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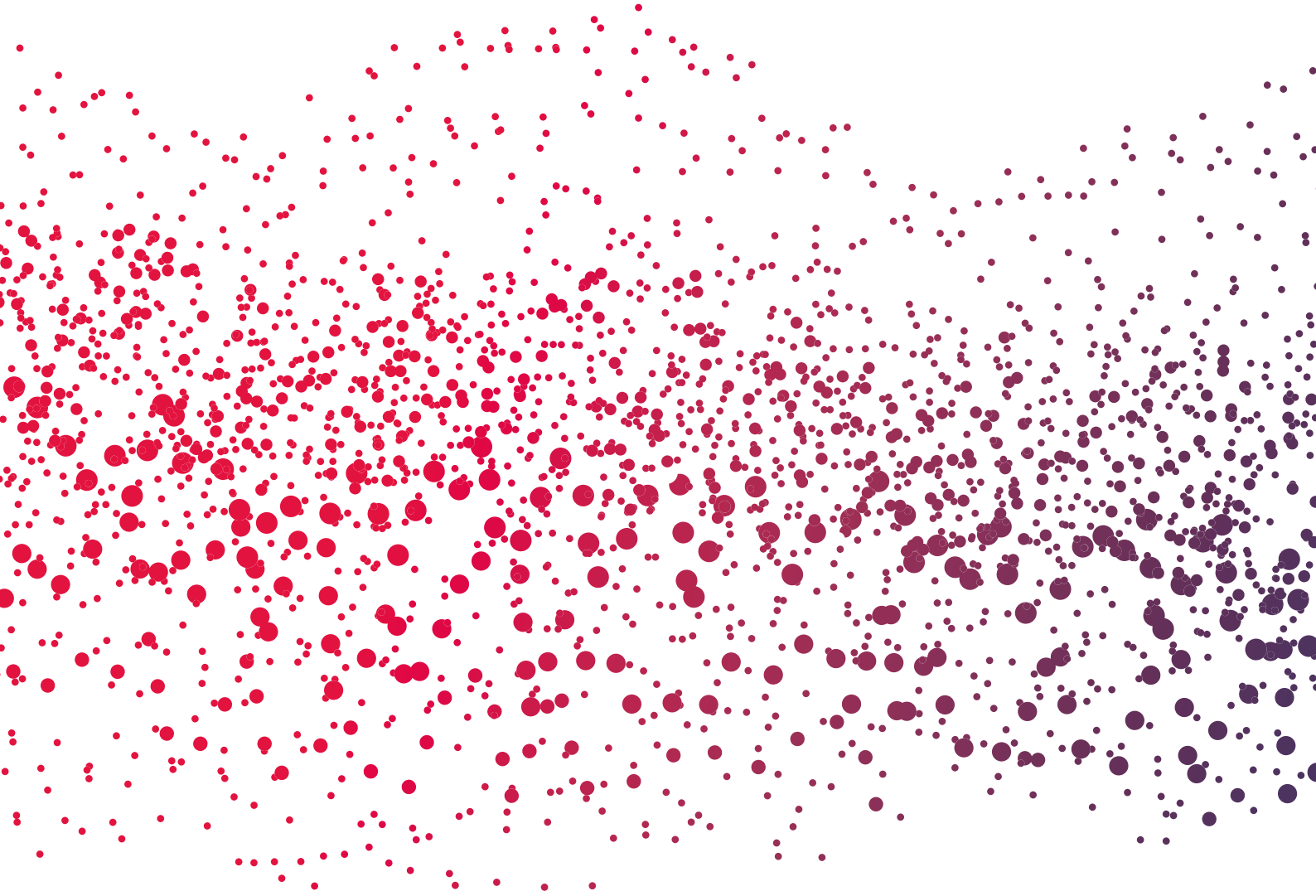
Otology & Audiology Article Review



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- Page 05: Tali Bar-Moshe✓:
  - Perceptions Toward Internet-Based Delivery of Hearing Aids among Older Hearing-Impaired Adults.
    - *Chandra N.; Searchfield G.D.*
    - *Journal of the American Academy of Audiology Vol 27(6) 441-457, 2016.*
    - *This article is important since it enlightens the attitude of experienced elderly HA users toward direct-to-consumer HA purchase, emphasises their concerns and shows the importance which those participants attribute to our professional work.*

- Page 07: Tali Bar-Moshe✓:
  - Self-Fitting Hearing Aids: Status Quo and Future Predictions.
    - *G. Keidser & E. Convery.*
    - *Trends in Hearing Vol. 20 1-15, 2016.*
    - *This article gives a very good overview of the current status of the SFHAs (Self-Fitting Hearing Aids), shapes, features, advantages, disadvantages, problems and challenges, and summarises different studies made in this area.*

- Page 09: Reddy Sivaprasad ✓:
  - Hearing Aid Benefit in Patients with Mild Sensorineural Hearing Loss: A Systematic Review.
    - *Johnson CE et al*
    - *The Journal of the American Academy of Audiology, 2016; Vol. 27 (4), 293-310.*
    - *This study is a systematic review of literature on the benefits of AC hearing aids in mild SNHL and HF SNHL. The review found only 5 articles provided quality evidence to calculate the benefit. The benefit of 0.85 (small to medium size) is quite encouraging and the authors call for use of this information in the education and counselling of patients. The benefit could easily be much more with the latest technology as the review included studies which used early generation digital technology.*

- Page 10: Reddy Sivaprasad & Tine Van Belle ✓:
  - The effects of frequency lowering on speech perception in noise with adult hearing-aid users.
    - *Miller CW et al.*
    - *International Journal of Audiology, 2016; Vol. 55 (5), 305-312.*
    - *In this study, the benefits of frequency lowering (FL) techniques have been studied in speech in noise tasks. The same population was used for studying the effects of all 3 FL techniques. The study clearly exposes gaps in current understanding of this technique.*

- Page 11: Reddy Sivaprasad & Anna Pugh ✓:
  - Description of Adults Seeking Hearing Help for the First Time According to Two Health Behavior Change Approaches: Transtheoretical Model (Stages of Change) and Health Belief Model.
    - *Gabrielle H. Saunders, Melissa T. Frederick, Shien Pei C. Silverman, Claus Nielsen, and Ariane Laplante-Lévesque.*
    - *Ear and Hearing, 2016; Vol. 37 (3), 324-333.*
    - *This study tried to evaluate the decision making process of first time help-seekers (with hearing loss) using 2 popular models of health behaviour change. Questionnaires were used to find if there is complimentary information in the same population.*

- Page 13: Reddy Sivaprasad ✓:
  - Analysis of Performance on Cognitive Test Measures Before, During, and After 6 Months of Hearing Aid Use: A Single-Subject Experimental Design.
    - *Jamie Desjardins.*
    - *American Journal of Audiology, 2016; Vol. 25 (2), 127-141.*
    - *This is a single-subject experimental design study where 6 subjects with SN hearing loss were fitted with hearing aids. Some auditory and visual cognitive tasks were administered before, during and after fitting hearing aids. The study showed hearing aids improve certain auditory and a few visual cognitive measures; withdrawing hearing aids brings down these scores to baseline levels.*

- Page 15: Pierre Devos ✓:
  - Speech Perception in Classroom Acoustics by Children With Cochlear Implants and With Typical Hearing.
    - *Frank Iglehart*
    - *American Journal of Audiology, vol. 25, pp 100-109, June 2016.*
    - *The study compares speech perception capacities of implanted children versus normal hearing ones, among several SNRs and reverberation times corresponding to ANSI standards for classrooms.*

- Page 16: Pierre Devos ✓:
  - Masked Speech Perception Threshols in Infants, Children, and Adults.
    - *Lori J. Leibold, Angela Yarnell Bonino & Emily Buss*
    - *Ear and Hearing 2016; 37; 345-353.*
    - *Authors analyse infants' capacity to detect target speech in different competing noises (speech shaped noise and two-talker noise), and compare the results to those involving children and adults.*

- Page 18: Laure Huyghe ✓:
  - Application of the Consumer Decision-Making Model to hearing aid adoption in first-time users.
    - *Amyn M. Amlani*
    - *Seminars in Hearing Vol 37 (2) 2016, 103-119.*
    - *The study of consumer decision-making models is interesting to gain more knowledge about which steps consumers take before deciding to try-buy a hearing aid. In the article, the author provides us with a theoretical background on the process from the first-time listener's perspective. He uses the Consumer Decision-Making Model (CDM) to do this.*

- Page 19: Anna Pugh ✓:
  - The Effect of Decreased Audibility on MMSE Performance: A Measure Commonly Used for Diagnosing Dementia.
    - *Lindsey E. Jorgensen, Catherine V. Palmer, Sheila Pratt,Kirk I. Erickson, Deborah Moncrief.*
    - *Journal of the American Academy of Audiology Vol 27 (4), 2016 27:311–323*
    - *All in all, this paper offers some interesting insights, and provides a raft of references to learn more about the topic which is a significant issue in all our interventions with patients.*

