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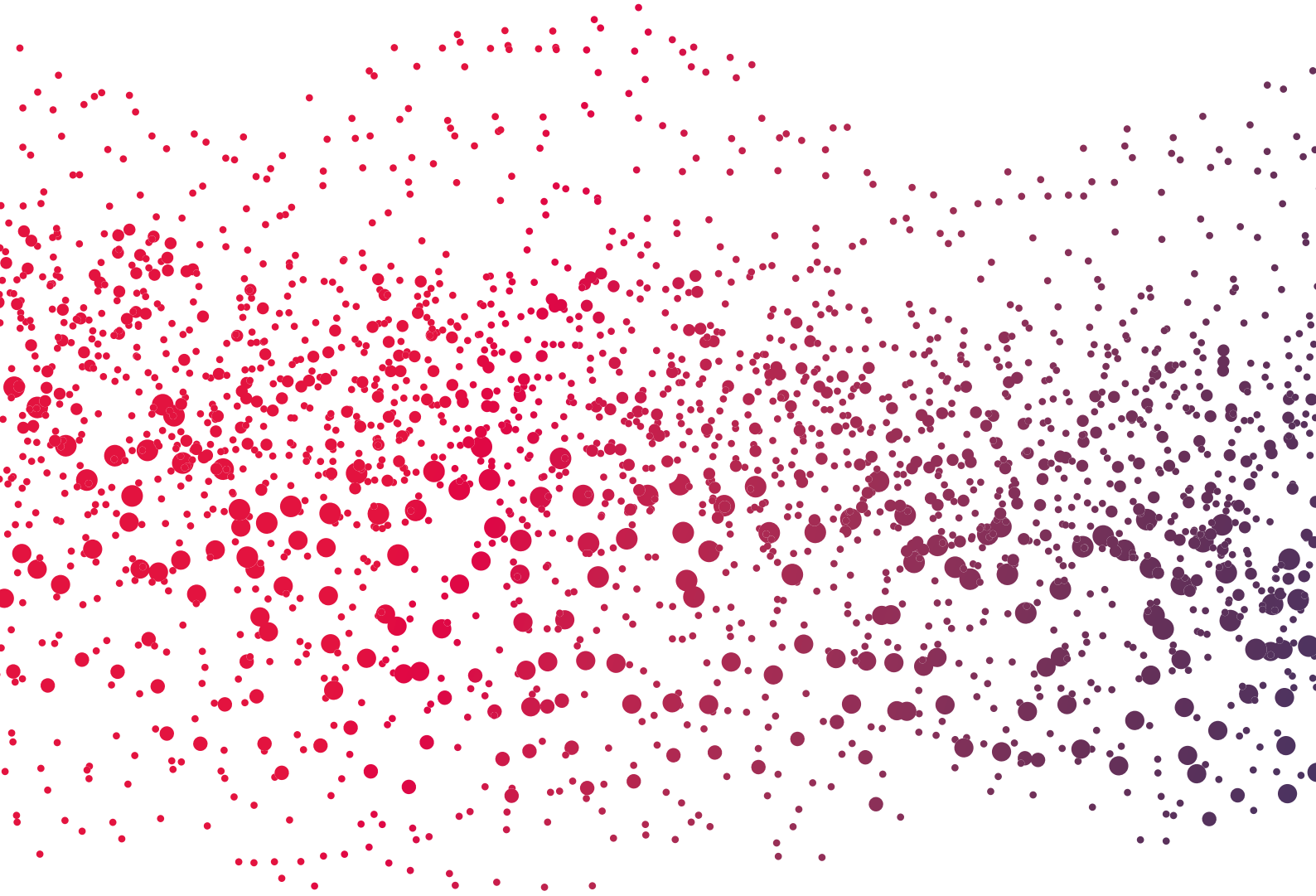
Otology & Audiology Article Review



JULY 2013

Amplifon Centre for Research & Studies: Audiology Review – July 2013

- Working Memory, Age, and Hearing Loss: Susceptibility to Hearing Aid Distortion.- Arehart, Ket al.

