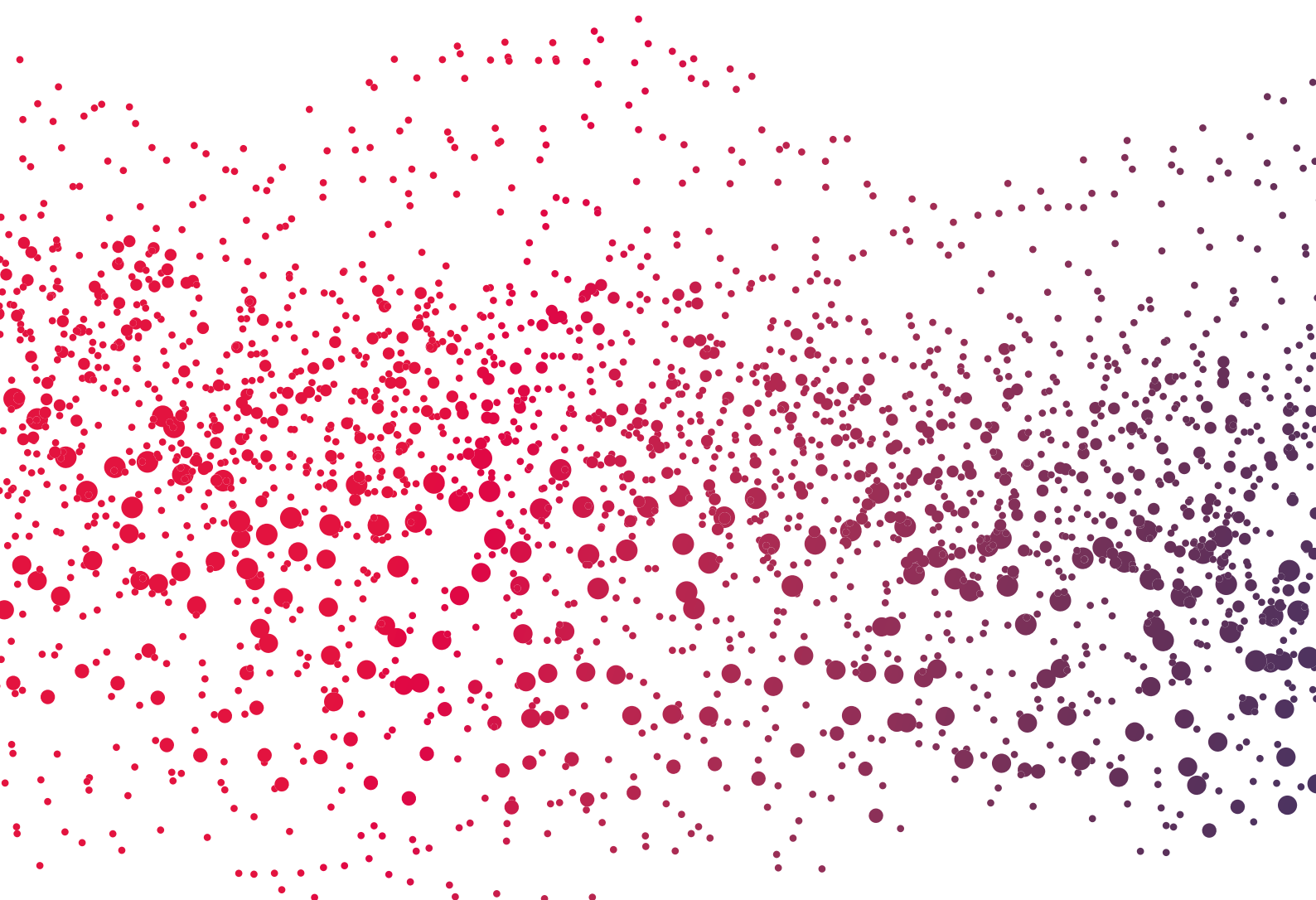


CRS SCIENTIFIC JOURNAL

Otology & Audiology Article Review



OCTOBER 2015

- Page 03: The Prevalence of Notched Audiograms in a Cross-Sectional Study of 12,055 Railway Workers.
 - Arve Lie, Marit Skogstad Torstein Seip Johnsen, Bo Engdahl and Kristian Tambs.
 - *Ear and hearing*, 2015; Vol. 36 (3), e86–e92.
 - Noise-induced hearing loss (NIHL) is one of the most commonly reported occupational diseases in the industrial world. This study has examined three types of rail workers those who are exposed to noise and those who are not. The most recent audiograms of 12055 workers of different age groups and genders were collected and prevalence of different types of audiometric notches was measured. The findings clearly indicated that an audiometric notch should not validate the case of a NIHL.
- Page 04: Effective Identification of Functional Hearing Loss Using Behavioral Threshold Measures.
 - Robert S. Schlauch, Tess K. Koerner, and Lynne Marshall.
 - *Journal of Speech, Language, and Hearing Research*, 2015; Vol. 58, 453–465.
 - This study compared between 4 different simple screening tools to identify functional hearing loss. Subjects were trained to feign hearing loss. Statistical tests were administered to analyse and develop within and between protocol comparisons. The authors recommended choosing between 2 protocols that can be used in any clinic as a very powerful screening tool to identify functional hearing loss.
- Page 06: Determinants of hearing-aid adoption and use among the elderly: A systematic review.
 - Ho-Yee Ng, Alice Yuen Loke.
 - *International Journal of Audiology*, May 2015, Vol. 54, No. 5: 291–300.
 - Several factors seem to influence hearing aid adoption by older adults. This is a systematic review of articles published since 2000 and has identified 7 factors and further integrated them into a model for the use of clinicians. The authors further explained these factors in each of the stages of health behaviour change model and made suggestions based on the published literature to successfully lead patients to hearing aid adoption.
- Page 08: Hearing with Two Ears: Evidence for Cortical Binaural Interaction during Auditory Processing - pp. 384–392(9)
 - Henkin, Yael; Yaar-Soffer, Yifat; Givon, Lihi; Hildesheimer, Minka.
 - *J Am Acad Audiol* 26:384–392 (2015)
 - The purpose of this study was to explore whether binaural interaction components (BICs) are evident in auditory event-related potentials (AERPs) during the advanced perceptual and postperceptual stages of cortical processing.
- Page 10: Transcutaneous Vagus Nerve Stimulation Modulates Tinnitus-Related Beta- and Gamma-Band Activity.
 - Petteri Hyvärinen, Santeri Yrttiaho, Jarmo Lehtimäki, Risto J. Ilmoniemi, Antti Mäkitie,
 - Jukka Ylikoski, Jyrki P. Mäkelä, and Antti A. Aarnisalo.
 - *Ear and Hearing* 2015, Vol. 36, N° 3, e76–e85.
 - This study investigates the change in brain activity for tinnitus patients by using transcutaneous non-invasive Vagus Nerve Stimulation an alternative procedure to the traditional VNS requiring surgery. Results are very promising.
- Page 11: The Impact of Degree of Hearing Loss on Auditory Brainstem Response Predictions of Behavioral Thresholds.
 - McCreery, Ryan W.; Kaminski, Jan; Beauchaine, Kathryn; Lenzen, Natalie; Simms, Kendell; Gorga, Michael P.
 - *Ear and Hearing* 2015, Vol. 36, N° 3, pg. 309–319.
 - The present study evaluated in a large sample of infants the relationship between ABR and behavioural thresholds as a function of degree of hearing loss and to what extent the latter can influence the predictions of behavioural predictions. Frequency specific correction factors resulted in more accurate predictions compared to constant factor.
- Page 13: Incidence Rates of Clinically Significant Tinnitus: 10-Year Trend From a Cohort Study in England.
 - Martinez, Carlos; Wallenhorst, Christopher; McFerran, Don; Hall, Deborah A.
 - *Ear and Hearing* 2015, Vol. 36, N° 3, pg. e69–e75.
 - The incidence of tinnitus can cause economic burden for health services. This study investigated the prevalence in the National Health Service in England. Inferential Statistical analysis suggests that in the next ten years 324, 000 new cases of significant tinnitus cases will emerge.