- Page 21: Anna Pugh ✓:
  - Is Hearing Loss Associated with Poorer Health in Older Adults Who Might Benefit from Hearing Screening?
    - *Paul Mick and M. Kathleen Pichora-Fuller.*
    - *Ear and Hearing 2016; 37; e194–e201.*
    - *This study considers the impact and benefit of hearing screening on the wellbeing and health outcomes for older adults, extending on from earlier research which highlighted the correlation of hearing loss with poor health outcomes including dementia, social isolations, and more frequent hospitalisation.*

- Page 22: Anna Pugh ✓:
  - Development and psychometric evaluation of a health-related quality of life instrument for individuals with adult-onset hearing loss.
    - *Carren J. Stika & Ron D. Hays.*
    - *International Journal of Audiology 2016; 55: 381–391.*
    - *This American study provides a much needed simple tool to measure and evaluate the impact for hearing impairments in adults on their health outcomes and quality of life. Starting from the familiar established architecture of the Health Related Quality of Life (HRQOL) and Hearing Handicap Inventory for the Elderly (HHIE) constructs, it offers a comprehensive and multidimensional recognisable model, and unlike some other measurement tools, it was developed with people experiencing hearing loss.*

- Page 23: Lorenzo Notarianni ✓:
  - A causal relationship between hearing loss and cognitive impairment.
    - *So Young Park, Min Jung Kim, Huerxidan Sikandaner, Dong-Kee Kim, Sang Won Yeo & Shi Nae Park.*
    - *Acta Oto-Laryngologica, 2016 Vol 136 5 pag 480-483.*
    - *Moderate hearing loss in young mice caused decreases in cognition associated with spatial working and recognition memories in 6 months. These results provide evidence for a causal relationship between hearing loss and cognitive impairment. This paper investigated the hypothesised mechanisms to connect sensory and cognitive functions including the sensory-deprivation and information degradation.*

- Page 24: Lorenzo Notarianni ✓:
  - Neurocognitive factors in sensory restoration of early deafness: a connectome model.
    - *Andrej Kral, William G Kronenberger, David B Pisoni, Gerard M O'Donoghue.*
    - *Lancet Neurology 2016, Published Online, March 11, 2016.*
    - *This paper reviews the evidence that auditory deprivation has widespread effects on brain development, affecting the capacity to process information beyond the auditory system and focuses on the restoration of components of the sensory experience with neuroprosthetic devices and although degraded relative to normal sensory functioning, allows for development of proximal cognitive skills dependent on that experience.*

- Page 26: Lorenzo Notarianni ✓:
  - Interventional Audiology: Broadening the Scope of Practice to Meet the Changing Demands of the New Consumer.
    - *Brian Taylor.*
    - *Seminars in Hearing, Issue 02 Vol 37 May 2016 pag 120-136.*
    - *Given the growth in the ageing population, low hearing uptake rates and the emerging science indicating that age-related hearing loss has long term consequences to health and wellness, an interventional audiology strategy is*

needed. This paper defines interventional audiology and offer guidance on bringing an interventional audiology to life in clinical practice.

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- Page 29: Lorenzo Notarianni ✓:
  - Is Hearing Loss Associated with Poorer Health in Older Adults Who Might Benefit from Hearing Screening?
    - *Andrej Kral, William G Kronenberger, David B Pisoni, Gerard M O'Donoghue.*
    - *Ear & Hearing Vol. 37(3) May Jun 2016 pag e194-e201.*
    - *Hearing screening programmes may benefit adults with unacknowledged or unaddressed hearing loss, yet there is limited evidence regarding whether such programs are effective at improving health outcomes. The objective was to determine if poorer audiometric hearing thresholds are associated with poorer cognition, social isolation, burden of physical or mental health, inactivity due to poor physical or mental health, depression, and overnight hospitalisations among older American adults with unacknowledged or unaddressed hearing loss.*

- Page 30: Katrien Hoornaert & Johanna Van Coillie ✓:
  - Development of Telscreen: a telephone-based speech-in-noise hearing screening test with a novel masking noise and scoring procedure.
    - *Harvey Dillon, Elizabeth Francis Beach, John Seymour, Lyndal Carter & Maryanne Golding.*
    - *International Journal of Audiology 2016; 55: 463-471.*
    - *In 2006, the Australian government requested the National Acoustic Laboratories (NAL) to develop an Australian telephone-based speech-in-noise test for national implementation.*

- Page 32: Paul Van Doren ✓:
  - Exploration of a physiologically-inspired hearing aid algorithm using a computer model mimicking impaired hearing.
    - *Tim Jürgens, Nicholas R. Clark, Wendy Lecluyse & Ray Meddis.*
    - *International Journal of Audiology 2016; 55: 346–357.*
    - *The aim was to re-establish hearing in the closest possible way to normal hearing. The computer model integrates the auditory processing, taking in account acoustical reflex and delayed feedback attenuation control by the medial olivocochlear system (at the brainstem).*

Perceptions Toward Internet-Based Delivery of Hearing Aids among Older Hearing-Impaired Adults.

Chandra N.; Searchfield G.D.

Journal of the American Academy of Audiology Vol 27(6), 2016, 441-457.

The traditional clinical-based model of hearing aids (HA) fitting is no longer the only model of HA delivery. Although the traditional model has been shown to increase patient satisfaction and benefits, HA useage and reduce HA return there are still barriers such as high cost and limited access to audiological services that contribute to low prevalence of HA ownership.

Three other models based on Internet delivery were developed in the last two decades. In the first the audiological assessment and HA recommendation is done by audiologists. The HA are purchased online and are shipped to the audiologist who fit them and give consulting services and follow up care. The other two models are described as direct-to-consumer models since there is no face-to-face meeting with audiologist: In one of them the HA are programmed according to information providing by the consumer (recent audiogram, questionnaire, online hearing test). The HA are shipped directly to the consumer. Self-made earmould impressions are taken by the consumer if needed. HA adjustment is done via mail or by local audiologist at the consumer's own expense. The other model is similar but here the pre-programmed HA and fitting software are sent to the consumer and they can do a self-fitting if needed.

This qualitative study examined the perceptions of 18 older HA users (age 64-81years), in New-Zealand, toward internet-based HA delivery using face-to-face semi-structured interviews.
Seven themes were found: 1) Lack of awareness to HA portals on the internet and willingness to learn more about it. 2) Purchasing HA in the internet can be cheaper. 3) Purchasing HA online is more accessible and convenience to people with health disabilities or those who live in rural areas. 4) The participants were concerned about the personal fitting of the HA, the way the hearing test will be conducted and its results, the process of adjusting and fine-tuning the HA and the correct size of the earmoulds and shells. 5) They raised a fear of scammers on the internet. They said that they are willing to buy directly from the manufacturer of the same instruments that they have already and they will like to get recommendations from someone they trust. They emphasised that they prefer a HA expert with knowledge and experience that will help them make the decision. 6) Prefer a face-to-face conversation with the audiologists and see the internet purchase as lacking the personal contact. 7) Less confident and familiar with the internet and prefer to do things in the traditional way. Understanding older patients doubts and concerns through this study finding can help develop internet-based HA delivery by producing them with solutions like guidelines to online purchases, trainable HA, online access to audiologist or web sites senior friendly.

Audiologists view internet-based HA delivery as the antithesis of best practice and raised many concerns for misdiagnosis, poor fitting, verification, follow up and threat to income (audiology associations and online forums). The authors suggest that certain aspects of internet use like provision of information about hearing loss and hearing aids, reduced costs, and potential for remote follow-up care and service, may enhance audiology practice.

Our professional world is changing and with the ongoing HA technology developments and growing accessibility to the internet there are also new models for HA fitting and purchasing. This article is important since it enlightens the attitude of experienced elderly HA users toward direct-to-consumer HA purchase, emphasises their concerns and shows the importance which those participants attribute to our professional work.
We have to be aware of what is going on outside our clinics and shops. Knowing this new market is like knowing your competitors – if you know them well you will have good answers! It's up to us to make sure that our patients and costumers are benefitting from our knowledge and experience and their journey is based on an informed and shared decision-making, working together with us towards the best individual solution.
How our profession will look in twenty years is still unknown but we must be aware of the changes, endeavour to be the best in our field and try to find the right way to ensure that our patients will have a successful hearing rehabilitation journey.

Self-Fitting Hearing Aids: Status Quo and Future Predictions.

Gitte Keidser & Elizabeth Convery.

Trends in Hearing Vol. 20, p 1-15, 2016.

