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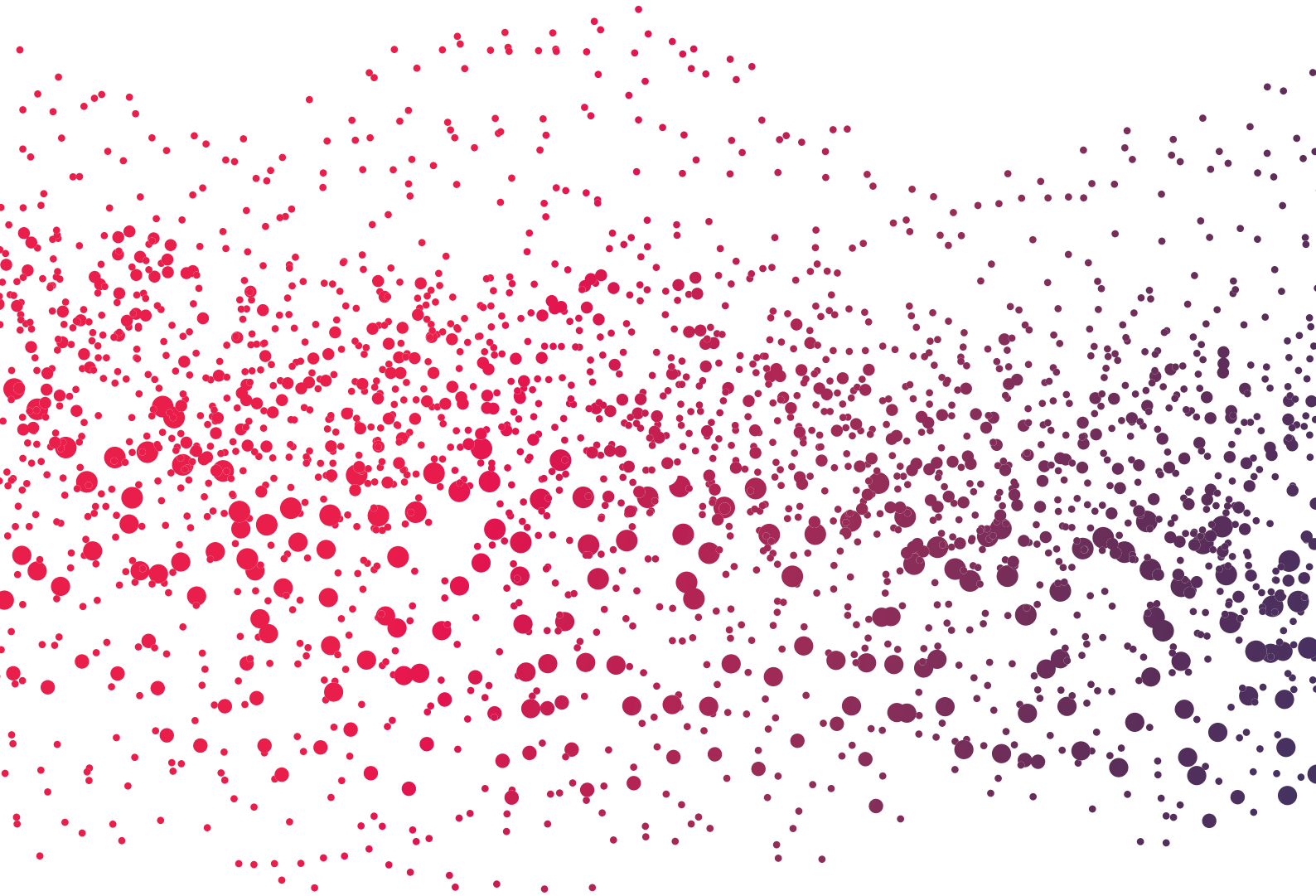

Approaches to treat sensorineural hearing loss by hair-cell regeneration

Technology and Infrastructure Needs in the Delivery of Virtual Hearing Aid Services

Trends in COSI responses associated with age and degree of hearing loss

CONTENT

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EDITORIAL

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Dear Reader, the Amplifon Centre for Research and Studies, CRS, houses one of the finest private libraries in the field of audiology and otorhinolaryngology, offering the sector's most important international journals. Every quarter, a team of Amplifon Audiologists from around the globe select the most relevant publications in the field of Otology and Audiology and offer a comprehensive review. The Amplifon Centre for Research and Studies coordinates the development of this quarterly review. We are happy to share these new reviews with you. For this issue, our team reviewed 11 interesting articles published in the second quarter of 2022.

Four reviews focus on the latest research on hearing loss, hair-cell regeneration, hearing loss after meningitis, subclinical hearing loss and guidelines for diagnosing noise-induced hearing loss.

Three reviews are related to new trends in hearing care, such as Direct-to-consumer hearing devices, virtual hearing aid services and remotely measured speech recognition in noise.

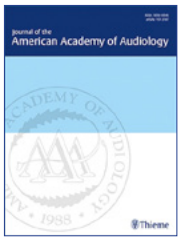
Finally, this issue features four reviews on person-centred factors of hearing care/ how to affect hearing aid use in young children, how noise acceptance and preferred signal to noise ratio for music and speech are different, how the description of hearing aids influences the experience and concluding with a review on a new study on the Client Oriented Scale of Improvement, one of the milestones in person centred hearing care.

Our Amplifon Centre for Research and Studies has also published a White Paper on "PATIENT-, CLIENT-, PERSON- OR PEOPLE-CENTRED CARE - General Health Care and Hearing Care", which is available on the new CRS web platform: https://crs.amplifon.com/en/publications

We hope you enjoy this issue of our CRS Scientific Journal

Mark Laureyns
Global International CRS & Medical Scientific Research Manager

APPROACHES TO TREAT SENSORINEURAL HEARING LOSS BY HAIR-CELL REGENERATION: THE CURRENT STATE OF THERAPEUTIC DEVELOPMENTS AND THEIR POTENTIAL IMPACT ON AUDIOLOGICAL CLINICAL PRACTICE



Hinton AS., Yang-Hood A., Schrader AD., et al.

Journal of the American Academy of Audiology (2021): 32(10), 661–9

doi: 10.1055/s-0042-1750281

By Thomas Zacharia – Australia

Approaches to treating sensorineural hearing loss through hair cell regeneration have advanced from pre-clinical stage to clinical trials in humans.

Sensorineural hearing loss (SNHL) accounts for 90% of all hearing loss cases. This condition is predominantly caused by hair cell loss due to noise exposure, ototoxic drugs, and viral/bacterial infections. Initially, hair cell loss was believed to be permanent in vertebrates until studies discovered hair cell regeneration in birds after aminoglycoside and noise insult. Later, hair cell regeneration was also identified in amphibians, reptiles, and fish. Although it was initially believed that mammals lacked such a capacity, later studies found that they do in fact have some regenerative capacity during the cochlear development stage and shortly after birth. However, this ability is lost well before the onset of hearing.

In regenerative species, hair cell regeneration is achieved through two mechanisms:

1. Transdifferentiation: when supporting cells directly differentiate to hair cells without first undergoing division
2. Asymmetric division: this process results in two daughter cells, one of which acquires a hair cell fate

Mammalian species do not have these mechanisms. However, both hair cells and supporting cells do share a common cellular precursor before their terminal commitment to either cell type. As a consequence, supporting cells are the primary target for hair cell regeneration studies.

CRITICAL NOTE:
Approaches to treating sensorineural hearing loss by hair cell regeneration have advanced from the pre-clinical stage to clinical trials in humans. Three main approaches are considered for hair cell regeneration: upregulating Atoh1 to convert supporting cells to hair cells; Atoh1 upregulation by inhibiting Notch signalling, which will allow supporting cells to convert to hair cells; and a combination of Atoh1 transduction with small molecule compounds which, in turn, convert supporting cells to hair cells.

a. Gene therapy to induce Atoh1 expression to regenerate hair cells

Upregulation of Atoh1, a helix-loop-helix transcription factor, helps with hair cell differentiation and with the viral transduction of supporting cells. Atoh1 adenovirus in guinea pigs in vivo produced new hair cells, but they were immature or took on primordial fate as they could not be distinguished as either cochlear or vestibular hair cells. Other studies reported that upregulation of Atoh1 in a subset of supporting cells resulted in new hair-cell-like cells. These failed to mature in new-born mice, and when performed in mature animals, all new hair-cell-like cells eventually died, suggesting that Atoh1 upregulation on its own did not improve auditory function in guinea pigs.

b. Inhibiting the Notch signaling pathway to upregulate Atoh1 and regenerate hair cells

Atoh1 is regulated partly by the notch signaling pathway, and active notch signaling is known to suppress hair cell formation. Notch signaling inhibition drives hair-cell formation from supporting hair cells. Upregulation of

Atoh1 with small molecules resulted in transdifferentiating supporting cells into hair cells, as small molecules can diffuse through the round and oval window due to lower molecular weight. This enabled researchers to obtain auditory brain stem response thresholds at lower frequencies.