  *When listeners with **hearing loss** are **older** and have **poor working memory** they will be much more **bothered by distortions** caused by specific **hearing aid signal-processing** systems and by noise. This study suggests **avoiding frequency compression for subjects with poor working memory capacity**.*

- Placebo effects in hearing-aid trials are reliable – Piers Dawes, et al.

  *This study examines the influence of placebo effects in hearing-aid trials. Do expectations of hearing aid users have a significant impact on perceived and measured aided performance? **When using identical hearing aids**, the "**so-called new hearing aids**" are **preferred** and even show **better results in a speech in noise test**.*

- A dynamic auditory-cognitive system supports speech-in-noise perception in older adults - Samira Anderson, et al.

  *An evaluation of the interacting contributions of peripheral hearing, central processing, cognitive ability and life experiences to understanding speech in noise by older adults.The study demonstrates **the limitations of the audiogram in predicting speech-in-noise performance especially with older adults** and emphasises **the importance of focusing more on cognitive function, lifestyle and central auditory processing**.*

- Will My Patient Benefit from Audiologic Rehabilitation? The Role of Individual Differences in Outcomes - HarveyAbrams, et al.

  An exploration of the current literature on auditory training and counselling-based audiological rehabilitation in the context of individual variability and the individual factors that are likely to influence post-intervention performance.

- Why do people fitted with hearing aids not wear them? – Abby McCormack, Heather Fortnum

  *In this scoping study the aim was to go through the great **amount & diversity of literature written about the subject of why people with hearing aids don't wear them**. The main objective was to find out what kind of information was missing and where innovative research possibilities could be found.*

- Estimation of bone conduction skull transmission by hearing thresholds and ear-canal sound pressure – Sabine Reinfeldt, et al.

  *The author's aim was to estimate sound transmission through human skull using two methods: subjective hearing thresholds and probe tube measurements in the bony part of the outer ear canal. **Ipsilateral bone conduction stimulation is the most effective** and **occluded bone conduction audiometry should be avoided**.*

- Self Reported Hearing Loss in Baby Boomers from the Busselton Healthy Ageing Study – Audiometric Correspondence and Predictive Value – De Wet Swanepoel, et al.

  *Population-based study (n=947) to determine the correspondence between **self-reported hearing loss** and the **prevalence of hearing loss** for the "**Baby-Boomer" population** (born 1946 to 1964).*

- Nonlinear Frequency Compression: Effects on Sound Quality Ratings of Speech and Music – Vijay Parsa, et al.

  *This article includes 2 studies on the evaluation of the **effects of Nonlinear Frequency Compression** with different compression ratio and compression frequencies **regarding sound quality** in normal hearing and hearing impaired adults and children.*

Working Memory, Age, and Hearing Loss: Susceptibility to Hearing Aid Distortion.

Kathryn Arehart et al.

Ear & Hearing 34(3):251-260, May/June 2013.

Gatehouse has already demonstrated a ***relation between cognitive abilities and signal processing*** *used in hearing aids. Subjects with "poor" cognition showed better performance with slow compression, while subjects with "good" cognition showed better performance with fast compression.*

In this study the relation between ***working memory capacity*** *and the distortion created by signal processing is evaluated.*

26 patients (62 – 92 year) with a hearing loss were divided in two groups: high and low working memory capacity. Each patient had to repeat 600 sentences. These were presented in quiet or in noise. One processing condition had the original (female talker) signal and the other 9 had a signal distortion due to frequency compression and cut-off.