Five years after introducing the concept of self-contained self fitting hearing aids (SFHA) the authors gave an updated overview of the progress that was made in this area, feasibility and challenges. SFHA are available on the Direct-to-Consumer market. Self-contained hearing aids can be adjusted without the need for external software or connection to the internet while self-fitting mean that the fitting process is done by the user without the assistance of the audiologist. The advantages of SFHA are low cost and increasing user's self management and psychological ownership which makes them a possible solution for unmet growing demand for hearing care in developing countries and underserved areas. The SFHA disadvantages include failure to identify pathologies such as conductive HL, inappropriate fitting that can lead to reduced speech understanding and even extended hearing loss and according to 80 hearing impaired participates in one study; also lack of professional guidance and concern of inferior fitting results.

The article describes the different products that are available today on the Direct-to-Consumer market and analyses their compatibility with the SFHA definition. Those products include BTE, RIC, Bluetooth-like earpieces and earbuds that can be fitted and fine-tuned with different software, cables and Apps. Some of them are considered to be hearing aids and some are not but offer the main features of conventional hearing aids. Although there is a growing range of lower cost products available through direct sales in developed countries there are limited data regarding their clinical validity.

There are three stapes the user must go through in order to use SFHA: 1) choosing and assembling the right SFHA parts (tip, tube, mould etc.) and place it correctly in the ear, 2) perform a self-directed automated in situ hearing test for initial fitting, 3) make fine-tuning adjustments if needed. Each of these steps poses challenges to the elderly user. There are still open issues and problems to be investigated and solve in order to make the SFHA more user-friendly such as a method to ensure correct insertion to the ear canal, monitoring ambient noise level, a test to detect asymmetry or conductive HL or developing a mechanism to save adjustments made from on-board controls. Although the empirical evidence collected so far supports the validity of the SFHA in terms of technical implementation, there are more developments needed for low health literacy, cultural differences, severe to profound HL and the delivery model in order to increase usage of the SFHA in developed countries.

This article gives a very good overview of the current status of the SFHAs (shapes, features, advantages, disadvantages, problems and challenges) and summarises different studies made in this area. It seems that the ongoing development of hearing aid technology are also implemented in the SFHA, which now, can probably give the user reasonable results. Most of the studies looked at the financial, technological and practical aspects of the solution the SFHA can give to hearing impaired elderly in remote areas or developed countries. From my professional point of view, this article, like other articles published on this topic, neglected to look at the whole process that we, as audiologists, are doing with our patients in their hearing rehabilitation journey and didn't investigate the contribution and added value of our

professional knowledge, experience, guidance and support to the success of the rehabilitation process. The hearing test and HA fitting itself are only part of what the authors referred to as the traditional fitting process. As we all know, if we do not put the patient in the middle of the process, truly understand and meet their needs, based on their personal experience for an informed and shared decision and find the best possible individual solution, there is a good chance that they will not be able to benefit from their HAs and eventually put them in the drawer.

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Hearing Aid Benefit in Patients with Mild Sensorineural Hearing Loss: A Systematic Review.

Johnson CE et al.

Journal of the American Academy of Audiology (2016), Vol. 27 (4), 293-310.

It is now well known that SNHL can lead to a variety of non-auditory consequences and it needs treatment in the form hearing aids. A 2007 systematic review has found that hearing aids improve the health-related quality of life (HRQoL) of adults with SNHL, meaning that patients and their families do not have to endure life with the negative effects of SNHL.

However, many individuals with Mild SNHL (MSNHL: 25-4000 Hz PTA of 26-40 dB HL or High Frequency SNHL) are unserved or underserved with amplification across the world due to a variety of factors including the accessibility and financial aspects. It is also observed that audiologists themselves are not clearly aware of the benefits of amplification in MSNHL. Though there are a few studies available on this topic, none of them has focused only on MSNHL.

The purpose of this study was to conduct a systematic review of the literature to address: (a) What benefits do adults with bilateral MSNHL obtain from traditional hearing aids in relation to reduction of activity limitations and participation restrictions, improvement in HRQoL, and satisfaction with their devices? (b) Is there evidence to support a recommendation of traditional hearing aids for persons with bilateral MSNHL?

All the authors independently searched through PubMed, Cumulative Index to Nursing and Allied-Health Literature, Cochrane Collaboration, and Google Scholar on a set of 54 search strings and looked only for studies with at least level IV evidence in Sep 2013. Out of the 109 articles that appeared in the searches, only 10 of them met the criteria and only 5 of them measured pre- and post- HA fitting. In the meta analysis, the effect size (ES) was calculated for these studies, where ES indicates the benefit (the difference between pre- and post-measures).

The benchmarks for evaluating ES estimates for studies using between-subjects analyses were 0.2, 0.5, and 0.8 for small, medium, and large effects, respectively. This study found that the calculated and unbiased-adjusted ES was 0.85 (0.44–1.25) which is small to medium size.

The collected 5 articles made it quite challenging for the authors to measure the effect size. The authors noted that the benefit as shown by the ES in this study is very significant and can be confidently explained to potential customers and funding agencies. They also noted that more studies are needed in MSNHL using the latest digital technology which was a big omission in the current review. This means the benefit is much greater than what is found in this study.

This study provides much needed statistical evidence for the benefit of hearing aids in MSNHL population. The method used to calculate the benefit was the latest and the study design was much improved from the 2007 meta analysis study. Audiologists should use these findings generously in educating their patients and other partners to build confidence and should also develop better counselling material.

The effects of frequency lowering on speech perception in noise with adult hearing-aid users

Miller CW et al.

International Journal of Audiology, 2016; Vol. 55 (5), 305-312.

Several studies have pointed out that hearing aids with wide frequency output beyond 4 kHz would help in identifying certain consonants. Improvements in receiver design and digital technology has improved the frequency range of digital hearing aids though it is still insufficient for amplifying higher frequency information. Alternative technology – frequency lowering (FL) - nonlinear frequency compression (NFC), linear frequency transposition (LFT), and frequency translation (FT) have been available for a long time now.
Nonlinear frequency compression moves high frequency information to low frequencies by compressing the energy on a log scale above the cut-off frequency. In LFT, frequencies up to two octaves above the designated start frequency are lowered linearly to one octave below the start frequency and added to the unprocessed lower frequency signal. Frequency translation (FT) is similar to the transposition method of LFT, however FT retains the original signal while simultaneously transposing the high frequency signal.
Some studies using the FL technology in adult and paediatric populations with hearing impairment have reported significant perceptual benefits compared to conventional amplification. Although research has demonstrated the perceptual benefits of each of the three FL techniques relative to conventional amplification, no study to date has compared the three currently available methods on the same population. This information would be useful for clinicians when selecting a frequency-lowering technology for a patient. The aim of the present study was to evaluate if differences in speech perception in noise are observed between three different FL strategies (NFC, LFT, FT) and conventional wide dynamic range compression (WDRC) processing.
10 experienced hearing aid users (63-82years) participated in this study. All participants were fitted binaurally with hearing aids having 3 FL technologies, in the same session. They were verified using standard real ear measurements procedures and all other features were switched off. Modified Speech Intelligibility Index (SII), SNR-50 (SNR required to achieve 50% correct scores) and subjective sound quality using questionnaires were measured in all subjects. ANOVA was used as the main statistical technique.

No statistically significant differences in SII between different FL conditions were found with the fitting method used in this study. The results of the subjective quality questionnaire, showed very few differences between conditions. SNR-50 thresholds (lower thresholds indicate better performance) for HA models WDRC, NFC, LFT, and FT were -5.6, -5.12, -5.55, and -0.94 dB respectively.
The results show that switching on any FL technique has yielded less benefit in noise when compared to switching off this feature. However, the subjective scores did not show any difference in the on-off conditions of these features. The authors cautioned that the failure of FL in improving SNR-50 scores could be mainly because the subjects did not have severe hearing loss at HFs (best candidates for FL) and perhaps also because of the fitting method used in this study. The authors also pointed to gaps in fitting and candidacy criteria for FL techniques and called for these to be established.

This study has used a small group of subjects but they had audiograms where the FL techniques have been shown to benefit. For the first time, this study has evaluated the benefit of FL in the most complex of all the speech perception tasks. The authors have discussed and debated the observations thoroughly. In fact, the discussion is the best part of this article.

Description of Adults Seeking Hearing Help for the First Time According to Two Health Behavior Change Approaches: Transtheoretical Model (Stages of Change) and Health Belief Model.

Saunders GH et al.

Ear and Hearing 2016; Vol. 37 (3), 324-333.

It is well known that individuals take about 10 years to seek help for hearing loss from the day they first suspect it. This figure seems to be the same even in societies where the help is provided by the government. It seems that factors such as higher levels of self-reported hearing difficulties, greater degree of hearing impairment, social pressure to take action, lesser ability to cope/poorer communication skills and more perceived benefits from hearing aids are associated with an increased likelihood of help seeking for hearing impairment, while negative attitudes of others and perceived stigma are negative influences on help seeking.