- Page 15: Associations of Leg Length, Trunk Length, and Total Adult Height With Meniere's: Cross-Sectional Analysis in the UK Biobank.
 - Tyrrell, Jessica; Taylor, Mark; Whinney, David; Osborne, Nicholas J..
 - *Ear and Hearing* 2015, Vol. 36, N°. 3, pg. e122-e128.
 - *The aetiology of Meniere's disease remains obscure even though complex multi-risk factors are known to be often implicated. This study investigates the possible correlation with anthropometric measures (such as leg and trunk length) with self-reported Meniere's disease. The possible association of environmental exposures that influence skeletal growth has been demonstrated to be a robust risk factor towards Meniere's disease.*
- Page 16: College students' personal listening device usage and knowledge
 - Venla Lohi, Samuli Hannula, Pasi Ohtonen, Martti Sorri & Elina Mäki-Torkko.
 - *International Journal of Audiology* 2015; 54: 265–273
 - *In conclusion the authors state that the average Personal Listening Device (PLD) user was able to discriminate a listening level that is safe versus unsafe and were aware of the harmful effects of high intensity level of music.*
- Page 17: Deterioration of Speech Recognition Ability Over a Period of 5 Years in Adults Ages 18 to 70 Years: Results of the Dutch Online Speech-in-Noise Test
 - Mariska Stam, Cas Smits, Jos W. R. Twisk, Ulrike Lemke, Joost M. Festen and Sophia E. Kramer.
 - *Ear and Hearing* 2015, Vol. 36, N°. 3, pg. e129–e137.
 - *This study indicates that deterioration of Speech Recognition Ability is not linear over age. Results of 70+ participants were not included in this study.*
- Page 18: Relationship between tinnitus pitch and edge of hearing loss in individuals with a narrow tinnitus bandwidth.
 - Magdalena Sereda, Mark Edmondson-Jones & Deborah A. Hall.
 - *International Journal of Audiology* 2015; 54: 249–256.
 - *An interesting article that confirms previous findings that tinnitus pitch generally falls within the area of hearing loss. A strong argument of this study is for measurements of high frequency hearing loss because a lot of patients experience a tinnitus pitch that is higher than 8 kHz.*
- Page 19: Hyperbaric oxygen for idiopathic sudden hearing loss: is the routine application helpful?
 - Luigi Capuano et al.
 - *Acta Oto-Laryngologica*. 2015; 135: 692–697.
 - *In this study, the proportion of patients with complete recovery was the highest in the combined Intra Venous Steroid (IVS) and Hyper Baric Oxygen (HBO) group and the ratio of patients responding to therapy was the highest in the IVS + HBO group.*
- Page 20: Hearing decline in menopausal women – a 10-year follow-up.
 - Johan Svedbrant, Rusana Bark, Malou Hultcrantz & Christina Hederstierna.
 - *Acta Oto-Laryngologica*. 2015; 135: 807–813.
 - *In this study a hearing decline was shown across all frequencies but more pronounced in the high-frequency region: there is a faster decline in the peri-menopausal group at 3 kHz for both ears.*
- Page 21: Benefits of Phoneme Discrimination Training in a Randomized Controlled Trial of 50- to 74-Year-Olds With Mild Hearing Loss
 - Melanie A. Ferguson, Helen Henshaw, Daniel P. A. Clark and David R. Moore
 - *Ear and Hearing* 2014; Vol. 35(4), e110–e121 with announcement of award in *Ear and Hearing*, 2015; Vol. 36(3).
 - *The overall aim of this study was to evaluate the benefits of a home-delivered, phoneme discrimination training program as a potential clinical intervention for people with mild hearing loss. Its specific focus was on 50- to 74-year olds with mild sensorineural hearing loss who experienced hearing difficulties but did not have hearing aids.*
- Page 23: Cochlear Implantation Improves Localization Ability in Patients With Unilateral Deafness.
 - Tavora-Vieira et al.
 - *Ear and Hearing*, 2015; Vol. 36(3), e93-e98.
 - *Significant better results were found in 14 subjects. Two subjects showed no benefit. These two subjects had very long duration of deafness and lost their hearing at 6 and 7 years of age. The critical age of bilateral auditory pathway development seems to be important to establish whether localization can be improved with CI in unilateral deafness.*

The Prevalence of Notched Audiograms in a Cross-Sectional Study of 12,055 Railway Workers.



Arve Lie, Marit Skogstad Torstein Seip Johnsen,
Bo Engdahl and Kristian Tambs.

Ear and Hearing 2015 Vol. 36 (3), e86-e92.

Diagnosis of NIHL is very crucial so that correct preventive measures can be taken at work places. Presence of a notch in 3-6 kHz area of the audiogram is considered a proof of NIHL. However, there are no internationally accepted guidelines for the same.

1. According to ISO 1999, the expected hearing loss due to noise exposure is relatively modest – in the order of 5 dB (in 3-6 kHz area) after 40 years of exposure to 85 dB(A) noise levels.
2. It is difficult to differentiate NIHL with age-related hearing loss.
3. American and European guidelines have described the presence of a notch as an important indication of NIHL. On the other hand, literature also suggests that a notch can occur in non-exposed conditions. Moreover, the definition of a notch is not clear.