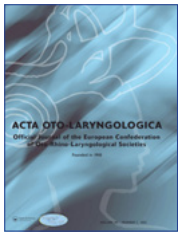
c. Defining distinct cochlear progenitors and combination of molecular targets for hair cell regeneration

Within the postnatal mammalian inner ear, there are distinct populations of progenitor cells that have defined capacities to form vestibular, cochlear, or neural cell types. Some studies showed a combination of CHIR99021, a small molecule Wnt (Wnt is a portmanteau created from the names Wingless and Int-1) pathway activator, and the small molecule valproic acid, enables the proliferation of quiescent cochlear hair cell progenitor cells from mice, non-human primates, and humans. In other words, this means that progenitor cells can be induced to divide asymmetrically to replace themselves and form new hair cells. Administration of this drug in mice who had NIHL showed a 10—35 dB improvement in their ABR thresholds after five weeks.

The authors report that these three preclinical approaches have since been advanced to clinical trials, carried out by three different companies. Novartis is performing an intralabyrinth viral transduction to upregulate Atoh1 (Hath1 in humans) to directly convert supporting cells to hair cells in individuals with severe to profound hearing loss. Audion is conducting an intratympanic small molecule compound approach to inhibit the Notch pathway to upregulate Atoh1 in order to directly convert supporting cells to hair cells. At time of writing, neither of the results of these studies had yet been published. Lastly, Frequency Therapeutics is undertaking an intratympanic two small molecule compounds approach with Wnt signalling pathway activator combined with sodium valproate to induce asymmetric division of supporting cells in order to generate new hair cells. The results of this study showed improvement in speech in noise tests.

The authors conclude that PureTone Audiometry is the gold standard test for identifying and classifying HL. However, for assessing patients undergoing regenerative therapy, more test batteries are required – such as speech in noise, auditory brainstem response (ABR), otoacoustic emission, electrocochleography – in order to objectively measure hearing functions. •

HEARING LOSS AFTER BACTERIAL MENINGITIS, A RETROSPECTIVE STUDY



Persson F., Bjar N., Hermansson A., et al.

Acta Oto-Laryngologica (2022): 142(3-4),298–301

doi: 10.1080/00016489.2022.2058708

By Sofie Peeters – Belgium

This study investigated the incidence of sensorineural hearing loss and the risk factors for hearing loss in patients treated for bacterial meningitis in Skane (Sweden) between 2000 and 2017.

This study investigated the incidence of sensorineural hearing loss (SNHL) and the risk factors for hearing loss (HL) in patients treated for bacterial meningitis in Skane (Sweden) between 2000 and 2017.

Of the initial 556 patients identified for the study, only 187 patients were included in the final population after excluding the neonatal group, patients with viral infections, fungal or non-infectious meningitis, borrelia or nosocomial, postoperative or ventricular shunt-related infections. The most commonly identified bacteria were Streptococcus pneumoniae (58%) and Neisseria meningitidis (12%).

Information about gender, age, otoscopy and microbiological results were included alongside subjective HL and hearing tests (available for 119 subjects).

In the framework of the study, HL was defined as PTA4 (average 500, 1000, 2000 and 4000Hz) ≥ 25 dB HL and the presence of conductive HL (ABG > 10 dB on at least two adjacent frequencies) and HF (average 6000 and 8000Hz) was calculated if thresholds were available. Patients with purely conductive HL were not included in the HL group. A total of 81 subjects were diagnosed with HL (13 of whom unilaterally).

Patients were divided into four age groups in order not to overestimate the prevalence of HL. Data was analysed in two ways: first, by including only those subjects for whom a hearing test was available (A); and second, by including all patients making the assumption that patients who had not undergone a hearing test did not have HL (B).

No correlation was found between gender and HL (0-11 years / 12-21 years/ 22-65 years and 65+ years). However, the incidence of HL was strongly associated with age. Adult and elderly patients had increased odds of HL (partly explained by the fact that the prevalence of HL increases with age). In children and teenagers, no hearing thresholds >40 dB HL on frequencies 6000 and 8000Hz were identified.

There was evidence that pneumococcal infection and concurrent acute otitis media (AOM) increased the odds of HL, whereas in patients with meningococcal infections no association between the infection and HL was seen (it should be noted that meningococcal infections were almost exclusively found among children and teenagers, therefore age could also have an influence on this factor).

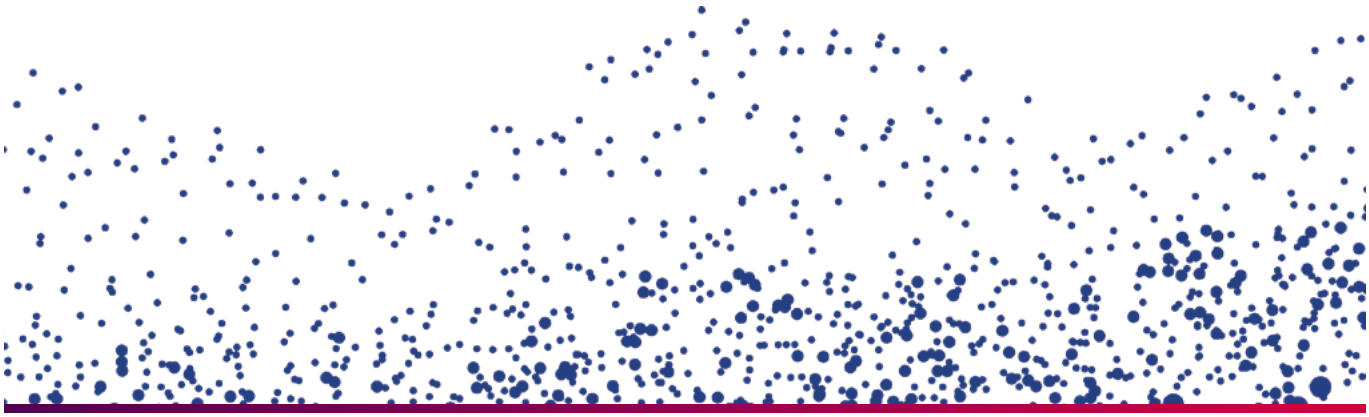
These findings are consistent with a previous Dutch study (Heckenberg SG et al., 2012) which determined that the odds of HL increased by a factor of 2.6 in patients with concurrent AOM.
In group B, S.pneumoniae increased the odds of HL almost four-fold after controlling for other risk factors.

CRITICAL NOTE:
This study is very interesting because it covers data spanning 18 years. As a consequence, the findings can be easily generalised. The study highlights that the guidelines for examining patients with bacterial meningitis should certainly include otoscopy in the future because the existence of concurrent AOM greatly increases the odds of hearing loss.
Moreover, the study explores unilateral and bilateral hearing loss caused by bacterial meningitis, but there is scant information regarding the degree of hearing loss and what the audiograms look like (curve). Having this information could give a better idea of the impact on hearing.
Lastly, better documentation of hearing pre- and post-meningitis could provide better insight into the direct effect of the infection and/or the treatment of bacterial meningitis on hearing.

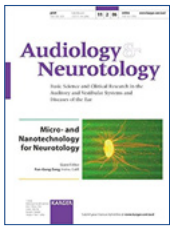
The strength of this study lies in the robustness of its data pool, covering 18 years of data, meaning the results can be generalised.

One of the limitations of this study is that, despite recommendations, one third of the patients had not undergone a hearing test after recovery. Extra attention should be paid to collecting results of hearing tests after recovery. Secondly, there was no way of objectively ascertaining that the HL was caused by the meningitis because most patients had not undergone a hearing test prior to the infection.

The findings of this paper highlight the need for existing guidelines to focus on the importance of patients undergoing otoscopy when admitted to hospital with bacterial meningitis and that early diagnosis of concurrent AOM and subsequent myringotomy might decrease the risk of developing HL. At time of publication, a prospective study on the same population was underway which, hopefully, could validate the findings more robustly. •



IDENTIFYING SUBCLINICAL HEARING LOSS: EXTENDED AUDIOMETRY AND WORD RECOGNITION IN NOISE



Drennan WR.

