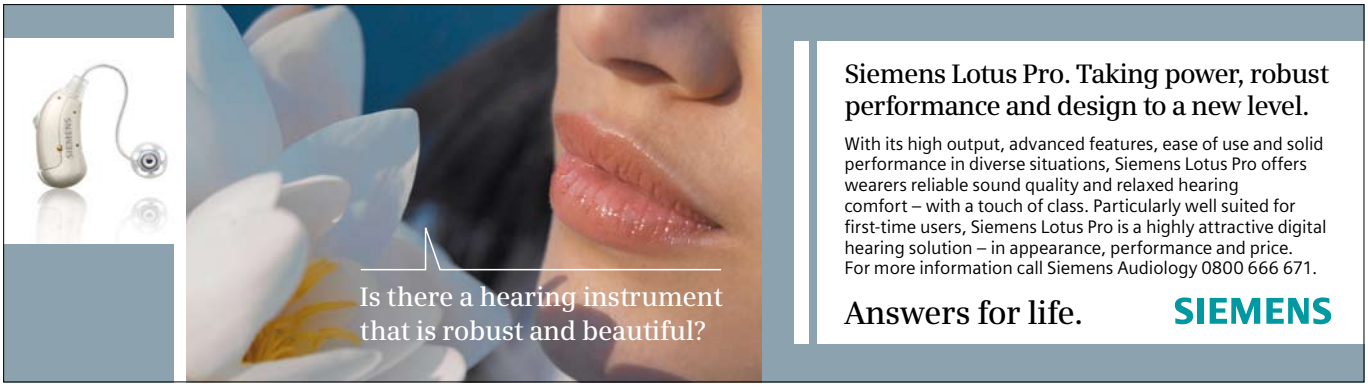
Summary: This study examined the relationship thresholds obtained from 25 listeners using pulsed, warbled, and pulsed-warbled tones at test frequencies recommended by the American Speech-Language-Hearing Association (ASHA) guidelines. No significant differences were observed between thresholds, regardless of stimulus type and testing frequency.

Comment: The use of pulsed or warbled tones is often recommended for patients with tinnitus, and also for some children. Previous research has indicated that warbled tones usually result in thresholds comparable to pure-tones (i.e. <5dB difference). However, variability is greater at higher frequencies as the bandwidths of the signals increase with increased frequency. Unlike existing research, this study also tested inter-octave frequencies.

Using a 'clinical agreement' definition of 2 thresholds having ≤5dB difference, results showed that the clinical agreement between all 3 thresholds and all frequencies ranged between 88–100%. The greatest amount of difference was between the pulsed-warbled and warbled tones at 250Hz. Statistical analysis revealed no significant difference between the 3 stimulus types, along with strong correlations. This suggests that substitution of audiometric stimuli is acceptable, should a situation require it.

Reference: Ear Hear. 2009;30(4):485-7.

http://journals.lww.com/ear-hearing/pages/articleviewer.aspx?year=2009&issue=08000&article=00011&type=abstract



Professionals with hearing loss: maintaining that competitive edge

Authors: Tye-Murray N et al

Summary: In focus groups, 48 salaried professionals with hearing loss (HL) discussed communication issues in relation to their work-related experiences. While they did not appear to undergo excessive stigmatisation in their workplaces, most believed that HL had negatively affected their job performance. Some expressed a sense of having lost their competitive edge, and some believed that they had been denied promotions because of HL. However, most reported having overcome their hearing-related difficulties by various means, and many were determined to remain active in the workforce. Many of the participants were unfamiliar with the Americans with Disability Act, a law that is meant to provide equal access to persons with disabilities.

Comment: Hétu and colleagues undertook pioneering work in the 1990s on the effect that occupational HL had on workers' self identity and self esteem. This study expanded on this by recruiting professionals in the workforce to participate in focus group discussions. The findings suggest that maintaining job competency and a competitive edge was the primary concern of participants. Factors which influence this include the individual's self concept and internal sense of control, use of hearing or assistive-listening devices, perceptions of supervisors and colleagues, accommodations made in the workplace, coping strategies learnt/used, and the work environment of the professional.