The aim of this study was to describe the prevalence of notched audiograms among Norwegian railway personnel with and without noise exposure to better assess the usefulness of such notches in the diagnosis of NIHL.

The authors have collected the most recent audiograms of 12055 workers (drivers and conductors; track workers; rail office workers). From the audiogram, 3 types of audiogram notches were measured for each audiogram.

1. Coles Notch - Hearing thresholds at 3 or 4 or 6 kHz of 10 dB or more compared with that at 1 or 2 kHz and 6 or 8 kHz
2. Notch Index - Mean hearing threshold of 2, 3, and 4 kHz minus the mean of 1 and 8 kHz
3. 4 kHz Notch - Hearing threshold of 4 kHz at least 10 dB greater than that at 2 and 8 kHz

The significant findings of the study were:

1. Average depth of the Coles notch was less than 10 dB for the frequencies 3 to 6 kHz. The notch index >0 was somewhat deeper whereas the 4 kHz notch was the deepest, close to 20 dB. Table 2 shows the prevalence of notched audiograms in the three occupational groups.
2. In male workers, Coles notch and notch index were more common than the 4 kHz notch. In women, the prevalence of notches fell to half of that seen in male workers. There are age-specific trends also seen in notch patterns.
3. Unilateral notches were more common than bilateral ones. Notches were seen in all types of employees even if they were not exposed to noise.

Based on the above findings, the authors concluded that audiograms with notches can occur with and without being exposed to noise at work place. A notch should not be a criterion for diagnosis of NIHL.

This is a unique cross-sectional study which has included a huge number of participants. The age-old hypothesis of notched audiograms and its link to NIHL has been studied. This study acts as a good reference for everything about notched audiograms and their link to NIHL. However, the authors did not explain the very reason for an audiometric notch.

Effective Identification of Functional Hearing Loss Using Behavioral Threshold Measures



Robert S. Schlauch, Tess K. Koerner, and Lynne Marshall.

Journal of Speech Language and Hearing Research. 2015; Vol. 58, 453-465.

Functional hearing loss is a false elevation of thresholds which cannot be explained by any known organic disorder. The role of the clinical audiologist is to identify a functional hearing loss, if present, and quantify actual hearing capability. Though several tests are available for this, audiologists generally rely on test-retest threshold at 1 kHz and the agreement between pure-tone average and spondee threshold (ST-PTA agreement). It was found that STs measured using an ascending approach and tonal thresholds measured using a descending approach yielded a 100% true-positive rate and a 0% false-positive rate for identification of functional hearing loss when the pass-fail criterion represented an ST-PTA difference greater than 10 dB. The average ST-PTA difference in persons feigning a loss under these conditions was 41.6 dB.

The authors have examined if noise bands (used instead of spondees) can be an effective test as ST-PTA agreement. Another objective of the study was to compare the relative effectiveness of an ascending-descending ST-PTA procedure with that of an ascending-descending threshold procedure using tones (two tones and three frequency tones) alone. The overall goal of this study was to develop an effective and efficient test battery for detecting functional hearing loss in a clinical population.

120 participants who were 'trained' to feign hearing loss were randomly assigned to noise band protocol, spondee protocol, two-tone protocol and three-tone protocol. In the noise band group, noise bands (2s duration) were presented in ascending fashion to find threshold and, later, tones were presented in descending fashion. In the spondee group, spondee thresholds were measured in ascending approach and the tonal thresholds in the descending approach. For the two-tone group, tonal thresholds (500 and 1000 Hz) were measured in ascending approach followed by descending approach. For the 3-tone group, tonal thresholds (500, 1000 and 2000 Hz) were first measured in descending approach followed by the ascending approach. For all these patients, thresholds (500, 1000 and 2000 Hz) were first measured (both in feigning and non-feigning conditions) before administering the actual procedure.

1. While not feigning, thresholds obtained (between all the four groups) were highly correlating with each other. Thresholds for noise bands and spondees were better than those of tones.
2. While feigning, for all our groups, the initial ascending thresholds were at remarkably similar hearing levels— the average PTAs across groups were all within 2 dB. The descending PTAs were also similar across the groups and were 15 to 20 dB higher than the original ascending thresholds. The largest differences across groups were seen for ascending thresholds- the ST was 10 dB or lower than the noise-band or tonal thresholds.

Based on these findings, the authors suggested the following important measures that can be used in the clinical setting:

1. A discrepancy of 15 dB or more on a test-retest for a 1.0-kHz tone is a useful pass-fail criterion for functional hearing loss.
2. A comparison of the average thresholds for tones obtained in the initial audiogram with the same thresholds for frequencies obtained in the screening test for descending tones. A pass-fail criterion of a difference greater than 5 dB.

Further, the authors recommended 2 protocols which yield the best true positive and false positive rates for clinical application – spondee protocol multi-step assessment and three-tone protocol multi-step assessment. The authors concluded that noise bands were not very effective to replace spondees as a screening tool for functional hearing loss.

This study presents us a very effective screening tool to identify functional hearing loss or pseudohypacusis. The design to compare 4 different methods was a very effective one. The statistical procedures to compare between these tests and select the best protocol were very strong. The protocols finally recommended by the authors were reminiscent of the very old Ventry and Chaiklin's 1965 study on the same subject.

Determinants of hearing-aid adoption and use among the elderly: A systematic review.



Ho-Yee Ng, J. and Alice Yuen Loke.

International Journal of Audiology Vol. 54(5),
291-300.

According to the WHO the number of elderly people will increase dramatically and will be 2 billion at 2050. Presbycusis is considered to be one of the chronic conditions that influence the well-being of elderly people.

Air-conduction hearing aids, a non-invasive option is considered one of the most common and viable solution for presbycusis. The benefits of amplification in the immediate short term and long term are clearly documented. However, it is shown that older adults take around 10 years to acquire their first hearing aids (from the time of onset) and the adoption rates are around 20% across the world. There seems to be a variety of non-audiological factors interacting with audiological configuration producing unique pattern of hearing aid use.

This review aims to identify the determinants of hearing aid usage among older adults. Hearing aid usage, the dependent outcome of this review, is measured in two dimensions: hearing aid adoption and hearing aid use. The two dimensions refer to the acquisition or ownership of hearing aids and the frequency with which the hearing aids are used in terms of the number of hours used daily, respectively.

The authors conducted a systematic search of publications in electronic databases using PICO format and identified 396 studies published after 2000 on this subject. They were all published in peer-reviewed journals and were both experimental and observational in nature. Further quality assessment of each of the articles resulted in inclusion of only 22 studies and the rest were rejected.