Audiology and Neurotology (2022): 27(3), 217–26

doi: 10.1159/000518962

By Majda Basheikh - Canada

A review of three different measures that further evaluate speech understanding ability, even in normal-hearing individuals

Speech understanding in noise (SIN) is one of the most commonly-reported complaints among patients in hearing clinics, and is found among patients with varying levels of hearing, including normal hearing individuals. More specifically, this study examines normal hearing individuals and factors beyond the conventional audiogram to investigate contributors to speech understanding difficulties in noise.
The study explored three behavioural measures which are not standard within conventional audiometry:

1) Word Recognition in Noise with and without interaural time differences (ITD)
2) Binaural intelligibility level difference (BILD) that is ITD based
3) Extended high frequency (EHF) audiometry

The population was made up of a total of 119 subjects, aged 18 to 72 years old, with normal hearing up to 8 kHz. All participants had word recognition in quiet scores of 90% or greater at 50 dB HL. They also presented with normal tympanograms and symmetrical hearing. After completing a conventional audiogram, an extended high frequency audiogram was completed from 9 to 16 kHz.

The BILD was conducted using a 12-word spondee list, spoken by a female talker on a recording with the presence of background noise. The average signal-to-noise (SNR) ratio for 50% correct responses (SNR50) was recorded in two conditions: diotic presentation (speech and noise had ITDs of 0 µs) and dichotic presentation (speech had ITD of 700 µs whereas noise had ITD of 0 µs). The BILD was calculated as the difference of the SNR50 between these two conditions.
With respect to word recognition in noise, results indicated an average reduction of about 6 dB in the SNR50 when noise was presented. Furthermore, the greater the Pure Tone Average (PTA), the greater the reduction in ability to recognise words in noise. These findings were expected and were supported by related research findings in the field.

CRITICAL NOTE:
Alternative diagnostics beyond the conventional audiogram could contribute to further identifying hearing loss in individuals who would be typically defined as normal hearing. Further considerations should be taken into account in clinical practice when consulting individuals with perceived hearing loss.

Extended high frequency measurements were also shown to have an effect, although small (9% variance), on SNR50, particularly when controlling for age and PTA. This suggests that word recognition ability declines in the absence of extended high frequency information. The BILD was shown to decrease with increasing age, but this had no effect on PTA. The authors of this study argue this correlation is consistent with previous studies of peripheral age-related synaptopathy, whereby the synaptic connections to inner hair cells degenerate with age.

In conclusion, conventional audiograms only provide a limited amount of information. Subclinical hearing loss is indicated when factoring in extended high-frequency thresholds, word recognition in noise, and BILD. Consideration of these factors further explains why even normal hearing individuals also report difficulties with speech understanding in noise. •

GUIDELINES FOR DIAGNOSING AND QUANTIFYING NOISE-INDUCED HEARING LOSS

Moore BCJ., Lowe DA. & Cox, G.

Trends in Hearing (2022O): 26, 1–21

doi: 10.1177/23312165221093156

By Marco Bonali – Italy

This paper compares different types of noise-induced hearing loss, and recommends specific evaluation methods for each of them for developing tailored diagnostic and quantification systems for clinical practice.

Noise-induced hearing loss (NIHL) is a particularly widespread issue, in particular among populations who work in specific trades, such as the military or construction. The main factors causing this problem are: the inadequate fit of hearing protections and the lack of use of such protective equipment.

NIHL occurring as a result of noise exposure (NE) in the workplace often leads to legal disputes with the worker's employer in order to claim compensation for the hearing damage. During such proceedings, some key concepts should be evaluated: the real cause of the HL and the possible co-participation of multiple events; the relationship between the NE and the effective impact on hearing; and also the compatibility of the pattern of HL with the damage induced by the noise exposure.

Despite the complexity of this type of evaluation, diagnosis is usually obtained only by means of serial audiograms. The authors argue that instead, focus should be placed on NIHL diagnosis and quantification methods, and propose guidelines for a better evaluation of this pathology and for a more precise management of medico-legal disputes. This is structured around six key pillars, as detailed below.

Medical History:

The first thing to assess for the diagnosis of NIHL is the history of the patient, so as to exclude other potential factors (external to the working context) which could lead to HL. Due to the complexity of some cases, a medical specialist should be called upon. The absence of other causes of HL (such as use of ototoxic medications, ear diseases or head injuries), crossed with the patient's age-related effect on hearing could be the first step for identifying NIHL with reasonable probability.

The authors argue that additional elements should be taken into account and studied in depth. For instance, the characteristics of noise exposure, the different types of hearing protections used and the specific features of potential tinnitus and hyperacusis experienced by the patients.

CRITICAL NOTE:

Accurate and standardised assessment of Noise Induced Hearing Loss in workers should be mandatory in order to ascertain the exact correlation between noise exposure and direct damage to a subject's hearing. This is all the more important in the event of lawsuits claiming compensation.

In this paper, the authors propose guidelines for accurately diagnosing and quantifying noise-induced hearing loss considering all types of noise exposure. This study could serve as the basis for further studies on this topic, for reaching a global assessment standard in this field.

Requirements for Sufficient Noise Exposure:

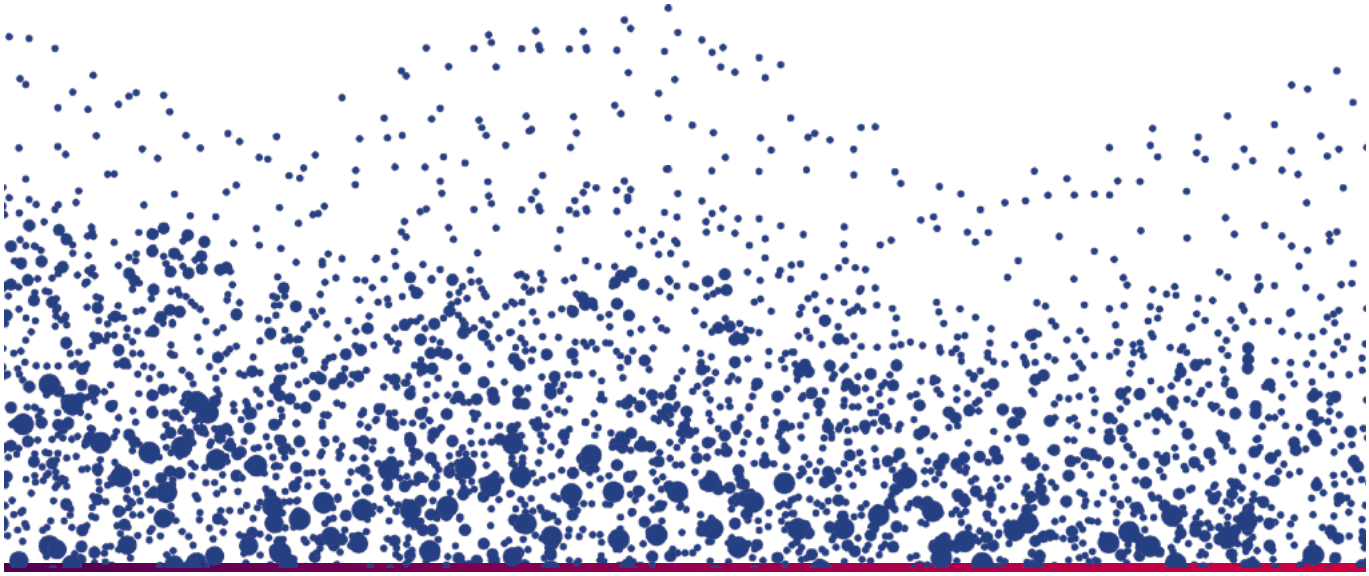
One of the most widely-used methods for assessing the NIHL (especially in the UK) is the Coles, Lutman & Buffin (CLB) Guidelines, commonly referred to as CLB, and is based on the assumption that exposure to a specific amount of noise could, in at least 50% of people, lead to a measurable degree of HL. One of the weaknesses of this system, however, is that it estimates the NIHL only in 50% of people and this value is too low from a probabilistic point of view (an alternative could be the new percentage of at least 10% of people). Moreover, different types of noise involve different thresholds for inducing NIHL. For example, a case of a steady broadband noise, 90 dB(A) could be sufficient to potentially induce NIHL, whereas exposure to impulsive sounds in military and non-military occupations involve lower threshold values.

Diagnosis based on Audiometric Configuration:
The diagnosis of NIHL should be differentiated on the basis of the type of exposure: Steady Broadband Noise; Impulsive Sounds in Industry; Intense Impulsive Sounds; and Intense Tones. This is because of the different types of audiogram patterns related to the above mentioned exposure types, and the different level of noise required for a reasonable association with NIHL. In summary, specific diagnostic methods (i.e. CLB vs Moore), threshold values and audiogram patterns should be considered in each field of noise.

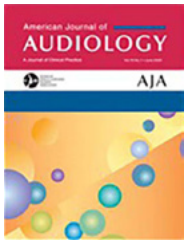
Quantification of NIHL:
The quantification of NIHL should also be evaluated in relationship to the different types of exposure. The authors recommend the use of standards such as comparison of the Hearing Threshold Levels (HTL) measured, and the Age-Associated Hearing Levels (ISO 7029, 2017 or other normative data), through the use of a standard percentile of reference (50%).