There are 2 models that have been widely applied to study the influence of these factors – Trans-theoretical model (TTM) or Stages of Change Model and Health Belief Model (HBM).
This is the first study I've found that considers the two most established health behaviour theories in relation to hearing impairment and the impact it has on people's perceptions of their hearing health, and the authors confirm that I haven't missed something; this paper is the first of its kind to consider this.
The premise of the TTM is that readiness for change underlies the decision to engage in and maintain a health-promoting behaviour, such that individuals have the potential to progress and regress throughout stages of readiness towards change. While the model includes multiple concepts, such as decisional balance, self-efficacy, and processes of change, this study focuses on three stages of change: (1) precontemplation, (2) contemplation, and (3) action. Whereas the HBM proposes that six interrelated constructs influence the likelihood an individual will engage in health behaviour change: (1) perceived susceptibility, (2) perceived severity, (3) perceived benefits, (4) perceived barriers, (5) perceived self-efficacy, and (6) cues to action. They are explained in the following tables.

The present study was designed to answer the question "Can attitudes and beliefs as assessed using the frameworks of the TTM and HBM be used to characterise individuals seeking help for the first time?" 182 subjects who were suspecting hearing loss and scheduled for their first hearing test, participated in this study (age range 50-89 years). 4 questionnaires were administered to all the participants - Hearing Handicap Inventory for Adults/Elderly (HHIE, measures self-perceived hearing handicap), Psychosocial Impact of Hearing Loss (PIHL, measures impact of hearing loss), University Rhode Island Change Assessment Scale (URICA, identifies the stage of change) and Hearing Beliefs Questionnaire (HBQ, assesses HBM constructs). Pearson correlation coefficients were calculated to examine relationships between degree of hearing loss and questionnaire responses. ANOVAs were used for between-group comparisons.

On URICA scores, individuals had higher scores on the contemplation and action stages than on the precontemplation stage. This is to be expected because all participants had already sought a hearing test. ANOVAs showed individuals with no impairment had significantly higher precontemplation scores and significantly lower contemplation and action scores than individuals in the other two groups. HBQ scores by degree of hearing impairment generally show the expected trends—that individuals with greater hearing impairment perceived fewer barriers, and more susceptibility, severity, benefits, and cues to action. However, a repeated measures ANOVA did not show a significant effect of degree of hearing impairment across HBQ scores.

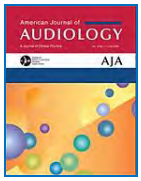
The authors further analysed if URICA stages of change can be predicted by the other questionnaire scores or factors. HHI score was a highly significant predictor of URICA scores, explaining 30% to 37% of the variance. Duration of hearing difficulty was a significant predictor of all three URICA scores, explaining 6% to 10% of the variance. HBQ scores together explained 14.8% of the variance in precontemplation scores, 4.8% of the variance in contemplation scores, and 3.5% of the variance in action scores. The results indicate that HBQ and URICA measure different things and both give us crucial information that helps in counselling and treatment planning.

This study attempted to find out how complementary the 2 models were in relation to patients' decision processes. Selection of the tools and population was appropriate. Methodology and statistics could have been more sophisticated. The results though are not conclusive, the authors claim they will be presented in the next part.

The researchers advocate an intervention combining both the TTM and HBM by increasing self efficacy and increasing perceived benefits as motivators for change.

Further research into this intervention is ongoing, and is bound to be interesting.

Analysis of Performance on Cognitive Test Measures Before, During, and After 6 Months of Hearing Aid Use: A Single-Subject Experimental Design



Desjardins JL

American Journal of Audiology, 2016; Vol. 25 (2), 127-141.

Untreated hearing loss is known to be associated with less working memory, less selective attention, slow processing speed, accelerated cognitive decline and general cognitive impairment among other cognitive difficulties. Two hypotheses explain these phenomena – Deprivation Hypothesis (auditory impairment could result in a permanent cognitive degeneration) and Information Degradation Hypothesis (the cognitive resources normally used for higher-level comprehension, such as storing auditory information into memory, selectively attending to a listener, and processing auditory information quickly, get used for speech decoding and understanding because of weaker peripheral hearing). On the other hand, some studies suggest hearing aid use may improve certain cognitive measures in older adults. Whereas the evidence is still emerging for this claim, choice of appropriate cognitive measures (involving auditory task or visual task) seems to affect the results.

The purpose of the present study was to identify the effectiveness of hearing aid use as a treatment to improve an individual adult's performance on cognitive test measures. The authors used a single-subject experimental design.

6 subjects (54-64 years; with mild-moderate hearing loss) who never used a hearing aid before participated in this study. A battery of cognitive tests was employed before, during and 6 months post the HA fitting. There was also a withdrawal session where the same measurements were done 2 months after 6 months of continuous use.

Subjects were fitted with RIC devices and the usage skills were monitored using the Practical Hearing Aid Skills Test–Revised (PHAST-R). The International Outcome Inventory for Hearing Aids (IOI-HA), a subjective hearing aid outcomes measure, was administered to participants, via e-mail, at 20 weeks of hearing aid use, to assess the effectiveness of the hearing aid treatment in the current study.

The cognitive test battery comprised visual and auditory tasks. Auditory Tasks - Listening Span Test (measures working memory); Auditory Selective Attention task (measures selective attention); and Auditory Reaction time task (measures auditory processing speed). Visual Tasks – Reading Span Test; Visual Selective Attention Task; and Perceptual Processing Speed test.

A 95% confidence interval of the difference between the three baseline test scores (i.e., 95% baseline critical difference) was calculated for each participant for each cognitive test. Differences between baseline and treatment data points were considered significant (i.e., significant change attributable to the use of amplification; significant treatment effect) when two or more consecutive treatment data points exceeded the upper limit of the 95% baseline critical difference.

Table 3 shows effect sizes and the change in cognitive performance from the baseline study phase (i.e., pre–hearing aid fitting) to the treatment phase (i.e., aided testing) for each participant on each cognitive test. They indicate that the treatment effect was significant for most of the subjects in Listening and Reading span tests and Auditory Selective Attention tasks.

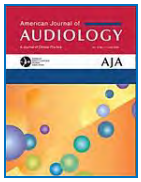
Two weeks after their last treatment test session, participants returned to the lab for the withdrawal test session, during which the cognitive test battery was administered unaided. A significant withdrawal effect was evident for most participants. That is, the participants' performance returned to near baseline performance levels after 2 weeks of not using the hearing aids.

These findings suggest that hearing aid use may compensate for auditory impairments at sensory input level, rather than at the level of the central nervous system. That is, the effects of hearing aid use may provide an immediate effect on encoding of working memory and selective attention ability, most likely by improving audibility and decreasing the cognitive load of the listening task. Hearing aids may lessen the cognitive processing resources a listener with hearing loss must expend to understand speech.

The authors pointed out that - using hearing aids, even when hearing loss is relatively mild and individuals are relatively young (i.e., 54–64 years old), may improve performance on some auditory cognitive tests. They concluded that hearing aids may be an effective treatment to mitigate performance on cognitive tests in adults. The positive treatment effects of hearing aid use are likely the result of improved audibility and a reduction in cognitive load.

This study addressed one of the burning issues in Audiology using a simple and different methodology. Selection of the research question and the choice of tests were appropriate. Inclusion of visual tasks helped in understanding the extent of cognitive improvements. The withdrawal session helped in understanding that the improvement effects were only up to sensory input levels. This study helps immensely and favours the benefits of hearing aids in the ongoing debate.

Speech Perception in Classroom Acoustics by Children With Cochlear Implants and With Typical Hearing



Frank Iglehart

American Journal of Audiology, vol. 25, pp 100-109, June 2016.

The American National Standard Institute published standards for learning places acoustics (ANSI/ASA S12.60-2010/Part1) where reverberation times (RTs) are recommended for normal and hard of hearing children. This study responds to 3 principal questions:

1. *Is this standard realistic?*
2. *Is there a difference in speech perception capacities between CI and normal hearing children when listening in the same RTs conditions?*
3. *Is an RT 0.0 (no reverberation) sound booth better than a low reverberant classroom?*

23 CI users (aged between5 and 16 years) and 23 typical hearing children were tested in a test room at different RTs (0.9, 0.6 and 0.3 s) and different SNRs. A subgroup of each was also tested in audiological sound booth. These 3 RTs represent respectively a midrange classroom, standards for normal hearing children and standards for hearing impaired children.
For CI users, increasing SNR from 18 to 21 dB had a significant effect and reducing RTs from 0.9 to 0.6 and from 0.6 to 0.3 also... even at higher SNR levels. For all HI children, testing in sound booth was statistically better than in the lower RT classroom.

For typical, hearing children, reducing RTs from 0.9 to 0.6 offers a significant effect, whilst reducing to 0.3 didn't show any increasing scores. Evaluations in sound booth didn't show any significant effects.
These results agree with the ANSI standards and show a huge difference in speech perception capacities between CI and typical hearing children (up to 45% in the same listening situation). Evaluation in sound booth didn't show any increased scores for typical, hearing children but did for CI users... showing that evaluations in audiological rooms overestimates perception abilities for CI users (and probably for HA users too)!