The ***intelligibility scores*** *for patients with* ***high working memory capacity*** *were* ***higher*** *because they were* ***less affected by the distortion*** *of the signal. -* ***29 % of the variability in intelligibility scores is explained by working memory capacity****, 11% is explained by age and 7% is explained by hearing loss at 4000 Hz.*

Important when adjusting hearing aids for end-users with ***poor working memory capacity*** *is to* ***avoid frequency compression*** *because this could lead to more distortions and thus to less intelligibility.*

Overall this is a very interesting study demonstrating that the ***selection of signal processing should also take cognitive aspects into account****. A weakness of this study is that the frequency compression is used on subjects that may not even theoretically benefit from this kind of processing at all. Another weakness is that only high and low working memory capacity is considered, what about average working memory capacity?*

Placebo effects in hearing-aid trials are reliable

Piers Dawes, et al

International Journal of Audiology Jul 2013, Vol. 52, No. 7: 472–477

16 experienced unilateral hearing aid-users were selected in this study. Each person tested ***two identical hearing aids that were identically fitted****. Participants were told that they had to '****evaluate new hearing aid technology****'. They had to* ***compare*** *a '****new****' hearing aid* ***to*** *a '****conventional****' hearing aid. A speech in noise test (FAAF), sound quality rating test and personal preference questionnaire was used to evaluate hearing aid outcome. Results indicate that* ***speech in noise performance was significantly better for the 'new' hearing aid****. Sound quality ratings also scored significantly higher than the 'conventional' hearing aid.* ***75 % preferred the 'new' hearing aid****. This study shows similar results as previous studies (Dawes et al. 2011).*

Participant expectation *appears to have a* ***significant effect on performance****.* ***Hearing-aid studies*** *should include controls for placebo effects. Given the current state of knowledge, the* ***best solution is a double-blind design*** *in which neither participants nor experimenters are aware of the identity of the control or experimental condition. Hearing-aid trials that don't include this design should be carefully interpreted. Placebo effects could also be utilised in clinical audiological settings to increase patient benefit but this is a matter for further research.*

Very interesting study. The ***results should be taken with some caution****; except for overall preference ,although the* ***differences*** *may be significant, they are* ***very small.*** *Only 3% performance difference in intelligibility on a speech in noise test is not impressive. The same goes for the quality rating, the difference is not even 1/10 on the rating. In further studies researchers could involve more participants to increase reliability. How is the professional advice of an audiologist impacting the perceived and measured results in a clinical situation?*

A dynamic auditory-cognitive system supports speech-in-noise perception in older adults

Samira Anderson, et al.

Hearing Research. 300:18-32, June 2013

With ageing and deterioration in peripheral auditory functions, ***the ability to understand speech in adverse listening conditions*** *often becomes more difficult but is* ***highly variable amongst individuals****. To understand this variability,* ***120 adults****, aged between 55 and 79 years, were evaluated according to their* ***hearing status****,* ***cognitive skills*** *and* ***central processing functions****. Certain* ***life experiences*** *were also included such as physical activity, intellectual engagement and musical training. The participants in this study had a history of neurological conditions or hearing aid use. Previous studies have mostly researched separately the various aspects of the decline in speech-in-noise perception with ageing rather than, as with this article,* ***how the various contributing factors dynamically interact including life experiences****.*

Based on the outcomes of three approaches and models, ***cognition and central processing predict a significant proportion of the variance in speech-in-noise performance****. For those with musical training at any time in their lives, cognition plays a more important role. While life experiences play a bigger role for the group with no musical training, by controlling for socio-economic status, the role of cognition in the no-musical training group is revealed.*

The strong role of cognitive function is supported and a ***relationship between auditory working memory and speech-in-noise perception in older adults is confirmed****. Hearing as assessed by* ***pure tone audiometry and DPOAEs did not make a significant contribution to the variance in speech-in-noise perception****. This confirms that the audiogram is a poor predictor of speech-in-noise performance. This challenges developers of hearing aid algorithms to consider more how central processing responds to different amplification algorithms. There is also support for existing evidence that training can improve central processing and cognition in older adults.*

An interesting and well conducted study which adds further weight to existing evidence about the ***limitations of the audiogram in predicting speech-in-noise performance especially with older adults****. It emphasises the* ***importance of focusing more on cognitive function, lifestyle and central auditory processing*** *when* ***managing*** *the problem of* ***difficulty in understanding speech in noise****.*

Will My Patient Benefit from Audiologic Rehabilitation? The Role of Individual Differences in Outcomes

Abrams, H. et al

Seminars in Hearing. 34:128-140, May 2013.