Nine of the twenty-two studies included were conducted in the United States, eight were conducted in Europe, three in Australia, and only two in Asia. The majority of the studies were cross-sectional studies, three were cohort studies, two were randomised controlled trials, and one was a longitudinal study. The age of the participants of these studies ranged from 50 to 97 and the sample size varied significantly from 60 to 14,737.

Questionnaires were used in most of the studies to obtain data, while face-to-face interviews were employed in seven studies and case records in one.

Based on the systematic review, the authors identified some audiological and non-audiological factors. Four audiological factors and seven non-audiological factors appeared to determine hearing-aid adoption and use. The audiological determinants were: severity of hearing loss, type of hearing aids, background noise acceptance, and insertion gain relative to prescription target. The non-audiological determinants were: self-perceived hearing problems, expectation (on quality of life improvement and stigmatisation), demographics, group consultation, support from significant others, self-perceived benefit, and satisfaction with the hearing aid being used.

The authors further integrated these important factors into the trans-theoretical model (TTM) of health behaviour change. The six stages of TTM are

- (1) Pre-contemplation, during which an individual does not intend to change his/her behaviour in the foreseeable future;
- (2) Contemplation, during which an individual is considering changing and is aware of the benefits and barriers of changing;
- (3) Preparation, during which an individual is preparing to make a change by seeking information and talking to the relevant people;
- (4) Action, during which an individual makes a behavioural change;

- (5) Maintenance, during which an individual consciously maintains the changed behaviour;
and*
- (6) Termination, during which an individual achieves complete self-efficacy.*

The TTM enables clinicians and researchers to identify and work more on these factors to facilitate the change of health behaviour towards adoption of hearing aids.

It is very important for audiologists in the clinic to be aware of the factors that can influence their patient's behaviour and use this knowledge to help them to move forward and gain successful adoption and hearing aids usage.

This is a well conducted review study from the idea to actual identification of factors. The authors explained the variables and their influence in a systematic fashion. Further, incorporating these factors into the TTM is a very good idea, which helps any clinician to identify the stage reached by a given patient and prepare for working on the relevant factors.

Hearing with two ears: Evidence for cortical binaural interaction during auditory processing.



Henkin, Yael; Yaar-Soffer, Yifat; Givon, Lihi;
Hildesheimer, Minka.

J Am Acad Audiol 2015; Vol. 26, 384–392.

Integration of information presented to the two ears has been shown to manifest in binaural interaction components (BICs) that occur along the ascending auditory pathways. In humans, BICs have been studied predominantly at the brainstem and thalamocortical levels. However, understanding of higher cortically driven mechanisms of binaural hearing is limited.

The purpose of this study was to explore whether BICs are evident in auditory event-related potentials (AERPs) during the advanced perceptual and post-perceptual stages of cortical processing.

The AERPs N1, P3, and a late negative component (LNC) were recorded from multiple site electrodes while participants (15 young adults (21-32 years, 6 females) with normal hearing sensitivity) performed an oddball discrimination task that consisted of natural speech syllables (/ka/ vs. /ta/) that differed by place-of-articulation. Participants were instructed to respond to the target stimulus (/ta/) while performing the task in three listening conditions: monaural right, monaural left, and binaural.

By subtracting the response to target stimuli elicited in the binaural condition from the sum of responses elicited in the monaural right and left conditions, the BIC waveform was derived and the latencies and amplitudes of the components were measured. The maximal interaction was calculated by dividing BIC amplitude by the summed right and left response amplitudes. In addition, the latencies and amplitudes of the AERPs to target stimuli elicited in the monaural right, monaural left, and binaural listening conditions were measured and subjected to analysis of variance with repeated measures testing the effect of listening condition and laterality.

Three consecutive BICs were identified at a mean latency of 129, 406, and 554 msec, and were labelled N1-BIC, P3-BIC, and LNC-BIC, respectively. Maximal interaction increased significantly with progression of auditory processing from perceptual to post-perceptual stages and amounted to 51%, 55%, and 75% of the sum of monaural responses for N1-BIC, P3-BIC, and LNC-BIC, respectively. Binaural interaction manifested in a decrease of the binaural response compared to the sum of monaural responses. Furthermore, listening condition affected P3 latency only, whereas laterality effects manifested in enhanced N1 amplitudes at the left (T3) vs. right (T4) scalp electrode and in a greater left-right amplitude difference in the right compared to left listening condition.

Conclusions:

The current AERP data provides evidence for the occurrence of cortical BICs during perceptual and postperceptual stages, presumably reflecting ongoing integration of information presented to the two ears at the final stages of auditory processing. Increasing binaural interaction with the progression of the auditory processing sequence (N1 to LNC) may support the notion that cortical BICs reflect inherited interactions from preceding stages of upstream processing together with discrete cortical neural activity involved in binaural processing. Clinically, an objective measure of cortical binaural processing has the potential of becoming an appealing neural correlate of binaural behavioral performance.

The well-known left-hemisphere dominance in speech processing manifested in greater N1 amplitudes over the left temporal lobe, regardless of ear stimulation. Furthermore, support for the 'right ear advantage' for speech processing manifested in the greater hemispheric asymmetry (i.e. greater N1 amplitude over the left vs. right scalp) during right vs. left ear stimulation. Results may also be related to the stimuli /ta/ and /ka/ that differ by place-of-articulation.



Although there are some conclusions made about cortical binaural interaction during auditory processing there is little information about clinical implications. There is no information about how hearing impaired people and hearing aid users respond. More research in this area is necessary. In previous research on CI children, there were indications that binaural processing can be restored by bilateral implantation. So, maybe this could also be the case for hearing aid users, especially when there's known auditory deprivation.

Transcutaneous Vagus Nerve Stimulation Modulates Tinnitus-Related Beta- and Gamma-Band Activity.



Hyvärinen P., Yrttiaho et al.

Ear and Hearing 2015 Vol. 36 (3), e76-e85.

This study aims to objectify tinnitus by measuring Vagus Nerve signals. Previous electrophysiological brain studies show increased Beta (12-30 Hz) and Gamma (30-48 Hz) activity and decreased Alpha (8-12 Hz) activity in tinnitus patients. Transcutaneous (non-invasive) Vagus Nerve Stimulation (tVNS) has recently been proposed as an alternative procedure to the traditional VNS requiring surgery.

Seven tinnitus patients and eight normal hearing subjects without tinnitus (control group) were administered with the Tinnitus Handicap Inventory (THI). Tone audiometry was also measured for both groups. For the tinnitus group a complete tinnitus assessment was determined (pitch, frequency). The tinnitus group received electrical pulses through clip electrodes placed on the left tragus during six minutes (tVNS-on). During the electrical stimulation, a tone, similar to the tinnitus pitch, of 75 dB(A) was delivered in free field. The control group received a clip electrode on the lobulus (tVNS-sham) and also received the auditory stimulus. Both groups also received a period without VNS (tVNS-off). During auditory stimulation, spectral and synchronicity changes were compared within each group (tVNS on / off) and between both groups (control – tinnitus group).