Even if this study didn't entirely respect BKB-SIN test procedures and if criticism can be made about some details of the method, we can conclude that normal hearing children need SNR +6 dB and RT of 0.6 seconds whereas CI users need SNR +21 dB and RT around 0.3 seconds. Most of classrooms around the world do not respond to that recommendation...FM systems are a solution, working on classrooms acoustics is another one!

Masked Speech Perception Thresholds in Infants, Children, and Adults.

Lori J. Leibold, Angela Yarnell Bonino & Emily Buss.

Ear and Hearing 2016; Vol. 37 (3), 345-353.

Infants are known to be unlikely to easily detect speech in noisy environments. This study compared target speech detections capacities for infants, children and adults in two different types of competing noise: a speech shaped continuous noise and a two-talkers fluctuating noise (both of them producing different masking processing, respectively energetic masking and informational masking). 3 groups were tested (7 infants from 8 to 10 months, 10 children from 8 to 11 years and 8 adults) for detection of target disyllabic words in competing noises presented at 55 dB SPL. The mean detection level was obtained by a two-down, one-up procedure.

Results show that infants need a 20 to 24 dB higher SNR to detect target words than children and adults, whatever the noise. No noise type effect was found for adults who show the same results in both competing noises. Children are shown to be more sensitive to fluctuating noise than to speech shaped one, with detection levels around adult values.
The age effect is here in evidence!

Infants are sensitive to all type of maskers, using a broadband listening strategy "that supports rapid learning about the important features of speech across different languages, speakers and environments" but that increases susceptibility to any masking noise.
Children show more difficulties in detecting target speech in a two talker competing noise situation, probably because of the neural immaturity and the lack of listening experiences. They develop perceptual strategies to recognise the acoustic component of their native language and tend to a more sophisticated detection of speech mode in competing noise, using silent-gap by example. They are in maturation process and progressively approach adult results.

This supports some of known principles underlying children-specific methodologies that consider a global audiophonological immaturity until 12 years of age, justifying different needs in term of gain and SNRs and promoting the use of FM systems in the very first months (and years!) of life in cases of hearing impairment.
This means also that a relatively simple listening situation for an adult can be particularly difficult for a child or an infant... a child is definitely not a small adult!

Application of the Consumer Decision-Making Model to hearing aid adoption in first-time users.

Amyn M. Amlani.

Seminars in Hearing, Vol 37 (2) 2016, 103-119.

The study of consumer decision-making models is interesting to gain more knowledge about which steps consumers take before deciding to try-buy a hearing aid. In the article, the author provides us with a theoretical background on the process from the first-time listener's perspective. He uses the Consumer Decision-Making Model (CDM) to do this.

As an introduction, 3 other models are reviewed. The transtheoretical model states the individual's stages of change and the accompanying process of change in behaviour. This model gives information about the customer's current stage but provides no evidence of cognitive & psychological processes that influence the decision to take action. The medical and social models of disability is a model that recognises that hearing loss is no predictor of the degree of disability or handicap of the hearing impaired but is however influencing the social activity and wellbeing of an individual.

At last, the health belief model is a model where the stages of change in health behaviour are described as an influencing factor on the likelihood of action. Likelihood of action depends on the difference between perceived benefits and the perceived barriers. This model does not provide us with a strategy for influencing the health-related actions and doesn't take into account individual determinants that dictate a person's acceptance of a health behaviour.
The consumer decision-making model (CDM), is based upon a sequence approach:

1. Need recognition
We can influence the recognition of the consumer's needs by pointing out the difference between the individual's current situation and the desired lifestyle. This will lead to more thorough need recognition. The degree of motivation (engagement of individual), ability (environmental and individual resources), emotions (positive and negative) and opportunity will as a consequence influence the decision to take the next step.
Two other opportunity factors influence need recognition: time (before and after purchase) and information (amount, type of product demonstrations, non-technical language).

2. Information (search & processing)
In the search for information, the consumer will look for decision-relevant knowledge. About the product, brand, price, usage,… This can be existing knowledge, or they start looking online (the first and popular step). Consumers will primary look for benefit and value and are highly influenced (positive and negatively) by people in their environment.
The information is then processed in different steps which the audiologist can facilitate.

3. Evaluation
Before taking the decision, the consumer will evaluate based on perceived price, perceived quality and perceived value, in comparison with their needs or requirements.

4. Purchase intent
The pre-purchase decision will thus be influenced by the result of the previous step.
When there's no difference in quality for the individual, price perception influences value. If perception of price is not different from perceived quality, the latter influences the perceived value.
Personal note

Looking at the different models described in this article and information about how the consumer decides to take action, we surely can implement aspects of this article in our daily practice.
The author focused mostly on the first stages and offered concrete examples of how audiologists and the hearing aid market can influence (through marketing, communication, demonstration…) in the need recognition and information processing of the consumer.
For the last steps (evaluation and purchase intent), the reader is left in the dark. There is for sure an opportunity to dig further into how we can influence the behaviour of the consumer in these last (and equally important) stages.

The Effect of Decreased Audibility on MMSE Performance: A Measure Commonly Used for Diagnosing Dementia.

Lindsey E. Jorgensen, Catherine V. Palmer, Sheila Pratt, Kirk I. Erickson, Deborah Moncrieff.

Journal of the American Academy of Audiology Vol 27:311–323 (2016).

I had been looking forward to reading this paper on the impact hearing impairment and dementia. Acknowledging Yuehs' work on the under-diagnosis of hearing loss in the general population, and more so within those people with memory difficulties. I had hoped the paper would provide me with some deeper insights into how I could recognise the signs of the impact of memory loss in my patients. (Yueh et al 2003)

Accepting the difficulties presented by a lack of a standardised diagnostic tool for dementia, the researchers agreed that the Mini-Mental State Exam (MMSE) would provide an appropriate basis for the purposes of this study. The MMSE includes cognitive function questions to determine orientation, short term recall, the ability to follow simple three step instructions, long term recall, language abilities (including naming, reading, writing and repeating), and construction tasks.

On a scale of 30, the normative score averages at 27, 20-26 would indicate "mild dementia", 10-19 "moderate" degree of cognitive dysfunction, and <10 to indicate "severe" dementia

However over 60% of the test requires auditory comprehension and perception, suggesting that this may be an inherent weakness in the testing protocol. Whilst the paper points to earlier research indicating correlations with hearing loss and memory impairment, the paper seeks to answer the question as to whether a person with "normal" cognitive function" could appear to be experiencing dementia due to their hearing loss
[I would particularly recommend reading the Palmer study (Palmer 1998), quoted in the paper, which provides evidence for behavioural change modifications in people with Alzheimer's Disease once fitted with hearing amplification]

A previous study simulated visual impairment with sighted students to test cognitive function (Toner 2012), so Jorgensen and her colleagues decided to use this model for their study. 125 "cognitively healthy" young adults with 'normal hearing thresholds' were separated into five groups of degrees of simulated hearing loss from "normal" hearing parameters to severe to profound sloping loss.

Frequency specific attenuation of the speech signal was presented at varying levels based on the Killion and Mueller study for speech intelligibility scoring structures (Killion and Mueller 2010), and as anticipated, the greater the increase of simulated hearing loss, the greater the decrease in MMSE scores .

This study differs from others looking at similar areas of academic enquiry in that it required a comprehension task as well as auditory repetition; the five groups enabled greater data evidence; and had thirty measuring points.
The results showed that 40% audibility is required for accurate speech perception, that the majority of the study participants would have received diagnosis of dementia, and that decreasing audibility indicates higher severity of dementia diagnosis.
The study extrapolates this data by suggesting that this shows misdiagnosis of dementia is possible for people with hearing loss, and that mild to moderate hearing impairments are frequently under-diagnosed and under-recognised, and recommends that hearing impairments should be considered for patients undergoing tests for cognitive function

I was more than a little disappointed that the test subjects had neither hearing impairment nor cognitive dysfunction, but the supposition of the impact of hearing impairment on cognitive ability is more than anecdotal from clinicians.
All in all, this paper offers some interesting insights, and provides for a raft of references to learn more about the topic which is a significant issue in all our interventions with patients.

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Is Hearing Loss Associated with Poorer Health in Older Adults Who Might Benefit from Hearing Screening?

Paul Mick and M. Kathleen Pichora-Fuller.

Ear and Hearing 2016; Vol. 37 (3), e194–e201.

This study considers the impact and benefit of hearing screening on the wellbeing and health outcomes for older adults, extending on from earlier research which highlighted the correlation of hearing loss with poor health outcomes including dementia, social isolations, and more frequent hospitalisation.

The subject of hearing screening is contentious; the risk of raising expectations and identifying need, can in itself become politicised. However, it is acknowledged that more information is required to monitor and adapt to health outcome aspirations. This study contributes to the debate and also offers some surprising results.