The Use of Multiple Audiograms:
Regarding the availability of multiple audiograms for a given patient, the authors recommend different approaches depending on the context. If there are multiple audiograms performed after the NE within a short interval of time, e.g. 1-2 years, the average of the HTLs should be considered.
For audiograms taken over a long period of time after the interruption of the NE (e.g. military service), one of two scenarios should be applied: if the subject was not exposed to any other significant noise after their career in the military, the test to be taken into account is one of the most recent audiograms, because previous exposure does not influence HL over time. Should the subject be exposed to new and different types of noises, then the audiogram to considered should be that carried out as close as possible the end of their military career.

Frequencies to be Used When Quantifying NIHL:
During medico-legal disputes, one of the most important elements to consider is the average of NIHL for each ear at different frequencies. The authors highlight that it is mandatory to assess the overall magnitude of NIHL at 1, 2, and 4 kHz for each ear. •



OBJECTIVE AND SUBJECTIVE BENEFIT OF DIRECT-TO-CONSUMER HEARING DEVICES IN MIDDLE-AGED ADULTS



Helfer KS., Mamo SK., Clauss M., et al.
American Journal of Audiology (2022): 31(2), 348–58
doi: 10.1044/2022_AJA-21-00171
By Tali Bar-Moshe – Israel

After comparing speech recognition performance, this paper found that speech recognition improved with only two of the four DTCDs tested, whereas participants reported a decrease in listening effort with all four devices.

Technological developments and regulatory initiatives (e.g., OTC legislation) are reshaping the traditional rehabilitation journey. As a direct consequence of these evolutions, a growing number of direct-to-consumer hearing devices (DTCDs) are available on the market, in varying levels of technological and quality ranges. The main purpose of this study was to investigate the objective contribution of DTCDs to speech recognition and reducing listening effort in relation to hearing loss (HL) level. In addition, this study examined participants' subjective impressions from the DTCDs and willingness to use them.

A total of 40 middle-aged adults (MAge=58 years) with bilateral mild HL participated in the study. All reported some level of challenges with their hearing, and none were ready to use hearing aids (HAs). They were randomly assigned to four test groups, each trying one of four DTCDs: Sound World Solutions CS50+; Nuheara IQ Buds; Tweak Focus; and Bose Hearphones. The selected DTCDs were equipped with directional microphones and included some level of noise reduction feature presented from the rear, volume control and/or frequency response fine-tuning capability.

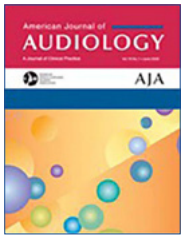
All participants completed a speech perception task (repeating sentences in the presence of different types of maskers, signal-to-noise ratio and target levels) with and without the binaural DTCDs fit to prescriptive targets. They also rated the level of listening effort required to complete that task, both with and without the DTCDs, and completed a questionnaire regarding comfort of use and perceived usefulness.

Speech-recognition precision varied among the various DTCDs, with statistically significant results for only two of the devices. However, all participants reported a decrease in listening effort across all four devices, and over half of them indicated willingness to use the DTCDs in their everyday life. There was no significant correlation between HL level (four-frequency PTA) and either objective or subjective benefits from the DTCDs. •

CRITICAL NOTE:
This study offers a lab-controlled assessment of the use and benefits of direct-to-consumer hearing devices fitted to adults without any professional care and guidance.
The study has several limitations which should be taken into account considering the outcomes and implications.
Hearing rehabilitation outcome, benefits and effectiveness cannot be reduced to the statistical significance of the results of a speech perception test. Rather, it should be examined from a broader perspective, considering personal abilities, lifestyle, expectations and needs, use of communication strategies in different situations and learning skills that are required for proper hearing device use and maintenance.

A SCOPING REVIEW OF TECHNOLOGY AND INFRASTRUCTURE NEEDS

IN THE DELIVERY OF VIRTUAL HEARING AID SERVICES



DiFabio DL., O'Hagan R. & Glista D.
American Journal of Audiology (2022): 31(2),411–26
doi: 10.1044/2022_AJA-21-00247
By Thomas Tedeschi – United States

Based on an extensive review, the authors found that teleaudiology has the potential to increase greater access to care and provide greater flexibility in scheduling services for practitioners and patients alike. More education is needed for the widespread development of teleaudiology services within the broad audiology community.

The World Health Organization's report on World Hearing highlighted the vast prevalence of undiagnosed hearing loss (HL), and the limited worldwide availability of access to quality hearing care services. This, situation was compounded by the effects of the COVID-19 pandemic, and has heightened the need to deliver quality hearing healthcare services.
Due to the pandemic context, telemedicine adoption and virtual technology advanced at a greater pace than most healthcare practitioners expected. The authors of this publication set out to review existing literature and provide a summary of findings on teleaudiology and infrastructure requirements. The authors searched the MEDLINE, CINAHL, Scopus, Nursing and Allied Health, and Web of Science databases, which yielded over 4,264 peer reviewed articles focusing on telemedicine. After successive screening, the authors found 11 articles addressing directly the delivery of hearing aid services. Of these, ten involved adults. One article utilised an asynchronous service delivery method while the other articles utilised a synchronous method of delivery.

Interestingly, the articles noted that the initial HA fitting either took place face to face with the clinician or utilising teleaudiology but with a facilitator present alongside the patient. The barriers to the delivery of teleaudiology services were broken down into seven categories: Access and technology function (equipment, quality of the connection, technical support, etc.); Client sociotechnical (client abilities); Convenience (i.e. lack thereof, as it requires specialised equipment); Education and Training (lack of knowledge, unclear instructions); Interaction and quality (role of the professional); Service delivery (Scheduling); Technology innovation (application and user limitations). In addition, based on their review, the authors outlined ways in which facilitators can play an important role in helping overcome some of those barriers.
The authors stressed that teleaudiology has the potential to promote greater access to care and offer greater flexibility in scheduling services for both practitioners and patients. However, the authors continued, the widespread implementation of teleaudiology services within the audiology community at large will require significant education efforts. •

CRITICAL NOTE:
It would have been very helpful if the authors had developed a checklist that practitioners could follow to plan, develop, implement, and measure an effective teleaudiology programme.
Teleaudiology is still in very early stages. We can only hope that teleaudiology adoption will grow; but we must also ensure that in-person care is not discouraged. As is evidenced in current literature, for hearing related services, patients are likely to still require in-person care to ensure proper diagnosis and fitting.
This article is highly recommended for anyone who is investigating the requirements for implementing teleaudiology services.

SPEECH RECOGNITION IN NOISE PERFORMANCE MEASURED REMOTELY VERSUS IN-LABORATORY FROM OLDER AND YOUNGER LISTENERS

Shen J. & Wu J.

Journal of Speech, Language, and Hearing Research (2022): 65(6), 2391–7

doi: 10.1044/2022_JSLHR-21-00557

By Julin Teo – Italy – Australia

This study investigates speech recognition in noise performance variability among older and younger listeners when tests are conducted remotely versus in-laboratory.

The restrictions brought about by the COVID-19 pandemic accelerated the adoption of Tele-health audiology and created an urgent need for more research on speech perception test performance conducted in remote versus in-laboratory settings.

Several studies in the past found that speech perception results were poorer when performed remotely as compared to in-laboratory; and performance was particularly sensitive to stimuli conditions. Some of the contributing factors for this difference in performance included the lack of ability in controlling test equipment and environment in remote tests, difficulty in verifying remote participants' characteristics such as hearing loss (HL) levels and language backgrounds, and the challenge of monitoring remote participants' attention during the test.

CRITICAL NOTE:
This study provided preliminary findings that speech perception test results for older listeners were not significantly different when tested in-laboratory versus remotely; whereas the younger listeners tested remotely performed significantly worse than in-laboratory.
It is interesting that the computer literacy level of the older listeners tested remotely potentially offset any performance gaps that were found in the younger listeners group.
As highlighted by the authors themselves, one of the limitations of this study is its limited population size, dictated by COVID-19 restrictions. As such, further studies should be carried out with a larger sample size which is more balanced between both test modalities, and include cross studies to investigate the effects of other variables such as headphone quality and attention to task.

Other studies in the healthcare field that examine performance in remote protocols for older adults found that limited technological knowledge, poor Internet access, lack of technical onsite support and the vast prevalence of HL were the main challenges of this test modality.

The main objective of this study was to compare speech recognition in noise performance differences between older and younger listeners when the test is conducted remotely or in-laboratory. The second objective was to investigate the performance differences for these participants and test modalities after taking away the effect of demographic variability and task difficulty measured in terms of signal-noise-ratio.