Tinnitus patients differed from the control group before tVNS was applied (baseline condition), measured by beta and gamma frequencies. They found that tVNS-induced changes in synchrony, correlating strongly with tinnitus handicap inventory scores.

The authors concluded that tVNS was successful in modulating tinnitus-related beta- and gamma-band activity and thus could have potential as a treatment method for tinnitus.

We need to be cautious about generalising the results because a very small number of patients participated. Also, only acute effects were measured for only six minutes (!). This study needs further research for long term effects. Might this evolve to a promising therapy for all tinnitus patients or is TRT with noise generators and hearing aids a more realistic approach? Maybe a tVNS-based tinnitus therapy might be useful for 'worse-tinnitus' patients? However, for us as audiologists, it's important to counsel tinnitus patients about the evidence about tinnitus-related brain activity. We can assure patients that their tinnitus is measurable in their brain.

The Impact of Degree of Hearing Loss on Auditory Brainstem Response Predictions of Behavioural Thresholds.



Ryan W. McCreery, Jan Kamisnki, Kathryn Beauchaine, Natalie Lenzen, Kendell Simms, and Michael P. Gorga.

Ear and Hearing 2015 Vol. 36, N°. 3, pg. 309-319.

Diagnosis of hearing loss and prescription of amplification for infants and young children require accurate estimates of ear and frequency specific behavioural thresholds based on auditory brainstem response measurements. Identification of hearing loss and provision of amplification within the timeframe recommended by the American Academy of Paediatrics 2007 requires estimates of infants' hearing thresholds using electrophysiological tests. The ABR is the most studied method of hearing threshold estimation in infants. If hearing loss is confirmed, ear-specific estimates of behavioural threshold based on the ABR are used to prescribe amplification. Inaccurate estimates of behavioural thresholds from ABR could lead to inappropriate diagnosis of hearing loss in children with normal hearing as it is possible to obtain incorrect estimates of behavioural thresholds based on ABR measurements for children with hearing loss. Underestimation of thresholds could limit speech audibility with amplification and negatively affect speech and language development. Overestimation, on the other hand, could lead to overamplification which risks hearing damage from exposure to unnecessarily high sound levels.

Thus, there is great value in continued efforts to improve the accuracy with which behavioural thresholds are predicted from ABR measurements.

Despite the consistent relationship between ABR and behavioural thresholds across multiple studies, predictions of behavioural thresholds from ABR thresholds may vary as a function of degree of hearing loss.

Lower intensity levels were evaluated during behavioural assessment. In contrast, for children with moderate or greater degrees of hearing loss, the ABR underestimated behavioural threshold by as much as 20 db depending on stimulus frequency.

An explanation for the tendency of ABR to overestimate behavioural thresholds in individuals with normal hearing and underestimate behavioural thresholds in patients with greater than mild degrees of hearing loss was proposed by Gorga et al (2006). It is suggested that this effect is related to an interaction between differences in temporal integration between listeners with normal hearing and those with hearing loss.

For this study, retrospective data was analysed for 309 ears (161 right ears and 148 left ears) from 177 children who received clinical ABR evaluation and behavioural audiological assessment at Boys Town National Research Hospital.

The objective of the present study was to estimate the extent to which degree of hearing loss influenced the relationship between ABR and behavioural thresholds predictions for fitting amplification in children. Thresholds for ABR and behavioural assessments were compared using retrospective analysis of clinical data.

The key findings were that relationships between ABR and behavioural thresholds were reliable, as has been documented in previous studies. A frequency-specific correction factor that takes into account degree of hearing loss resulted in more accurate predictions of behavioural threshold than approaches that used behavioural correction or used behavioural correction and then applied a constant correction factor regardless of degree of hearing loss.



This paper provides compelling evidence of the importance held by protocols for paediatric hearing aid fitting and the importance of communicating information in a multi-professional setting such as that encountered in hearing aid fitting in small children. To underestimate correction factors or calibration used with clinical instruments can result in a certain risk of under or over amplification.

Reference

Gorga M. P., Johnson T. A., Kaminski J. R., et al. Using a combination of click- and tone burst-evoked auditory brain stem response measurements to estimate pure-tone thresholds. *Ear Hear.* (2006);27:60–74

Incidence Rates of Clinically Significant Tinnitus: 10-Year Trend from a Cohort Study in England.



Carlos Martinez, Christopher Wallenhardt, Don McFerran, and Deborah A. Hall.

Ear and Hearing 2015 Vol. 36, N°. 3, pg. e69-e75.

Tinnitus remains one of the most common auditory symptoms and, depending on the criteria used to define the condition, prevalence rates in adult population vary from 8.2 to 20.0%, rising to 19.9 to 30.3% in those over 50 years of age.

While previous research goes some way forward to addressing the incidence of self-reported tinnitus and its perceived severity in the general population, it does not provide insight into the impact and burden of chronic tinnitus from a health care perspective.

This study used openly available anonymised patient-based primary care data from the United Kingdom Clinical Practice Research Datalink. The study population consisted of all individuals below 85 years of age registered with general practitioners during the study period of January 1, 2002 to December 31, 2011.

The study population comprised 4,703,226 persons in England with mean age of 34.7 years 50.5% females and mean body mass index of 24.8kg/m². Within this population 125,430 subjects were identified with any form of tinnitus. After applying the definition of significant tinnitus, 14,303 subjects with a first time diagnosis of significant tinnitus were found. The mean age of the 14,303 cases was 54.0 years (SD = 15.4). Significant tinnitus was recorded in all age groups but mostly between 50 to 69 years of age (48.5%).

A larger proportion had a higher socioeconomic status (33.1%) and had never smoked (56.7%).

Incident significant tinnitus was observed even in children under 10 years indicating that one in 50, 000 children under 10 met the criteria for incident significant tinnitus every year.

The total number of incident cases of significant tinnitus in England over 10 years (2002-2011) is estimated at approximately 258,000. The figures obtained in this study can be used to estimate the public health burden of tinnitus in the near future. 300,000 to 350,000 new cases of significant tinnitus are expected to occur in England between January 2012 and December 2021.

This is probably the first study in a large population sample on the clinical burden of patients with first time experience of clinically significant tinnitus that leads the individual to seek additional resources from within the NHS health care system.