Participants were categorised into two groups, based on age range 60-69, 70+, and were identified through the National Health and Nutrition Examination Surveys (NHANES) through 1999 to 2010 and further divided into subsets for people with "normal" hearing thresholds, and for those with unacknowledged or unaddressed hearing loss. Both self-reporting of hearing loss "Would you say your hearing is excellent, good, that you have a little trouble, moderate trouble, a lot of trouble, or are you deaf? " and pure-tone audiometry were performed, and a variety of tests were presented to identify areas of concern; ranging from cognition, social isolation, falls, hospitalisation, general illness history, depression, demographic information and medical history.

The results are interesting: in general it would appear that the study showed that people with unaddressed hearing loss had lower household incomes, and lower educational achievement.
The NHANES Social Support Questionnaire (NHANES SSQ) was used to identify social networks and support. Participants were considered socially isolated if they met at least two of the criteria: not married or in a domestic partnership, no one else to provide financial support, no close friends, and no-one to provide emotional support.
Pure-tone audiometric results associated social isolation as an issue for people between60-69, but not in those who were older. In fact the "odds of social isolation increased 52% per 10dB".

The Digit Symbol Substitution Test (DSST) is a visual test to link numbers and symbols, and delivered over measured time, in this case 120 seconds. People with unaddressed hearing impairments scored significantly lower on a mean average score than those without hearing loss
Interestingly the study doesn't support previous research which suggests an association between falls, hospitalisations and reduced hearing thresholds, nor a direct link to hearing loss and social isolation in the participants over 70 and older.

The researchers posit that these discrepancies may be due to a more positive perspective on ageing, learned coping and behavioural modification strategies, or even sample size. Further analysis of the NHANES data showed that increasing age and lower educational attainment are linked to subjective under-estimation of the severity of the hearing impairment, and the researchers recommend that audiometry, rather than self-reporting qualitative tools, provide a more reliable and accurate measurement of hearing impairment.

The researchers also discuss the theoretical, but unproven, link between cognitive decline, dementia and social isolation, and suggest that this is more likely a result of communication breakdowns leading to relationship failures, or additional mental strain to listen resulting in changes to the brains neural plasticity. They conclude by stating that "it is hard to imagine how social isolation or cognitive decline might cause declines in hearing"

An interesting and engaging paper.

Development and psychometric evaluation of a health-related quality of life instrument for individuals with adult-onset hearing loss

Carren J. Stika & Ron D. Hays.

International Journal of Audiology, 2016; Vol. 55: 381–391.

This American study provides a much needed simple tool to measure and evaluate the impact for hearing impairments in adults on their health outcomes and quality of life. Starting from the familiar established architecture of the Health Related Quality of Life (HRQOL) and Hearing Handicap Inventory for the Elderly (HHIE) constructs, it offers a comprehensive and multidimensional recognisable model, and unlike some other measurement tools, it was developed with people experiencing hearing loss.

Called the IHEAR-IT, the Impact of Hearing Loss Inventory Tool, consists of four main areas of concern: physical, psychological, social and interpersonal, and activity and participation, which are then further divided into 16 subsets, ranging from access to information, energy and fatigue to safety and vulnerability and intimacy. By reviewing existing tools, the project team developed and incorporated the most practical and applicable components. In particular, effort was made to ensure that the concept of "hearing disability" was widened beyond the traditional sociomedical model of organisations such as the World Health Organisation (WHO), to include personal and environmental factors

409 people across America participated in the development of the 73 items examined by IHEAR-IT as relevant and pertinent to their lives and wellbeing, and the paper discusses the development and progression through close scrutiny of the outcome data. The tool was then measured against comparable models of evaluating quality of life, and the impact of hearing loss on adults, and was found to be consistent with other epidemiological research and established mechanisms.

The team acknowledged potential limitations to the study in that most of the participants were motivated to discuss their hearing loss, being members of consumer organisations, few were employed, most had severe hearing impairments which is unrepresentative of the general population, and as part of the literature review, they identified that there has been no published research into women's sexual health and HRQOL

Just over half of the participants sent in their audiometric data to the research team, so the severity of hearing impairment was subjectively provided by many of the participants. In contrast to other research I have read this week, the IHEAR-IT research team suggest that "self-reported hearing loss explained self reported mental health and subjective wellbeing much better than did measured hearing loss".

The team are working to produce a shorter version of the IHEAR-IT which could be a practical tool, and one that we could all be using in our practices in the next few years.

A causal relationship between hearing loss and cognitive impairment.

So Young Park, Min Jung Kim, Huerxidan Sikandaner, Dong-Kee Kim, Sang Won Yeo & Shi Nae Park.

Acta Oto-Laryngologica, 2016 Vol 136 5 pag 480-483.

In this study, RAM/NOR-based cognitive functions between normal and hearing-impaired young mice were compared to investigate the relationship between hearing and cognition. There is abundant literature providing evidence for the relationship, yet the causality is still not clear. The underlying question is whether hearing loss is a causal factor for cognitive impairment or only comorbidity associated with ageing.
The sensory-deprivation and information-degradation hypotheses consider cognitive decline as the by-product of devoting cognitive resources to effortful sensory perception. Increased perceptual load and consequential decrease in cognitive reserves lead to cognitive decline. Cognitive changes by information degradation are potentially reversible, whereas those by sensory deprivation may be permanent.
Another potential mechanism of the sensory-deprivation hypothesis is de-afferentation and atrophy in the auditory area, which could also affect cognitive functions. The common-cause hypothesis, in contrast, proposes a third factor; namely, a shared pathology in the ageing brain such as loss of the integrity of brain physiology or widespread neural degeneration. To disentangle those hypotheses and rule out the common-cause hypothesis, age-matched longitudinal work would be needed. This is the first study in which the age and hearing-matched longitudinal research has been conducted on cognitive function. The auditory system can be permanently impaired by noise in this mouse model.

Additional advantages in using young inbred mice are a short life span and few demographic confounding factors. The relationship between auditory and cognitive functioning in the elderly has been the subject of many studies, yielding conflicting results. Many cross-sectional or longitudinal cohort studies documented that hearing loss is associated with cognitive decline or dementia.

This study intended to investigate the effect of hearing loss on cognitive function, as estimated by radial arm maze (RAM) and novel object recognition (NOR) tasks in mice through age- and hearing-matched longitudinal work during a 6-month period. Methods Twenty-four male C57BL/6 mice aged 1 month with normal ABR thresholds were used. Twelve mice in the hearing loss (HL) group were exposed to white noise at 110 dB SPL for 60 min every day for 20 days. At post-noise 6 months, all mice underwent RAM and one-trial NOR test. RAM performance measures and NOR discrimination index were compared between two groups. Results at 6 months after noise exposure, all mice in the experimental group had moderate hearing loss. Most of the RAM performances improved gradually within each group across five trials, probably due to learning effect. The HL group showed lower performance scores than the control group in several trial points in the RAM task. The contact time with the novel object was shorter in the HL group than in the control group.

In conclusion, moderate hearing loss in young mice caused decreases in cognition associated with spatial working and recognition memories in 6 months. These results provide further evidence for a causal relationship between hearing loss and cognitive impairment, and will help to support the sensory deprivation and connectome hypothesis. Further studies are necessary on long-term changes in cognition related with hearing loss, along with morphological assessment of the brain and cochlea.

Neurocognitive factors in sensory restoration of early deafness: a connectome model.

Andrej Kral, William G Kronenberger, David B Pisoni, Gerard M O'Donoghue.

THE LANCET Neurology

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Reception of sensory information depends on the integrity of specialised receptor cells that encode physical stimuli and transduce them for the brain's information processing machinery. Loss of neurosensory input affects quality of life profoundly and is a major contributor to the global burden of disease through years lived with disability. Less frequently considered, however, are the downstream, distal, cognitive effects that are not related directly to sensory loss— e.g., effects on working memory and attention.
The aim of this Review is to demonstrate the implications of a connectome model for understanding variability in outcomes after sensory loss and later neurosensory restoration, using cochlear implantation in congenitally deaf children as a framework. Because brain development is a self-organising process, development of the connectome is highly dependent on sensory experience. As a result, sensory loss can be thought of as a connectome disease – i.e., an abnormal bias in the individual wiring and coupling pattern of the brain that has implications for adaptation to a neuroprosthetic device as well as downstream neurocognitive effects.
Sensory loss and restoration in children occur in the context of a dynamic developing brain. The juvenile brain adapts rapidly to the environment and is, therefore, highly sensitive to loss of sensory input and auditory neurons in the brainstem. Therefore, the age at onset of cochlear deficits in utero might affect profoundly the functional integrity of auditory pathways and, as a result, higher order brain systems and functions that rely on this sensory input.