Participants:
There were four groups of participants, and ratio of normal hearing was matched to be under 10% difference across in-laboratory and remote participants across same age groups:
- 62 younger remote participants (MAge = 28.6 years) with a 98.4% rate of normal hearing (NH)
- 16 younger in-laboratory participants (MAge = 19.7 years) with a 93.8% rate of NH
- 32 older remote participants (MAge = 68.8 years) with a 100% rate of NH
- 10 older in-laboratory participants (MAge =69.4 years), with a 90% rate of NH

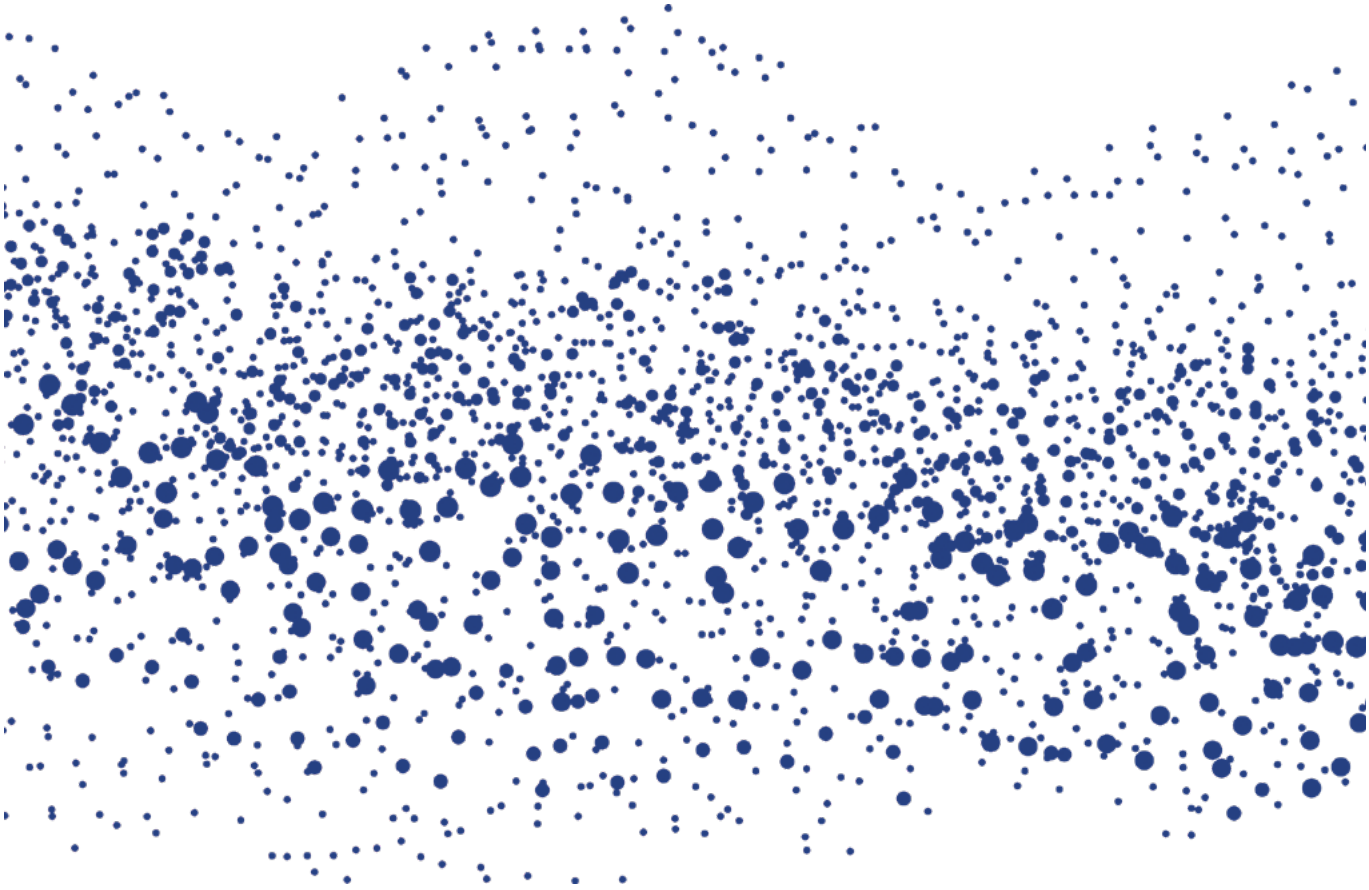
Materials:
A total of 72 sentences from the Diapix task were divided into four lists and presented in four different Signal-to-Noise-Ratio (SNR) conditions: -4dB; -2dB; 0dB; and 2dB SNR.

Procedures:
This is a self-administered transcription task where participants listened to a sentence and typed out what they heard in a textbox before moving on to the next sentence. All responses were checked to remove typographical errors before they were scored on the number of keywords recognised correctly.

This study found that younger listeners performed significantly better when tested in-laboratory than remotely, while there was no significant performance gaps between in-laboratory or remotely for older listeners. The results remained unchanged after controlling demographic variables such as age, gender, and education. The level of task difficulty due to SNR conditions did not significantly impact performance between the two test modalities.

The authors suggest that the insignificant difference in performance gaps between in-laboratory and remote outcomes in older listeners could be a result of the latter group being more technologically savvy than the former group, therefore counter-balancing any potential effects on performance gaps between the two test modalities. It was also proposed that computer literacy should be controlled for remote tests involving older listeners.

Restrictions due to the pandemic limited the number of participants for the in-laboratory test mode. The preliminary findings of this study could serve as a foundation for further research with larger and better matched sample sizes among the different test groups. A crossover study could also provide further information on the contributing factors of performance differences between the two test modalities. Lastly, a test-retest reliability evaluation on both conditions could also be included. •



IDENTIFYING THE FACTORS THAT AFFECT CONSISTENT HEARING AID USE IN YOUNG CHILDREN WITH EARLY IDENTIFIED HEARING LOSS: A SCOPING REVIEW

Nailand L., Munro N. & Purcell A.
Ear and Hearing (2022): 43(3), 733–40
doi: 10.1097/AUD.0000000000001139

By Pierre Devos - France

This review highlights the need for family support and education in order to foster consistent hearing aid use in children. This support should take into account the family's emotional, socio-economic and cultural characteristics and the child's degree of hearing loss in order to offer tailored programs.

In 2019, the Joint Committee of Infant Hearing (JCIH) updated its recommendations concerning early fitting of hearing aids (HA) and global intervention. The original 1-3-6 guideline (JCIH 2007) targeted screening by one month, diagnosis of HL by three months and intervention by six months. The newly-revised guidelines advocate a 1-2-3-month timeline. Precocity is a major factor in limiting language acquisition delays in school age children, as it makes it possible to take advantage of such a critical period of a child's development thanks to their neuronal plasticity. However, in order for this to be successful, certain conditions need to be met, namely: the quality of auditory inputs and an immediate and consistent use of HAs, i.e. from 8 to 10 hours/day (or min 75% of the day) on average, as identified in existing literature. In order to achieve this, good HA use habits must be established as early on as possible, influencing factors must be clearly understood by users and their families, as do the main barriers in order to overcome them.

The authors relied on a combination of human and algorithmic selection of publications between 2009 and 2019. This initially yielded 1,857 articles, 25 of which met all the inclusion criteria, including the age limit of six years, i.e. the limit under which children "are unable to advocate for themselves in establishing consistent hearing-aid use habits". Based on the literature, the authors identified the main factors which affect consistent HA use in children, which they sorted into four overarching themes, each of which was subsequently divided into subthemes, labelled either as "fixed" (i.e. which cannot be changed by providers intervention) or "malleable" (amenable to change).

CRITICAL NOTE:
This review extracted poorly quantified or numerical scaled data from literature and is mostly based upon the authors' personal interpretation. Additionally, the inclusion criteria were limited to children under six years of age, thereby excluding other potential relevant data.
However this article does shed light on the principal factors contributing to consistent hearing aid use and those on which professionals can have an impact (malleable factors versus fixed ones), whether centred on children, parents or professionals.
Very interesting to read on how, beyond hearing aid fittings, we can positively impact future language outcomes of early identified hearing impaired children.

The results:
This classification into fixed or malleable factors serves as a guide for professionals for focusing on parameters they can positively influence.

Global theme 1 (i.e. "Each child is an individual") seems to be the most fixed theme. This means that professionals must navigate the individual and immutable characteristics of a particular child in order to offer tailored and personalised family guidance and support, to enlist the child's parents in their audiological intervention, to adapt material solutions and to define intervention strategies that may facilitate and improve HA use.

Global theme 2 (i.e. "Parents are key") is affected by the family's socio-economic reality. Maternal education level was considered to be a fixed factor, and appears to be linked to poorer HA use. Notwithstanding, parents

remain key players in promoting consistent HA use in young children. Each parent is unique and characterised by their own emotion and beliefs. Professionals must understand this and learn to navigate them in order to find the best way to share information.