Higher health expectations among more recent generations of UK adults are a likely contributor to the growth in the number of instances of medical help seeking for tinnitus. The baby boomers born in the 1940's and early 1950s has now reached retirement with greater wealth than at any time in history and is at the age of most intensive use of NHS services for tinnitus. In support of this view, the findings show more cases of significant tinnitus among patients with a higher economic status, that is, those who are most likely to expect onward referral. Improved public and patient awareness of symptoms is provided by the growth in internet use. Much easier access to information through the internet has started to change the relationship between patients and professionals. Patients are less likely to consult their GP as passive recipients and are more likely to seek information themselves before the GP appointment and to be more demanding. On the basis of the incidence estimates reported in this study, the yearly cost of tinnitus to the NHS in England could easily exceed £4.9 million, because this estimate alone is based on one GP appointment (£45; Personal Social Services Research Unit 2013) and one outpatient appointment (£108, NHS 2014). Tinnitus is more challenging than many other health conditions, because there is no objective measurement of the condition, no



consensus regarding diagnosis assessment, and no standardisation of the management pathway. Further research is needed to address these issues but there is compelling evidence to support the provision of effective care that is tailored to the needs of each individual.

This paper should interest hearing aid specialists not only from a clinical point of view, because patients in need of amplification can be concurrently affected by tinnitus, but also from the dynamics that a section of the population undertake to gain more knowledge about their condition, becoming more empowered through use of the internet. This means that new paradigms are being born and the hearing aid field of activity is certainly not immune to these.

Associations of Leg Length, Trunk Length, and Total Adult Height with Meniere's: Cross – Sectional Analysis in the UK Biobank.



Jessica S. Tyrell, Mark S. Taylor, David Whinney,
and Nicholas J. Osborne.

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e128.

Specific risk factors such as those genetic and/or childhood environmental, early life socioeconomic status, viral infection, autoimmunity, and nervous system dysfunction have all been identified as potential contributors implicated in Meniere's disease. Hundreds of thousands of people around the world are affected by the condition yet, to date, very limited information is available on the role of early life exposure in developing Meniere's.

This research recruited (from 2006 to 2010), 502,682 volunteers aged between 37 and 73 years of age. The participants were recruited via G.P., surgeries and advertisements. Each participant was asked to complete a questionnaire and donate blood and urine samples. Those reporting Meniere's numbered 1327 and the rest (479,500 subjects) were used as the controls.

Standing and sitting heights (trunk length) were taken. Subjects defined as of small stature (148 cm) were excluded (n 1573) and a further 261 subjects were excluded with leg length greater than 120 cm and less than 60 cm. Multiple logistic regression analysis was used to examine associations of the components of height with Meniere's.

The prevalence of Meniere's within UK Biobank participants with valid height measures and appropriate confounding variables was 0.28%. Individuals were at greater odds of reporting Meniere's if they were older, female, with shorter leg and trunk lengths, and more obese. Individuals born in areas of greater deprivation were also at greater odds of reporting Meniere's OR, 1.10 (1.03-1.16). Areas of greater deprivation may be associated with poorer nutrition that in turn can represent a risk factor towards height and leg length. Increasing height and leg length was associated with lower odds of Meniere's. Individuals who were not of white ethnic origin were at lower odds of reporting Meniere's. The odds of reporting Meniere's were not influenced by smoking status.

The strength of this research is in the staggering sample size with 1376 individuals reporting Meniere's. The research represents the largest worldwide case control study on the subject, and the first to investigate the components of adult height with the disease. This study demonstrated robust associations between Meniere's and the components of adult height, with particular associations with leg length. Specific associations between leg length and Meniere's may suggest that early life environmental exposures that influence skeletal growth can also influence Meniere's risk in later life. Although these findings are not clinically relevant for the treatment of Meniere's, they do all the same provide compelling support, from a perspective of health prevention, for the importance of the childhood environment (nutrition, lower burden of disease) in the growth and development of a healthy neurosensory system.

Another interesting association made in this paper was that of leg length and metabolic disorders underlying type 2 diabetes along with lower insulin sensitivity. Although not directly pertinent with the hearing aid field of activity, this paper does provide further and compelling evidence for the Hearing Aid Specialist of the multifactor's behind health conditions and thus the importance of a thorough anamnesis even in hearing aid fitting.

College students' personal listening device usage and knowledge.



Ho-Yee Ng, J. and Alice Yuen Loke.

*International Journal of Audiology Vol. 54(5),
291-300.*

180 college students in Oxford, USA, between 17 and 25 years of age participated in this study, trying to document the usage and knowledge of safety limits of their Personal Listening Devices (PLDs). Students were asked to complete questionnaires about their listening behaviour and their interpretation of harmfulness of loud music and the relation with the duration of listening. They were audiometrically screened, and were asked to set their personal PLDs to a level which they normally used for listening to 3 of their favourite songs, while the volume was recorded using Real Ear Measurements.

The measured mean level was 73 dBA (range 46,1 to 103,3). 44 participants showed levels greater than 80 dBA, yet only 7 were listening for durations exceeding the noise exposure recommendation of the SCENIHR. Only 8% reported using hearing protection, if needed.

The results suggest that listeners who use their PLD for more than 7.5 hours a week, exhibit statistically worse hearing levels.

85% of the participants stated that they would shorten PLD use duration, if information on harmfulness is given by audiologists or doctors.

The authors of this study would like to state that they did not include listening behaviour in background noise, which results in higher volumes (using open ear buds).

In conclusion they stated that the average PLD user was able to discriminate a listening level that is safe versus unsafe and were aware of the harmful effects of a high intensity level of music.



Deterioration of Speech Recognition Ability Over a Period of 5 Years in Adults Ages 18 to 70 Years: Results of the Dutch Online Speech-in-Noise Test.



Mariska Stam, Cas Smits, Jos W. R. Twisk, Ulrike Lemke, Joost M. Festen and Sophia E. Kramer.

Ear and Hearing 2015 Vol. 36 (3), e129–e137.

More than 10 years ago Smits et al. (2004, 2006) developed a digit-triplet speech-in-noise test, called “the National Hearing Test” (NHT). It’s a functional self-test with can be performed by telephone, and later on by an internet application. The NHT determines the speech-reception –threshold by using 3 digits in a steady state noise. The test is widely used and several versions are available in different languages.

The aim of this study was to use this large database to analyse if deterioration can be observed in SRTn over a period of 5 years. 427 participants (normal hearing and hearing impaired), using strict criteria were included in this study. (N=1506 initially)

Multiple analyses, including age, gender, chronic conditions (diabetes and cardiovascular diseases) social situation and education level were done. Participants were aged between 18 and 70.