Our innate genetic programme, therefore, includes periods of high susceptibility to environmental modification (sensitive periods), with augmented plasticity of neuronal connections at young ages. Hearing deprivation during early development prevents functional maturation, delays cortical synapto-genesis, and increases subsequent synaptic elimination, ultimately affecting central functions such as intensity coding, cortical column functioning, cochleotopic representation, representation of auditory space, and corticocortical interactions including top-down control and auditory object formation. Effective stimulation through a cochlear implant during a sensitive period in early development can exploit juvenile plasticity, induce maturation, and compensate for these deficits in animals and children. Another factor influencing neurodevelopmental outcomes is brain plasticity at the age of intervention: early intervention within a sensitive period prevents further degenerative changes, induces functional maturation of the brain, and results in better outcomes than does late intervention. Late intervention leads to insufficient adaptation and, thus, poor outcomes irrespective of whether onset of deafness was prenatal or congenital; late intervention provides meaningful results only if the auditory system matured with previous acoustic hearing (also pertains to acquired and progressive hearing loss). As a result, diagnosis and treatment of hearing disorders as early as possible has become routine clinical practice.

Early cochlear implantation compensates for most deficits caused by profound hearing loss in childhood. Deaf children who receive a cochlear implant early in life and have normal cognitive capacity show language learning trajectories similar to their hearing peers. Loss of hearing has cascading neurological and neurocognitive effects, because no part of the brain works in isolation, loss of a sensory system such as hearing also affects other functions, including higher order neurocognitive tasks. Individuals with normal hearing use various listening strategies—eg, for tone-in-noise detection or pitch perception—for which multiple acoustic cues might provide the same information. The social environment is another key factor for neurocognitive development. Parental sensitivity and cognitive stimulation affect language outcomes in children with a cochlear implant as strongly as does age at implantation, and characteristics of the family environment influence

executive functioning outcomes after implantation. Executive functioning is defined as the cognitive control and oversight processes needed to undertake planned goal-directed activities.
Because of the strong associations between language and executive functioning (particularly working memory) in people with a cochlear implant and in individuals with normal hearing, speech–language interventions can improve neurocognitive outcomes in people with a cochlear implant. In the few studies that have investigated changes in executive functioning in people with a cochlear implant after speech–language therapy, greater improvements in speech and language skills than in executive functioning skills have been reported. Sensory loss is prevalent in human populations and can have profound effects on development, adjustment, and quality of life. Neurosensory prostheses offer the potential to mitigate the effects of sensory loss, restoring some components of sensory functioning downstream influences on central neural and neurocognitive development probably arise as a result of sensory loss and not as a result of sensory restoration by the cochlear implant; in fact, sensory restoration in a connectome model offers the potential for improvement in outcomes.

Application of a sensory connectome model to the effects of cochlear implantation provides possible neural and neurocognitive explanations for variability in spoken language outcomes extending well beyond device and audiological characteristics. Investigation of these connectome-based explanations is a fruitful area for research that could lead to intervention recommendations to benefit those who have suboptimum outcomes after implantation.
Application of a connectome model to individuals with sensory impairment suggests that outcomes of hearing loss and subsequent cochlear implantation will extend beyond the direct result of sensory loss— e.g., perception of spoken language in the case of hearing.

Very interesting paper on the brain's extremely complex and plastic wiring mechanisms, the hierarchies within and how a better understanding of these can shed more light towards further understanding, and explaining, the variability of outcomes in cochlear implant patients.

Interventional Audiology: Broadening the Scope of Practice to Meet the Changing Demands of the New Consumer.

Brian Taylor.

Seminars in Hearing, Issue 02 Vol 37 May 2016, 120-136.

Automated technology, the rising costs of health care, and the constraints and burdens caused by demographics such as that of the growing ageing population will necessarily require that audiologists rethink their value proposition and paradigms in the health care marketplace. The rising popularity of self-guided testing and use of smartphone apps, will make it imperative that audiologists' meet demands of a marketplace that is likely to want to further engage with professionals when people are younger and have milder degrees of hearing loss. Furthermore, audiologists have a significant opportunity to become an integral part of a physician's team of trusted advisors and play an essential part in this effort to provide the right care at the right time. With interventional hearing health care strategies that seek to minimise impairment and maximise daily function, the audiologist will most probably play an increasingly prominent role in the future in controlling health care costs while delivering timely, cost efficient, and highly effective care. According to MarkeTrak data, the average age of a patient in the United States who is fitted with their first pair of hearing aids is just shy of 70 years of age, and the patient is likely to be seen for the first time by an audiologist for a hearing test shortly before his initial purchase.

This suggests that society continues to categorise hearing loss as a disease of the aged. Hearing loss is the second leading cause of years living with disability, second only to depression. Emerging research suggests that hearing loss may actually accelerate some disabilities such as cognitive dysfunction and vestibular impairment. The treatment of hearing loss by audiologists can provide interventional assistance by providing routine hearing evaluations for patients of patient-centered medical care homes that seek to focus on prevention, early detection and evidence-based treatment. This is likely to result in improved quality of care, patient compliance, improved outcomes, and reduced overall cost of care. The audiologist is now being increasingly viewed within the wider medical community as an essential component of patient care for a broad range of disease processes that previously were not considered relevant to hearing impairment.

An example of the value of interventional audiology being included in the comprehensive team of primary caregivers who seek to minimise impairment and maximise function can be seen in the recently published research by Lin and Ferrucci documenting the robust association between high frequency hearing loss, and an increased risk of falls. The researchers found that, for every 10-dB increase in hearing loss, there was a 1.4-fold (95% confidence interval 1.3 to 1.5) increased odds of an individual reporting a fall over the preceding 12 months. Although there is a paucity of evidence from randomised controlled trials, early identification, remediation, and treatment of hearing loss are thought to lead to higher overall quality-of life outcomes. Common sense requires audiologists to educate physicians and other medical practitioners about the linkage between hearing impairment and numerous medical conditions.

With regard to hearing loss and comorbidities, Cognitive Decline by 2050, will see 1 in 30 Americans suffering from dementia. It is thought that delaying the onset of dementia by 1 year could potentially reduce the incidence of dementia by 15%, thus saving billions of dollars in health care costs. Lin et al at Johns Hopkins University followed 1984 individuals between the ages of 36 and 90 years of age. None of the participants had cognitive impairment as measured on standardised tests at the beginning of the study, but some of them did have hearing loss. The participants were followed over an 18-year period. The effects of age, medical risk factors, diabetes, and hypertension were controlled in the study design. Results of the study indicated that individuals with untreated hearing loss have a greater risk of subsequently developing dementia than do individuals without hearing

loss. Specifically, Lin and colleagues found that study participants with hearing loss at the beginning of this longitudinal study have a 40% chance of a greater rate of cognitive decline compared with those with normal hearing at the beginning of the study. Diabetes hearing loss is more than twice as common in adults with diabetes compared with those who do not have the disease, according to a new study funded by the National Institutes of Health. Twenty-one percent of the people with diabetes surveyed had hearing loss, compared with only 9% of subjects without diabetes in this outcomes-based study that controlled for other variables.

Depression and Social Isolation Depression also is associated with the elderly individual who has acquired hearing loss. Jones and White conducted a meta-analysis on studies that examined the relationship between hearing loss and mental health. They concluded that individuals with hearing loss were more vulnerable to depression than people from the general population. More recently, Garnefski and Kraaij examined the relationship between cognitive coping strategies, anxiety, depression and acquired hearing loss. Their results suggested that maladaptive coping skills and symptoms of anxiety and depression are related issues among individuals with acquired hearing loss. Simply stated, patients with hearing loss tend to suffer more from the ill effects of depression and anxiety when compared with individuals with normal hearing. It seems that hearing loss adds to the complexity of the situation for patients suffering from these conditions. Mick examined the relationship between hearing loss and social isolation in a large group of adults between the ages of 60 and 84. The objective of their study was to determine if age-related hearing loss is associated with social isolation and whether factors such as age, gender, and hearing aid use moderate this association. There were 1,453 male and female participants in this study, all between the ages of 60 and 84 years. Social isolation was defined using the social isolation score. Results indicated that greater amounts of hearing loss were associated with increased odds of social isolation in women aged 60 to 69. Other groups did not show a significant relationship between hearing loss and social isolation. These results suggest that women within this age range are more likely to alter their lifestyle due to their hearing loss. Chan-Ming estimated the prevalence of depression among adults with hearing loss. Using the nine-item Patient Health Questionnaire, the prevalence of depression among 18,318 participants of the National Health and Nutrition Examination Survey was examined. The prevalence of depression increased as hearing loss became worse except in those who self-reported as deaf. Among individuals over the age of 70, no significant association between self-reported hearing loss and depression was found. Adults under the age of 70, particularly women, had a significant association between moderate hearing loss and depression. These two studies suggest that there is a relationship between age-related hearing loss and social isolation and depression.