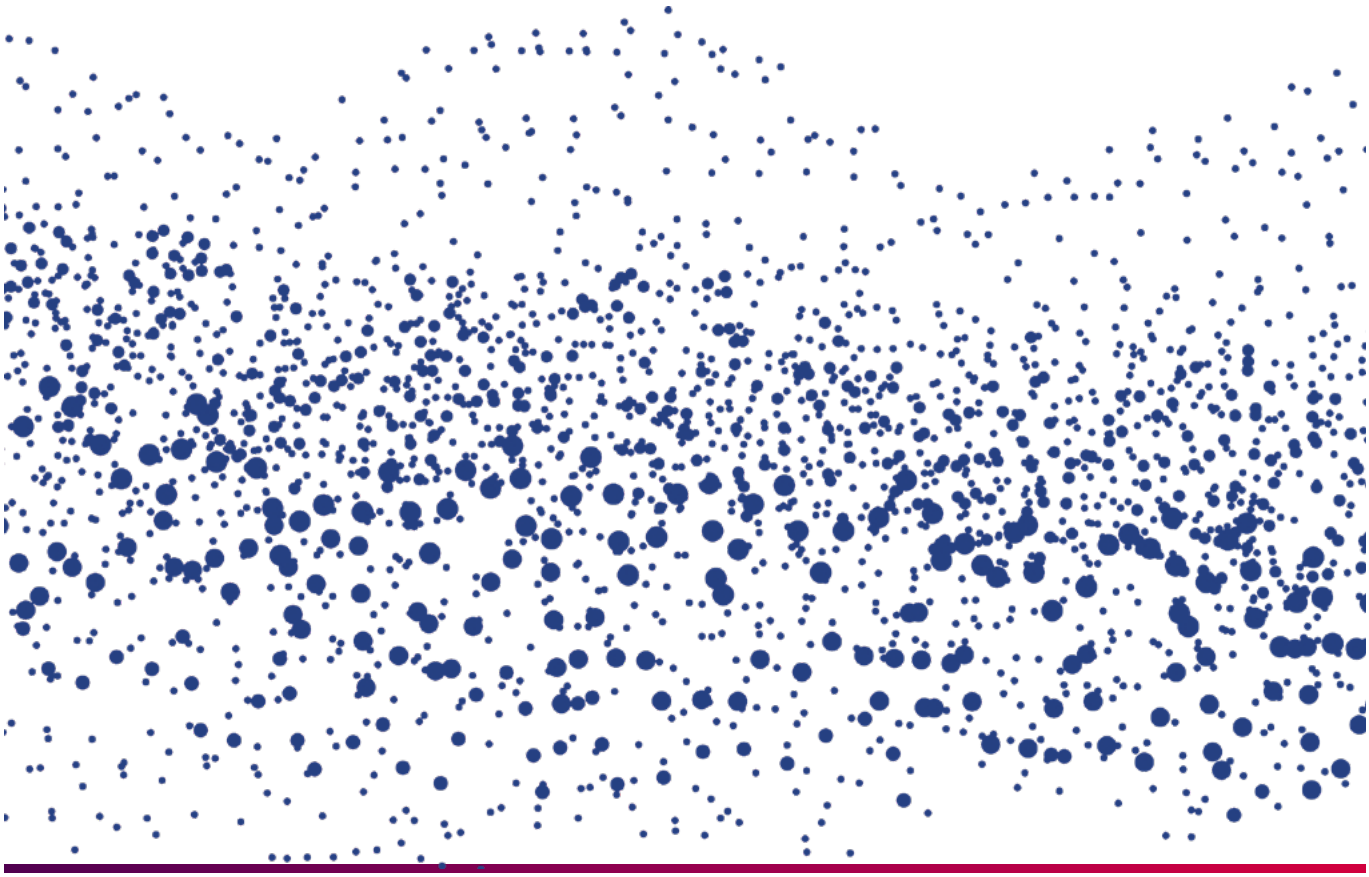
Global theme 3 ("Parents' support") is characterised by comprising only malleable factors. Many aspects of HA use require parents' support, from maintenance to environment-related listening strategies. The information facilitated to parents must be adapted to their specific needs, in terms of language, cultural sensitivity, reading capacity, etc. including the intervention of trained interpreters to minimise language barriers, (e.g. translated) audiovisual tools to ensure appropriate guidelines are understood by all, or parent-to-parent support, the latter being identified as an essential component for parents who are newly confronted with HL.

Global Theme 4 focuses on the role of audiology professionals and the impact they can have. The key element as identified by the authors is collaborative work and "one voice" counselling across all provider services. Professionals need to adapt their services to the specific circumstances and preferences of parents. In fact, a previous survey (2016) indicated that 50% of audiology professionals needed training in counselling in order to improve their counselling skills.

Of particular note, the authors highlight that the feedback given to families regarding real hearing-aid time of use (data logging) is described as having two possible consequences: it can either improve time use or lead to parents become defensive. Another common observation concerns the mismatch between parents' report and the actual data logged information about time of HA use. Parents often overestimate time use duration, and this is why professionals are the ones who ought to deliver this information, supported by achievable and progressive goals.

Conclusions

Both fixed and malleable factors have been found to influence HA use consistency. Although fixed factors cannot be changed per se, they ought to be seen as "red flags" for identifying children who are at risk of suboptimal HA use, and for implementing an appropriate family support programme. Because parents are key players in HA use habits, reshaping educational programmes to the specific needs of each family should be based on malleable factors. This can go a long way towards ensuring consistent HA use in early identified hearing-impaired children, ultimately resulting in better language outcomes at age six, by minimising the delay as compared to typical hearing peers. •



ACCEPTABLE NOISE LEVELS AND PREFERRED SIGNAL-TO-NOISE RATIOS

FOR SPEECH AND MUSIC

Lee D., Lewis JD., Johnstone PM., et al.
Ear and Hearing (2022): 43(3),1013–22
doi: 10.1097/AUD.0000000000001157

By Frederic Debruycker – Belgium

The results highlight the likely influence of the target signal on the ANL results. In addition, the lack of relationship between ANL and PSNR (Preferred Signal-to-noise Ratios) confirms that the mechanisms involved in these two processes are different.

Acceptable Noise Level (ANL) measurement is a well-known indicator for quantifying the smallest signal to noise ratio (SNR) an individual can tolerate.
Traditionally, the ANL test uses a speech signal as target and a noise as competing signal. Different studies show slight differences in ANL results depending on the noise signal used (e.g. speech spectrum noise, multi-talker, traffic, noise babble, etc.). Music has also been used as a competing signal for speech instead of the background noise, and showed a lower tolerance compared to babble noise.
No studies had previously used music signal as a target for ANL measurement.The goal of this study is to compare speech and music as a target signal so as to observe whether the same mechanism is used, regardless of the signal on which subjects are to focus.

This study included 99 normal-hearing participants and used three target signals: speech; music with lyrics; and music without lyrics. The competing signal was a 12-talker babble.

CRITICAL NOTE:
The three target signals cover slightly different spectra, as highlighted by the authors, and this could have an impact on the measure of HL on the ANL results.
The authors suggest that the type of music (rhythm, spectrum, acquaintance of the listener with the music) may have an impact on the results
Since ANL for music is predictive of ANL for speech, this could lead to the development of a non-speech ANL test, which could be used globally, provided the instructions are translated.

Results showed a strongly significant difference between both target signals. ANL is the highest (lower tolerance) for speech, followed by music with lyrics. Music without lyrics shows the lowest ANL score.
Based on these results it would seem that the presence of speech is a significant factor which influences ANL. Further, there is a high correlation (*p < 0,001 / r > 0,80), between the results for the different targets. Therefore, ANL for music is predictive for ANL for speech.

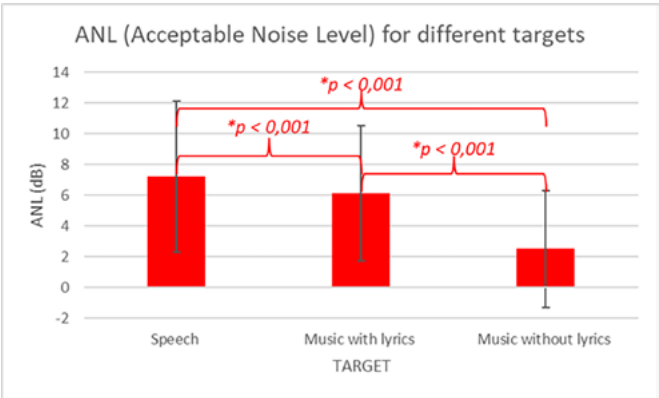


Fig 1. *ANL results for three different target stimuli. Significant differences exist between each signal.*

The second objective of this study was to determine listeners' Preferred Signal-to-Noise Ratio (PSNR) depending on the target signal.
In contrast to the ANL, where the listener can control the background noise, the PSNR uses a fixed level of noise. The listener has to determine their preferred level for each of the three targets while a constant background noise of 75 dB is present. On average, music with lyrics showed a higher PSNR, followed by speech signal. Music without lyrics was preferred at a slightly lower level. Even if the level differences are limited, they are significant.