The findings have important implications not only for counselling patients, but also for developing aural rehabilitation programmes and/or workshops to educate employers and employees. For example, in addition to maximising the patient's use of their hearing technology, providing educational or training materials for the workplace, communication tactics, contacts for community support groups, along with psychosocial support and counselling (e.g. to encourage and empower the individual to take control of a situation) would also be important.

Reference: Ear Hear. 2009;30(4):475-84.

http://tinyurl.com/yhd7ytc

Validation of the Spatial Hearing Questionnaire

Authors: Tyler RS et al

Summary: A questionnaire is presented that encompasses situations emphasising binaural hearing – the Spatial Hearing Questionnaire (SHQ) – a self-report assessment tool comprising 24 items, scored from 0 to 100. When administered to 142 subjects using one or two cochlear implants (CIs), speech perception and localisation abilities were measured, and the Speech, Spatial, and Other Qualities questionnaire was completed to evaluate validity of the questionnaire. Internal consistency reliability was high (Cronbach's $\alpha = 0.98$) and construct validity was adequate (significant correlations existed between the SHQ and other test measures). A preliminary factor analysis revealed that patient responses are underpinned by three general factors: localisation, speech in noise and music in quiet, and speech in quiet, explaining 64.9%, 13.0%, and 5.3% of the variance, respectively.

Comment: The questionnaire described in this article was developed around the same time as the more well-known "Speech, Spatial, and Qualities of Hearing Scale" (SSQ) developed by Gatehouse & Noble (2004). The 24-item SHQ is shorter and quicker to administer than the SSQ, and covers 8 areas considered important for binaural hearing: hearing male voices, female voices, children's voices, and music; sound localisation; understanding speech in quiet; and understanding speech in noise – both where the speech and noise are from the front, as well as when the speech and noise are spatially separated.

The initial evaluation of the SHQ as described in this article compares unilateral to bilateral CI recipients. However, further validation could be conducted for hearing aid (HA) wearers, and those using both a CI and HA. The SHQ provides clinicians with a shorter and easily administered alternative for assessing patients' spatial hearing skills. The questionnaire is provided at the end of the article.

Reference: Ear Hear. 2009;30(4):466-74.

http://journals.lww.com/ear-hearing/pages/articleviewer.aspx?year=2009&issue=08000&article=00009&type=abstract

Cochlear implant surgery in patients more than seventy-nine years old

Authors: Eshraghi AA et al

Summary: For 21 patients aged >79 years at cochlear implantation with follow-ups past their 8th decade, there were no intraoperative complications, permanent medical or surgical complications. Chronic pain and temporary vertigo were the most commonly reported problems (n=3 for each). During post-op follow-up, there was one case of transient-incomplete facial nerve weakness, one of delirium, and patient with urinary retention; all episodes were temporary and resolved successfully. Patients reported significant improvements in audiological performance, post-op pure tone average, and post-op speech scores. Nine reported they could use the phone and 11 reported that the cochlear implant was greatly beneficial.

Comment: There have been arguments made that issues such as age-related degeneration of the central and peripheral auditory systems, poorer overall health, increased surgical risk, cost-benefit ratios, workforce productivity, and life expectancy make cochlear implantation for elderly recipients less favourable. However, as shown in this study, the elderly experience significantly improved speech perception performance, increased self confidence, increased social participation, improved quality of life, and decreased hearing handicap, post implantation. The issue of 'implanting the elderly' will become increasingly pertinent due to an aging population, the increasing life expectancy, and the likelihood of greater levels and higher prevalence of hearing loss in this population. The question of 'how old is too old' will be one that implant programmes will have to address and re-address, along with how to appropriately evaluate post-op benefit. Are measures of speech perception adequate, or are quality of life and subjective benefits equally important?

Reference: Laryngoscope. 2009;119(6):1180-3.

http://www3.interscience.wiley.com/journal/122268078/abstract