Findings were that older participants have on average poorer results compared with the younger ones. The largest deterioration was found in the group between 50 and 59 years of age. While the average deterioration was 0.38 dB over 5 years, the group between 50 and 59 scored 0.64 dB. Taking in account that 0.4 dB change results in a 8% loss in speech recognition in difficult situations, one can have an idea of the impact of this deterioration.

This study indicates that deterioration is not linear over age. Results of 70+ participants were not included in this study.

The sample sizes of groups with one chronic condition (diabetes or cardiovascular diseases) were too small to analyse.

Drop-outs of the study were mainly younger participants, those with a better hearing ability, a lower educational level and single parents. The authors mention the possible dilution of the effect due to these drop-outs.

References

Smits C., Kapteyn T. S., Houtgast T.. Development and validation of an automatic speech-in-noise screening test by telephone. *Int J Audiol.* (2004);43:15–28

Smits C., Merkus P., Houtgast T.. How we do it: The Dutch functional hearing-screening tests by telephone and internet. *Clin Otolaryngol.* (2006);31:436–440

Relationship between tinnitus pitch and edge of hearing loss in individuals with a narrow tinnitus bandwidth.



Serada M., Edmondson-Jones M., & Hall D.A.

International Journal of Audiology Vol. 54(5), 249-256.

Two models of tinnitus generation were named in this retrospective study: the tonotopic reorganization model and the homeostatic plasticity model. In a previous study (Serada et al. 2011) tinnitus pitch fell within the area of hearing loss in a small subset of participants with a narrow bandwidth tinnitus. This finding would be consistent with the tonotopic reorganisation theory and should be confirmed in a large group (n=100). The authors predicted that people who experience a narrow (tonal) tinnitus bandwidth should report a dominant tinnitus pitch that corresponds closely to the edge of hearing loss. Edge of hearing loss was considered as the frequency at which the hearing loss curve passed from clinically normal to impaired hearing.

Tinnitus pitch generally fell within the area of hearing loss. The results demonstrated a significant positive correlation between dominant tinnitus pitch and edge frequencies. Despite statistical significance, the size of the correlation coefficient indicates only a weak relationship between tinnitus and audiometric edge.

Further multiple regression analysis indicated that the degree of hearing loss is the main driver of dominant tinnitus. Edge of frequency was not a good predictor of tinnitus pitch. For the majority of participants, dominant tinnitus pitch corresponded to a frequency that was more than one octave above the edge frequency. This result rather supports a homeostatic plasticity model for people reporting a narrow tinnitus bandwidth and is inconsistent with the reorganisation theory. This finding supports the homeostatic plasticity model in the same way as it does for people who experience a broader tinnitus spectrum.

An interesting article that confirms previous findings that tinnitus pitch generally falls within the area of hearing loss. A strong argument of this study is for measurements of high frequency hearing loss because a lot of patients experience a tinnitus pitch that is higher than 8 kHz. This resulted in the inclusion of more than 100 participants. Besides, the method for determining dominant tinnitus pitch was rather based on objective calculation from the tinnitus spectrum than subjective report. For further research it would be interesting to investigate what these findings could mean for the treatment of tinnitus.

Other article: Serada M., Hall D.A., Bosnyak D.J., Edmondson-Jones M., Roberts L.E. et al. 2011 Re-examining the relationship between tinnitus pitch and hearing sensitivity. *Eur Arch Otorhinolaryngol*, 271, 41-48.

Hyperbaric oxygen for idiopathic sudden hearing loss: is the routine application helpful?



Luigi Capuano, Matteo Cavaliere, Giuseppe Parente, Alberto Damiano, Gabriella Pezzuti, Dante Lopardo & Maurizio Iemma.

Acta Otolaryngologica. 2015; 135: 692 - 697.

In this retrospective cohort study, 300 patients (300 diseased ears) were divided into 3 groups according to the therapy received: group A: IVS: intravenous steroid, group B: HBO: hyperbaric oxygen and group C: IVS + HBO. Pure tone audiograms before (day 0) and after (day 30, 60, 90 and 180) treatment were evaluated.

In all groups, the results were not significantly influenced by age, association with dizziness, hypertension, diabetes, dysthyroidism or smoking habits.

Significant results:

- *The proportion of patients with complete recovery was the highest in the IVS + HBO group.*
- *The ratio of patients responding to therapy was the highest in the IVS + HBO group.*
- *Hypercholesterolemia (>240 mg/dl) determined responses significantly worse in all the groups.*
- *Mean ages were compared and patients with up sloping type audiogram were found to have lower age.*
- *In all the groups, the proportion of patients with complete recovery was the highest in those with the up sloping and flat audiometric configuration, compared with down sloping and profound configuration.*
- *Mean gain of cases in whom therapy was started in the first 2 weeks were significantly higher.*
- *Mean gain of group C was better than group A and group B*

HBO and IVS alone have produced comparable improvements, so HBO alone becomes crucial when full steroid therapy is contraindicated.

Any therapy must be started as soon as possible (within 14 days from the beginning).

Hearing decline in menopausal women – a 10-year follow-up.



Johan Svedbrant, Rusana Bark, Malou
Hultcrantz & Christina Hederstierna.

Acta Otolaryngologica. 2015; 135: No. 8: 807–
813.

In healthy women, the menopause appears to act as a trigger of a relatively rapid age-related hearing decline. The explanation for this can be the reduced level of oestrogen or the high serum cortisol levels related to the stress during the menopause.

This study is part of a prospective longitudinal study for women in their 50s. A total of 100 women remained in the study for the full 10-year follow-up. Four groups were constructed: pre-menopausal, peri-menopausal, post-menopausal and post plus-menopausal.

There were measurements at baseline, and at 2, 7 and 10 years: a hearing measurement at each frequency for both ears and a blood sample (for hormonal testing) was collected in the morning before the hearing test was performed.

Hearing decline was shown across all frequencies but more pronounced in the high-frequency region; there is a faster decline in the peri-menopausal group at 3 kHz for both ears. There is a slower decline in the right ear at 1 kHz for pre-menopausal women compared with the peri-, post- and post plus-menopausal groups.

This study could not verify a significant correlation between blood levels of cortisol and hearing decline.

Remarks:

The hearing level at baseline was generally good. The hearing decline in the present study of women between 50 and 60 is comparable to the level of decline of 70-year-old women in the reference material (Baltimore Longitudinal Study of Aging).

Only the high-frequency (8 kHz) in the left ear shows statistical significance between high and low cortisol level groups, but this may be attributable to a type 1 statistical error.

The drop-out by the end of the 10 years follow-up was 31%, which is high.

Benefits of Phoneme Discrimination Training in a Randomized Controlled Trial of 50- to 74-Year-Olds With Mild Hearing Loss.