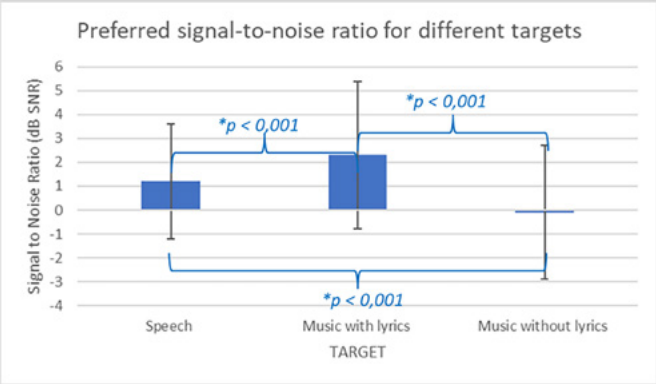


Fig 2. *PSNR results for three different target stimuli. Significant difference exists between each signal.*

Lastly, as a third objective, the authors set out to compare the results of both measurements, and to observe the relation, if at all, between ANL and PSNR. The authors found no correlation between ANL and PSNR. This means that a higher ANL, which is a sign of a need for greater contrast between the signal and noise, does not mean that the same person would chose a higher SNR by selecting a louder signal level.

The results highlight the likely influence of the speech signal on the ANL results. On the other hand, the lack of relationship between ANL and PSNR confirms that the mechanisms involved in these two processes are indeed different. •

DESCRIPTIONS OF HEARING AIDS INFLUENCE THE EXPERIENCE

OF LISTENING TO HEARING AIDS

Rakita L., Goy H. & Singh G.

Ear and Hearing (2022): 43(3), 785–93

doi: 10.1097/AUD.0000000000001130

By Angela Ryall – Canada

This study explores the influence of different narratives (positive, neutral, and negative) of hearing aids on patient outcomes, specifically their performance on a speech in noise task and amplification satisfaction. In addition, the authors investigated the extent to which patient personality plays a role in the impact of such narratives

This study explored the influence of different narratives (positive, neutral, and negative) of hearing aids (HA) on patient outcomes, specifically their performance on a speech in noise (SIN) task and amplification satisfaction. The authors also investigated whether the personality of patients makes them more susceptible to influence.

The population was made up of 19 adults (54-81 years old), who were all English native speakers, who had less than six months' experience with HAs and had symmetrical sensorineural hearing loss (within the fitting range of a Phonak Audeo Marvel 90-312 RIC HA) with a pure-tone average of 40 dB HL.

Participants completed three one-hour appointments, each separated by one month. On the first session, participants completed a personality questionnaire (Big Five Inventory) and the Expected Consequences of Hearing Aid Ownership (ECHO) questionnaire. Each of these sessions relied exclusively on one narrative style (positive, negative, or neutral) and condition order varied from one participant to another. Participants were blind to which narrative condition the session was. Participants were told each session focused on describing a different pairs of HAs. However, it was the same device at each session, with the exact same configuration. The participants wore the HAs throughout the whole appointment, while the researcher discussed

CRITICAL NOTE:

This article demonstrates the key role clinicians have in shaping patients' first impressions when introducing amplification. Of course, some patients may have preconceived ideas from the media or their friends and family, but the authors' findings highlight that the perspective from the clinician and their overall description of the HAs can influence client performance. These results show that when hearing care professionals speak positively about HAs and their exact features/benefits, patients may experience greater satisfaction and become more motivated to use/wear them. The findings show that if clinicians do discuss specific features and HAs during HA evaluation appointments, it will have a positive effect on patients' experience. The researchers acknowledge the small sample size and short-term effects. It would be interesting to assess the long-term effects, for instance, over one to six months or longer, to see whether satisfaction and SIN performance is consistent.

This article also provides some information about how personality type can be easily motivated by the descriptions as well. In the initial case history with new patients, clinics can incorporate a few questions to assess personality in order to effectively manage the appointment and identify which particular HA features they should focus on.

the various features of the HAs either in a positive, negative, or neutral narrative. The HAs were set to Phonak's proprietary prescriptive settings based on each participant's HL, and settings were the same across all three sessions.

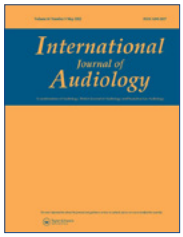
Each narrative took approximately five minutes, and the researcher used the same PowerPoint template for all three conditions, each using slightly different information based on the applicable condition. The positive condition focused on fast acclimatisation to the HAs, clear sound quality, and improved hearing when in background noise. The negative condition focused on all HAs requiring an adjustment period, a possible unnatural sound, and limitations when in background noise. Lastly, the neutral condition described how the HAs are programmed, the specific parts of the HAs, and no exact features mentioned. The participants then continued to wear the HAs while completing a subjective listening assessment and a SIN task (QuickSIN). The subjective listening assessment included: a passage read out aloud by the researcher, another by the participant, and then listening to audio clips from the Phonak Target Media files. Afterwards, participants completed an 11-item questionnaire about their hearing experiences. For the QuickSIN, participants completed one practice list and two test lists at each session and the final score was calculated with the two test list average. No list was repeated across all three sessions. The HAs were returned at the end of each appointment. The true purpose of the study was explained at the debriefing during the last session.

The results did highlight that the narratives did influence participants' performance. When participants were presented with the positive narrative condition, they reported needing significantly less time to get used to the HAs and had better QuickSIN performance (2.5 dB improvement) than when presented with the negative narrative. Researchers suggest that in the positive narrative, the features were presented as enhancing speech understanding in background noise, which might have helped with performance as participants might have felt more motivated with the task. The researchers did note that some participants might have been easy or harder to sway due to their previous expectations and personality style. Participants who were reported to be more agreeable were more likely to change their responses to the questionnaire regarding their HA experience from one condition to another. The study found no relation with personality style with the subjective listening task or QuickSIN performance.

These results do indicate the important role that hearing health care professionals have when introducing HA technology to new and/or potential users. If there is a way to incorporate analysing patients' personality style, this may equip clinicians with more insight into to how to approach the delivery of new information (i.e., how they describe HAs).

The authors underlined the limitations of the study: the data was collected in a research facility rather than a clinical setting; possible short-term effects with the narrative condition as everything was assessed in the same session; small sample size; no condition blinding of the researcher when describing the HAs; and all participants already had some experience (under six months). •

TRENDS IN COSI RESPONSES ASSOCIATED WITH AGE AND DEGREE OF HEARING LOSS



Windle R.

International Journal of Audiology (2022): 61(5), 416–27

doi: 10.1080/14992027.2021.1937347

By Cathérine Boiteux – France

The authors investigate the relationship between hearing difficulties and perceived benefit with hearing aids across age, gender, hearing loss and asymmetry of hearing variables.

The Client Oriented Scale of Improvement (COSI) measures up to five situations in which patients wish to see improvement in their everyday life regarding their hearing. Once fitted, patients can assess the improvement for these situations.

The objective of the study is to answer three questions:
Q1: Are problematic situations correlated with age, gender, degree of deafness and asymmetry of hearing?
Q2: What are the differences among patient groups in terms of benefit?
Q3: Are there differences in benefits depending on the hearing situation?

The study was conducted in a medical department in England. Researchers collected age, gender, average pure tonal audiometry (PTA) for frequencies 500, 1000, 2000 and 4000 Hz per ear, and the duration of hearing aid use.

The COSI part 1 focuses on the collection of hearing problems. The patients formulated the items freely, which the researchers classified according to the 16 categories suggested by Dillon, *et al.* in their 1999 publication.
The COSI part 2 is designed for patients who have experience with hearing devices, focusing on two items: benefit and listening ability.

The population was made up of 995 patients in a normal audiology follow-up setting over a period of two months. All patients were over 55 years old, without complex deafness.

The COSI part 1 was completed by 86% of patients. The remaining 14% did not fill in this question because they reported that they had no hearing problems, or that this question was not applicable to their condition. A total of 32% of the respondents gave one single item; 32% provided two items; 24% gave three items; 8% listed four items and 3% reported five items.
The most cited complaint (46%) was issues with understanding the TV. In the categories, no difference was found between males and females, no correlation was established with hearing asymmetry, nor the level of experience wearing HAs. However, there is a definitive correlation between age and level of hearing loss (HL).