As part of post-fitting audiological rehabilitation, in spite of growing evidence, ***auditory training and counselling-based group rehabilitation are not commonly implemented****. Although research confirms that the provision of audiological rehabilitation improves outcomes, audiology professionals find it* ***difficult to determine which rehabilitative intervention will benefit individual patients****.*

In spite of significant advances in signal processing technologies in recent decades, hearing aid use alone is inadequate and requires rehabilitation support to optimise outcomes from the fitting of hearing aids. However, the outcomes from rehabilitation interventions such as auditory training and educational counselling in group sessions remain variable. This article tries to explain the possible causes of such variability and to suggest strategies to improve outcomes.

A substantial part of this article is devoted to an appraisal of systematic reviews and meta-analyses of the efficacy of auditory training in adults and counselling-based, group audiological rehabilitation undertaken by Chisolm and Arnold. In both of these rehabilitative approaches the conclusion was very similar, namely that there was a ***need for examining individual needs in order to determine the optimal intervention approach****.*

Several themes emerge which identify the potential influences of individual differences on outcomes:

- *Baseline performance: The poorer the baseline performance, the more likely that improvement will occur. This seems to be the most consistent indicator of post-fitting training performance.*
- *Age: The least consistent factor was found to be age but some studies which were reviewed found an association based on motivation levels and age with older participants completing training sooner than younger participants.*
- *Degree of hearing loss: Severity of hearing loss did not appear to be a factor in predicting post-fitting training performance.*
- *Other variables: Post-fitting rehabilitative interventions may be influenced by such factors as motivation, willingness to guess, verbal intelligence and involvement of significant others.*

There is an admission that, other than baseline performance, there are no specific demographic or audiometric measures that are particularly predictive. However there is a proposal for a progressively intensive approach to audiological rehabilitation. Progressive Audiologic Rehabilitation (PAR), assessing individual goals and matching these to intervention options, is said to be a realistic approach but further research is needed to assess its effectiveness.

Overall, a disappointing article in terms of its conclusions but interesting for its summary of the work undertaken by Chisolm and Arnold

Why do people fitted with hearing aids not wear them?

Abby McCormack, Heather Fortnum

International Journal of Audiology May 2013, Vol. 52, No. 5: 360–368.

In this scoping study the aim was to go through the ***great amount & diversity of literature written about the subject of why people with hearing aids don't wear them****. The main objective was to find out what kind of information was missing and where new innovative research possibilities could be found.*

Based on 10 articles, they made a listing of the reasons reported by hearing aid users.
Due to the different objectives of the studies, the number, ages and gender of participants per study and the different ways in which the participants could answer (open or closed questions), the list is very long with not that much of statistical evidence. ***They successfully grouped the different reasons into categories****.*

They were honest about the limitations of this study, since it was rather an exploratory study. But then again, some valuable suggestions were given for future research on this subject, based on their findings.