Melanie A. Ferguson, Helen Henshaw, Daniel P. A. Clark, and David R. Moore.

Ear and Hearing 2014; Vol. 35(4), e110–e121
with announcement of award in *Ear and Hearing*, 2015; Vol. 36(3).

The aims of this study were to:-

- Evaluate the efficacy of phoneme discrimination training for the hearing and cognitive abilities of adults aged 50 to 74 years with mild sensorineural hearing loss who were not users of hearing aids
- Determine compliance by participants with a self-administered, computer-delivered, home-based auditory training programme.

Despite a growing increase of auditory training products and research on such training, we still do not have a clear understanding of the effectiveness of auditory training for improving everyday listening skills. After a review of all the published research on auditory training, the authors of this article concluded that, although there was some evidence to support improved auditory skills from such training during the published studies, there was no firm evidence to suggest that auditory training translated to effective, real-world benefits. They also found that these studies generally lacked scientific rigour. It is important for those undertaking the training to feel that it is benefiting them in everyday conversation and this may be best shown in self-report questionnaires. However, self-report outcomes have been used in only 3 of the 13 studies which have been published and with mixed results.

Auditory training has the potential to be a useful clinical intervention to support people with hearing loss. Because of the importance of speech perception and cognition to good communication ability, the main focus in the present study was to examine outcomes across speech perception, cognition, and self-report of hearing difficulties in order to identify whether auditory training contributes to improved communication ability.

Study Design and Methods

Recruitment for this study resulted in 44 participants (15 female, 29 male) who met the inclusion criteria of:-

- Having symmetrical mild, sensorineural hearing loss
- Not being a hearing aid user
- Ability to run simple computer games or at least able to control a computer mouse
- English as their first language.

Participants were allocated to either an Immediate Training (IT) group (n = 23) or a Delayed Training (DT) group (n = 21).

The study used a “randomised, controlled, quasi-crossover design”. Test sessions are labelled to show that training occurred between times t1 and t2, and the “retention period” occurred between times t2 and t3 for both groups. Baseline audiological, cognitive, speech-in-noise performance tests were undertaken. The primary outcome measure was the Digit Triplets test with completion of self-report questionnaires (GHABP and SSQ). There was no significant difference between the groups for baseline phoneme discrimination thresholds, for any of the baseline performance tests, for questionnaire scores or for computer skills.

Home-delivered auditory training used a computer game. Training was based on a phoneme training package, fully described by Moore et al. (2005), but with graphics designed for adult participants. Eleven phoneme continua (/a/-/uh/, /b/-/d/, /d/-/g/, /e/-/a/, /er/-/or/, /i/-/e/, /l/-/r/, /m/-/n/, /s/-/sh/, /s/-/th/, and /v/-/w/), embedded in syllables where needed for natural articulation. The participants' task was to choose the odd one out from three phonemes presented in sequence. Participants were asked to train for 15 minutes each day, 6 days each week over a 4-week period which is a total of training time, if fully compliant, of 360 minutes.

Results and Discussion

- *Compliance with training: There was high compliance across all participants and there were no dropouts.*
- *On-Task Phoneme Learning: Across both groups of participants there was a highly significant improvement with training in phoneme discrimination threshold for all 11 phoneme pairs.*
- *Generalisation of Learning: There was no significant between-visit change in speech-in-noise test results for either the IT group or the DT group. Speech intelligibility did not change significantly with training or with repeated testing.*

In this study, learning was apparent for all 11 phonemic contrasts with the greatest improvement being seen for those contrasts that had the worst performance before training. Other studies have shown similar results which suggests that the greatest improvements on the trained task were made by those with the worst initial performance.

A critical question for this study was whether learning transferred to improvements in untrained measures of benefit for those with mild hearing loss. As with many auditory training studies, this study included speech perception as a generalisable outcome but it showed no significant improvement as a result of training.

This study, unlike most other training studies, examined cognition. Together with speech perception, cognitive ability has consequences for the disability and handicap resulting from hearing loss. There was a consistent pattern of change in pre- to post-training performance across the cognitive measures with significant improvements for the complex cognitive tasks but no improvements for the simple cognitive tasks. The authors of this article suggest that the mechanism underlying this result may not be a result of the auditory stimulus itself but more likely to be the result of active engagement with the auditory stimulus such as more effective listening ability.

In conclusion, phoneme discrimination training, as used in this study, provided modest self-perceived benefit for listening abilities in general and for the complex and challenging skills required for understanding speech in realistic environments.

Reference

Moore, D. R., Rosenberg, J. F., Coleman, J. S. (2005). Discrimination training of phonemic contrasts enhances phonological processing in mainstream school children. Brain Lang, 94, 72–85.

This excellent article was originally published in the July-August 2014 edition of Ear and Hearing. As announced more recently, this article's authors were the recipients of the 2014 Ear and Hearing Editors' Award. Using a high level evidence procedure (RCT), this article greatly increases our understanding of the extent to which auditory training is effective in improving everyday listening skills.

Cochlear Implantation Improves Localization Ability in Patients With Unilateral Deafness.



Tavora-Vieira et al.

Ear and Hearing 2015; Vol. 36(3), e93-e98

The ability of sound source localisation has been determined in sixteen adult subjects with postlingual unilateral deafness (age 36-73, 9 male / 7 female, deafness duration 3 months-39 years), fitted with CI on the deaf side (with 6 to 18 months experience: full time use of CI, 3-6 months intensive auditory training) . As several studies demonstrated that CI users rely mostly on ILD (interaural level difference), A&E (auditory speech sounds evaluation localization test) is used (with artificially created ILD) to establish localisation improvement.

Significant better results were found in 14 subjects. Two subjects showed no benefit. These two subjects had very long duration of deafness and lost their hearing at 6 and 7 years of age. The critical age of bilateral auditory pathway development seems to be important to establish whether localisation can be improved with CI in unilateral deafness.

Gender, age of implantation and duration of deafness showed no significant difference in this study. Further investigation is needed in a larger sample of each group of age and deafness duration. Age of onset seems to be very important to take into account in the future. This was not analysed in this study due to small sample size. Deafness duration could show significant difference in a larger group, as two subjects with long duration showed no benefit.

Binaural hearing is very important for sound localisation and understanding speech in noisy situations. In this study, all subjects first had a trial period with a CROS hearing aid and BAHA. No results of these two trial periods are shown although these results could be important.

In my opinion a trial period with CROS hearing aid should be the first step in treatment of single sided deafness. If the results are not satisfactory, a BAHA trial period is necessary. Depending on the results of these two trial periods, CI should be considered.

It would be interesting to combine localisation test results with questionnaires to have more information of subjective improvement of localisation in different daily situations and also in improvement of quality of life.