COSI part 2 was completed by 34% of the participants. The survey found no correlation between satisfaction

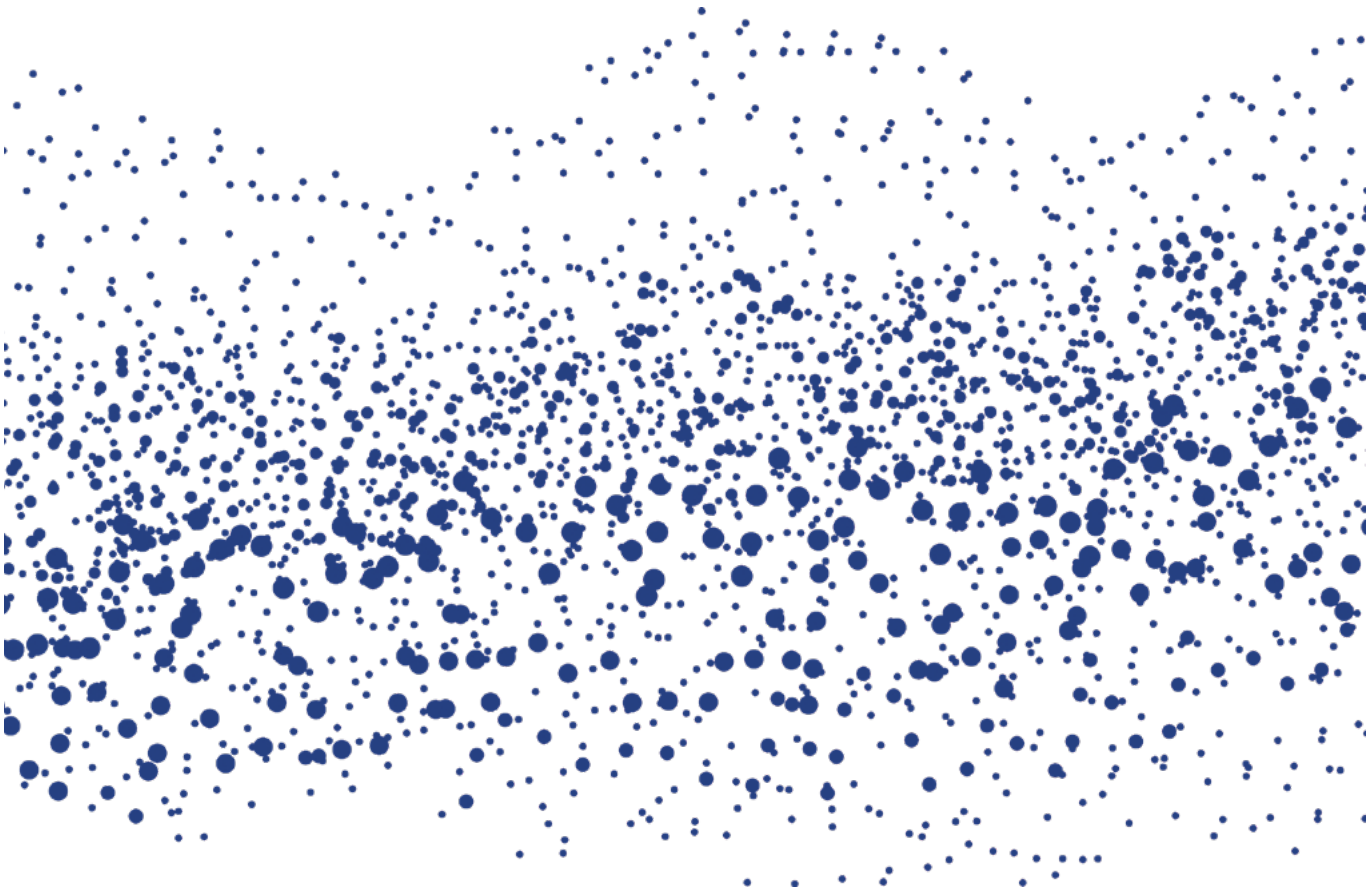
CRITICAL NOTE:

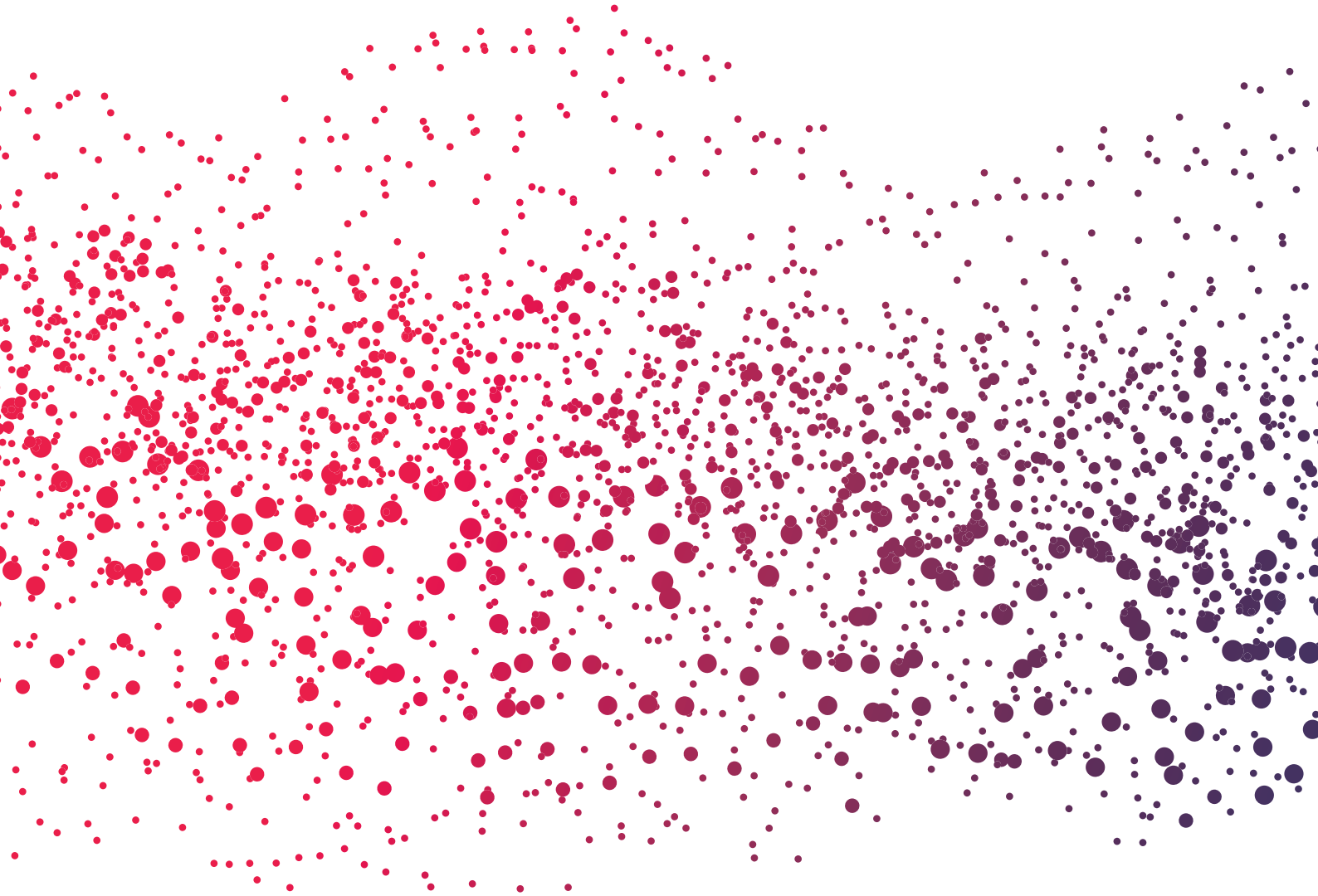
This study highlights the increase in needs of patients regarding television viewing as a function of age. This shows that it is an important activity for maintaining their quality of life.
The main complaint of patients followed by hearing care professionals is understanding in a noisy environment. This would indicate that patients' motivation for having the device is likely to impact the benefit.
It is somewhat surprising that the authors define part 1 of the COSI as "the collection of hearing problems", while in the original publication by Dillon et al. 1999, it states that COSI part 1 is about "identifying the specific listening situations in which each subject wished to be able to hear better". Such a wording might have influenced the outcome of this study.*

** Dillon H. Birtles G. & Lovegrove R. Measuring the Outcomes of a National Rehabilitation Program: Normative Data for the Client Oriented Scale of Improvement (COSI) and the Hearing Aid User's Questionnaire (HAUQ). J Am Acad Audiol 10 : 67-79 (1999)*

and the parameters collected. No specific improvement was found depending on the hearing situation.
When compared with previous studies, the results suggest that the distribution of HL matches that published in the Dillon, *et al.* study. However, the average age of the population is seven years younger.

The evolution of the results of the study is consistent with the evolution of technology: television, radio, etc. The evolution in benefit and HA skills varies slightly from one study to another. This depends on the patient recruitment criteria and does not make it possible to assess a difference in actual benefit. •





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