Hearing aid value/speech clarity
- Noisy situations/background noise 5 (52%; 46.9%; 28%; 25.3%; 22%)
- Does not help/poor benefi t 7 (30%; 29.6%; 23.4%; 17%; 15.6%)
- Poor sound quality 2 (12.7%; 6.3%)
- Not suitable for type of hearing loss 1 (5.5%)

Fit and comfort of the hearing aid
- Need help putting HA in 5 (42%; 28.1%; 8.5%; 2.8%; 1.4%)
- Need help taking HA off 1 (13%)
- Uncomfortable 8 (28.1%; 28%; 21%; 18.7%; 15.4%; 8.9%; 8.5%; 5.1%)
- Side effects (rashes, itching) 3 (18.5%; 10.9%; unknown)

Care and maintenance of hearing aid
- Need help changing batteries 3 (62%; 6.8%; 4.1%)
- Handling problems/ manual dexterity 5 (30.8%; 21%; 9.4%; 0.6%; unknown
- Volume control adjustment 2 (6.8%; 4.9%)

Attitude
- No need/hear well enough without HA 4 (42%; 23.7%; 23.1%; 8%)

Device factors
- Not working properly/broken 4 (36%; 17%; 7.8%; 1.4%)
- Disappointed with HA 1 (30.8%)
- Feedback/whistling 5 (9.4%; 8.4%; 6.8%; 4.3%; unknown)
- Device requires service 1 (6%)
- Battery life too short 1 (2%)
- Makes voice sound funny 1 (1.7%)
- Poor directivity 1 (0.3%)

Situational factors
- No opportunity/lack of situations necessary for HA 1 (62.5%)
- Only used for specifi c situations 1 (11.6%)
- Only works in limited situations 1 (2.6%)
- Does not work on the phone 1 (1.1%)
- Rare social user 1 (0.6%)

Financial factors
- Cost of repairs 2 (10.3%; 3%)
- Cost of batteries 3 (1.7%; 1.4%; 0.4%)

Psycho-social factors
- Nuisance/hassle 2 (5.1%; 4%)
- Forget to use it 1 (1.1%)
- Lost it 2 (0.4%; 0.3%)

Health care professionals
- Poor service from dispenser 1 (3.2%)
- Oversold expectations 1 (0.9%)

Appearance
- Stigma of wearing HA 1 (2.9%)
- Do not like the appearance 1 (1.7%)
- Cosmetic concerns 1 (unknown)

Infection/ear problems
- Have tinnitus 1 (0.9%)
- Cannot use due to external otitis 1 (0.4%)
- Ear wax problem 1 (0.3%)

Recommendations
- Family pressure to get HA 1 (0.9%)

Table 1: Overview of the reasons why hearing aids are not used in 10 different studies. First you see the category (in bold) then the subtopic with the 30% of the impact for non-use in each study. The left pane shows arguments that are used a lot and the right pane shows arguments that seem have much less impact on the use of hearing aids.

Interesting article, ***it could have been of more value if the different articles had been reviewed separately****. Or if they could* ***at least have given more detailed information on which type of hearing aid the users in the studies were fitted with****.*

Estimation of bone conduction skull transmission by hearing thresholds and ear-canal sound pressure

Sabine Reinfeldt, et al.

Hearing Research. 299, 19-28, May 2013

The author's aim was to estimate sound transmission through human skull (in other words the bone conduction sound transmission to the cochlea) using two methods: subjective hearing thresholds (audiometry) and probe tube measurements in the bony part of the outer ear canal. They consider that:

- *Sound perception sensation relates to cochlear vibration*
- *The bony part of outer ear canal lies in the same bony structure as the cochlea*
- *A probe tube placed at the tympanic membrane is disposed to measure the energy delivered by bone vibration conduction which is related to cochlear vibrations*
- *A vibrating cochlea elicits a subjective perception sensation*

3 vibration stimulation sites were tested: ipsilateral, contralateral and forehead. Conduction was calculated by subtracting contra/forehead response to ipsilateral levels.