It may be necessary to exert more social pressure to get patients at risk of hearing loss to act sooner.As the data show, there is a clear disconnect between the ages when an individual first notices a hearing loss and when they complete their first audiological assessment. By the age of 60, 80% of men and 70% of women notice some amount of hearing difficulty. Yet, only 41% of U.S. adults aged 70 years or older report having had a hearing test in the past 5 years. A key to engaging younger individuals in the process of checking their hearing at a younger age, when the loss is milder. is commonly referred to as making the imperceptible perceptible. Hearing loss of gradual onset is the imperceptible. An interventional audiology paradigm requires audiologists to identify ways to raise the condition of hearing loss to the top of the mind of the individual affected. Taking an imperceptible condition and making it top of the mind can be done by what Alcock refers to as creating positive triggers to action. Positive triggers to action have five distinct steps and can be used in marketing campaigns to encourage individuals who first notice a hearing loss to take action. The five steps to creating a positive trigger to action include:

1. Draw attention to a perceptible occurrence that people can relate to.
2. Assign meaning to this occurrence to link it to the imperceptible.
3. Highlight the hidden risk.
4. Offer a solution that minimises that risk by promoting an action that is easy to perform.
5. Increase self-esteem through taking that action.

Once an individual is triggered to take action, it is necessary that he or she has the ability to quickly and discreetly monitor his or her hearing. Given that most individuals do not perceive their hearing loss as a medical condition warranting personal attention from a medical practitioner, audiologists should not expect these individuals to actively seek them out for a comprehensive hearing assessment when they first notice possible hearing difficulties.
Another aspect of preventive services rests with the ability of audiology to champion online learning communities. Online learning communities are informational websites that allow patients, family members, and professionals to exchange ideas and seek educational information.

This paper substantiates and also in many ways legitimises the need for an increased interventional involvement of audiologists, also within a multidisciplinary framework, with the primary objective being that of the global quality of life of subjects at risk of or with hearing loss.

Is Hearing Loss Associated with Poorer Health in Older Adults Who Might Benefit from Hearing Screening?

Andrej Kral, William G Kronenberger, David B Pisoni, Gerard M O'Donoghue.

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Speech communication involves multiple auditory and cognitive mechanisms to hear, understand, and make use of information in spoken language. In daily life, performance on verbal tasks involves more than recognition and is influenced by the relative demands placed on the auditory-cognitive system. Performance may decline due to changes in the auditory environment, such as degradation of the acoustic signal with background noise, reverberation, distortion, or filtering of speech.
Rabbit (1966 – 1968) examined the effects of modulated noise on young adults' ability to recall lists or details of discourse passages presented auditorily. Even after controlling for the intelligibility of the speech presented in noise, Rabbit found that young adults were less likely to correctly recall lists of eight digits and remembered fewer passage details in noise compared with when stimuli were presented in quiet.

When there is a linguistic mismatch due to adverse listening conditions, demands on working memory capacity increase, triggering explicit processing to map sound to meaning from the acoustic signal.
In the test presented in this paper, 45 healthy adults between the ages of 18 and 30 years participated in the experiment. In addition to age, eligibility criteria included speaking English as a native language; normal otoscopy; pure-tone air condition thresholds of 20 dB HL or better in both ears (250 – 8000 Hz).
Individuals in three participant groups performed equally well on the working memory tasks in quiet conditions without background noise for small and large sets.

Extrapolating from the present results, the interaction between linguistic and perceptual demand on working memory may differ across populations. For example, populations with known perceptual challenges, such as individuals with hearing loss, may show interactions between noise levels even for the less linguistically demanding subtract 2 span task.
For future research there are several details to examine in terms of how different types of listening conditions and cognitive tasks will interact to affect people with differing perceptual and cognitive skills.

Interesting study corroborating the well-known adverse effects of background noise on perceptual performance with serious imaginable implications on hearing aid outcomes and that hearing aid fitting strategies should take into account.

Development of Telscreen: a telephone-based speech-in-noise hearing screening test with a novel masking noise and scoring procedure

Harvey Dillon, Elizabeth Francis Beach, John Seymour, Lyndal Carter & Maryanne Golding.

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In 2006, the Australian government requested the National Acoustic Laboratories (NAL) to develop an Australian telephone-based speech-in-noise test for national implementation.

Telscreen I
Based on the good results with hearing telephone screening tests in The Netherlands and the UK, NAL used digit triplets in speech-shaped masking noise with a variable signal-to-noise ratio (SNR). But there were also a few amendments:

- *Individual scoring of digits (aim: to improve test efficiency)*
- *Individual equalisation of digit intelligibility (to increase test precision by maximising the slope of the psychometric function)*
- *Accuracy-determined test termination (the test is terminated when a target accuracy is achieved)*

The masking noise was created by generating white noise, which was filtered to approximate the average spectrum of the triplets.

The adaptive test targeted the SNR at which each digit was correctly perceived 66,6% of the time.

105 participants completed PTA at 0,5, 1, 2 , 4 and 8 kHz and a hearing disability questionnaire (HDQ), and completed Telscreen at the lab using their office phone and on two further occasions using their home telephone.
While all correlations were highly significant, the correlations between the SRTn values and each of the questionnaire results and hearing thresholds were disappointingly low. To improve the ability of the hearing test, the masking noise was changed and Telscreen II was developed.

Telscreen II
A new masking noise was used: white noise, filtered to match the international long-term average speech spectrum (ILTASS), with an extra 2 dB per octave slope added from 0,1 to 4 kHz. Then the noise was filtered so that every second critical band from 0,4 to 4 kHz was attenuated by 40 dB and a 0,02 kHz sinusoidal modulation was applied with a modulation depth of 20 dB. The aim of this modification was to increase the masking of the low frequency parts of the stimuli and hence make detection of the stimuli more dependent on high-frequency hearing ability.
The algorithm was partly changed so that SNR was varied by adjusting the target level rather than the noise level.
75 participants completed PTA at 0,5, 1, 2 , 4 and 8 kHz and HDQ, and completed two home-base trials of Telscreen II.
A significant relationship was found between Telscreen II and 4 FAHL & HHQ score, with stronger correlations than Telscreen I.

Discussion

In Telscreen I, there was an individual equalisation of digit intelligibility and these same level adjustments were re-applied in Telscreen II, but the noise had a different spectrum. So the digits were not equally intelligible in Telscreen II.

Another possible further improvement can be made by increasing the low frequency component of the masking noise, so that Telscreen II would be an even more effective hearing screening test.

Despite the positive evaluation of the Telscreen test, there are two situations that can provide difficulties in reality. First of all, the test persons could choose their preferred ear to do the test. A person with a unilateral or an unbalanced hearing loss will always choose his or her best ear, which will give a better result than in reality as even a unilateral hearing loss gives difficulties for understanding in noisy environments. There is also no control on the background noise or distractions in the environment during the telephone screening, which could again influence the test results.

Secondly, the screening test is difficult to take by people with a severe hearing loss. The article assumes that people with severe hearing loss are aware of their loss and therefore have no need for a screening test. What we see in reality though can differ, with for example people who are in the denial phase of the change curve or people with a strong top-down process ability. Also for people with visual or with mental difficulties, this test could prove to be difficult to execute.

Future directions
The challenge in Australia is the large number of people from non-English speaking backgrounds. Telscreen III will be using tone pulses instead of digit triplets.

This screening test is a good solution for quick and inexpensive tests to reveal hearing disabilities with large groups of people. With an ageing population, the increase in access to hearing health in developing countries and the spread of online and mobile technologies, this test is a welcome basis for the development of future tests for identification of hearing problems. Today, this test has been already used for online and mobile versions.
On the other hand, the value of a thorough examination of the hearing of each person by a qualified audiologist should not be underestimated. Amplifon invests in quality hearing tests that take more than a quick screening over the telephone, which is also one of Amplifon's key differentiators in the market. Finally, the article doesn't mention the follow-up protocol for people who don't pass the test, which is a very important step in the guidance of people dealing with fresh information about heaving a hearing loss. This is where a real-life audiologist can make an important difference for the client.

Exploration of a physiologically-inspired hearing aid algorithm using a computer model mimicking impaired hearing

Tim Jürgens, Nicholas R. Clark, Wendy Lecluyse & Ray Meddis.

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One of the drawbacks in fitting hearing aids for cochlear hearing losses is the inability in modern hearing instrument fitting algorithms to compensate for the loss of tuning. In this article, Tim Jürgens discusses 3 cases of patients fitted according a new physiologically-inspired algorithm, based on the peripheral auditory model, proposed by Panda (MAP 1.14). The aim was to re-establish hearing the closest possible way to normal hearing.

The computer model integrates the auditory processing, taking in account acoustical reflex and delayed feedback attenuation control by the medial olivocochlear system (at the brainstem).

The model results in lower absolute thresholds, steeper compression and improved frequency selectivity, with means much closer to the compression schemes of a normal working cochlea.

It seems to me a promising start for future improvements for an issue that looked before as insolvable.