All measurements were done in both open and closed outer ear canals. It was observed that ***occlusion effect influenced a large part of the results*** *and as a consequence* ***occluded ear canal measurement can't be a way to estimate bone conduction transmission through the skull.***

Open ear canal probe tube measurement and open ear canal hearing thresholds gave nearly the same results *except for 0.5, 0.75, 2 and 3 KHz where a significant difference was found. This means that using probe tube measure to estimate BC transmission may cause errors of up to 10 dB at some frequencies… but was considered as a method for a correct estimation of bone conduction at most frequencies. Results were similar to those of previous studies where cochlear vibration was measured by laser at the promontory.*

Bone conduction depends on different contributors such as soft tissues or ossicles. The sensitivity of these factors in bony transmission is directly relative to the site of stimulation and the direction of the vibration (perpendicular or in line with ossicles). That is why ***the cochlea is more sensitive to an ipsilateral stimulation*** *than a forehead or contralateral one.*

Interesting topic which has clear consequences for clinical work*. Ipsilateral bone conduction stimulation is the most effective and occluded bone conduction audiometry should be avoided.*

Self Reported Hearing Loss in Baby Boomers from the Busselton Healthy Ageing Study – Audiometric Correspondence and Predictive Value

De Wet Swanepoel, et al.

Journal of the American Academy of Audiology, Fast track articles - online only

*The **Baby Boomer population** (born 1946 – 1964) is ageing and **they will become high users of health care**. Since hearing loss is estimated by the WHO to be globally the most chronic disability, the **screening for hearing loss is important to ensure timely diagnosis**, counselling and rehabilitation in order to minimize the impact of hearing disability.*

*Previous research has shown that the **accuracy of using a questionnaire** to determine hearing loss is equal to the **use of a one single question**. The nature of the question, however, might influence the outcome. In this study the question was '**Do you have a Hearing Impairment?'**, this implements a prior knowledge of hearing loss.*

80 % of all persons who answered positive on this question, had an average hearing loss of more than 25 dB for 500, 1k, 2k, 4kHz (4FA) or a high frequency loss (4, 8 kHz = HFA) of 35 dB in their worse ear.

***Self-reported hearing loss corresponds best to an average hearing loss of more than 25 dB** for 500, 1k, 2k, 4kHz and **second best to a high frequency loss** (4, 8 kHz) of 35 dB in the worse ear. 80 % of all persons who self-reported a hearing loss, reached one of these criteria. The single frequency that corresponds best to self-reported hearing loss is 4 kHz.*

*The main focus of the article is: how reliable is self-reported hearing loss? There is much evidence that **it is useful to test those who report a hearing loss**. However, there is **little attention to the group with a hearing loss who do not self-report this**, even though they may not be motivated to proceed with rehabilitation.*

Nonlinear Frequency Compression: Effects on Sound Quality Ratings of Speech and Music

Vijay Parsa, et al.

Trends Amplif, 2013 17: 54.

This article includes 2 studies (Study 1: 12 normal hearing adults, 12 normal hearing children, 13 hearing impaired adults, and9 hearing impaired children / Study 2: 12 normal hearing and 8 hearing impaired adult listeners) on the ***evaluation of the effects of Nonlinear Frequency Compression*** *(NFC) with different* ***compression ratio*** *and* ***compression frequencies*** *regarding* ***sound quality*** *in* ***normal hearing*** *and* ***hearing impaired adults and children****. Interesting findings are the differences between the normal and impaired listeners, where* ***impaired listeners seem to have almost no other appreciation of effects on quality for speech in quiet when the compression frequency is not lower then 3Kz. Compression ration*** *seems to have* ***no influence on quality while cut-off frequency did have a clear influence****. However, hearing impaired children tend to have similar results as normal hearing people. Evaluation of speech in noise and music revealed that hearing impaired subjects experience fewer differences between the non-processed sample and samples with NFC, in comparison with normal hearing. The authors pointed out that the benefits of NFC will be more evident when NFC is fitted individually, and there was no acclimatisation period included in this study.*

Nice and well conducted study, using an interesting way of ***scoring*** *"****MUSHRA****" (Multiple Stimulus Hidden Reference and Anchors) with "anchor points" like clipped samples and samples with 2000Hz cut off, as control points.*