

AUDIOLOGICAL ARTICLE

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THE AUDIBILITY EXTENDER BY WIDEX - MAKING INAUDIBLE SPEECH SOUNDS AUDIBLE

Children and adults with steeply sloping or severe hearing losses are often unable to hear important speech sounds. With the Audibility Extender program in the mind440 hearing aid, these sounds can be made audible again.

IMPORTANCE OF HIGH FREQUENCY SPEECH SOUNDS

The Audibility Extender program in the mind440 hearing aid is intended primarily for children and adults with steeply sloping or severe to profound hearing losses.

It is well-known that children and adults with such hearing losses face a number of communicative challenges because they do not have access to the entire range of speech sounds.

Steeply sloping and severe to profound hearing losses are often accompanied by so-called dead regions. Dead regions are areas of the cochlea with no or very few functioning inner hair cells - typically where hearing thresholds have dropped below 60-70 db HL. With a basal cochlear dead region, many high frequency sounds will not be audible, which can lead to confusion between words and meanings¹.

The ability to discriminate sounds in spoken language depends very much on how well you are able to hear these sounds. While vowel sounds mainly have energy in the low and mid frequencies, many consonant sounds have energy in the high frequency area. Consonants such as /s/, /sh/, /t/ are difficult to discriminate if you have a hearing loss in the high frequencies.

In English, the high frequency /s/-sound in particular carries a lot of important information about tense,

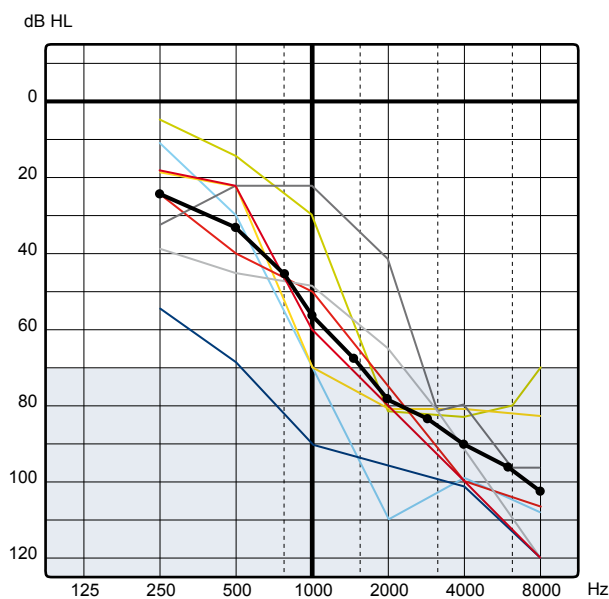


possessiveness, plurals, etc. If you cannot hear this information, you may make mistakes that will have a negative impact on your communication with others.

Furthermore, during language development in childhood it is essential that the child has access to the entire frequency range of speech sounds since learning to produce these sounds is completely dependent on whether they can hear them.

TRADITIONAL AMPLIFICATION DOES NOT DO THE JOB

Normal high frequency amplification will not make high frequency speech sounds audible for people with dead regions in the basal cochlea; indeed researchers have pointed out that simply amplifying high frequencies may in fact worsen speech discrimination for these people².



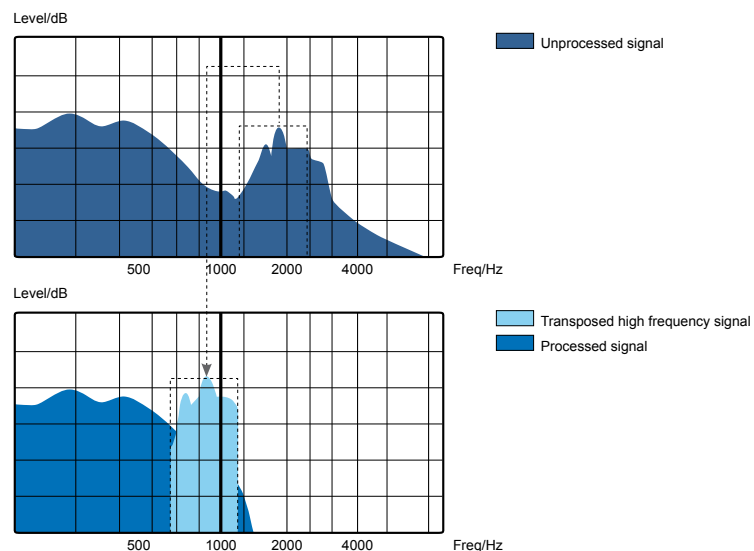
Examples of typical thresholds where the hearing aid wearer may have dead regions in the cochlea and therefore may benefit from the Audibility Extender

So for hearing-impaired people with dead regions, there are two options: we can accept that important information is lost to them, or we can attempt to make the information available by moving it to a frequency region where the inner hair cell structure in the cochlea is intact. This is precisely what the Audibility Extender in mind440 has been designed to do – moving inaudible sounds to an area where audibility can be obtained.

HOW IT WORKS

The Audibility Extender uses linear frequency transposition to move sounds to a different frequency area.

In mind440 the Audibility Extender chooses a start frequency based on the hearing loss configuration. The start frequency works as a cut-off point. High-frequency information above this point is moved down by one octave. More specifically, the high frequency information around the most prominent peak in the frequency band is moved to make the sound audible. The sounds flanking the most prominent peak are then filtered to minimise masking effects. The transposed sound is amplified so it is above the hearing threshold of the area it has been moved to.



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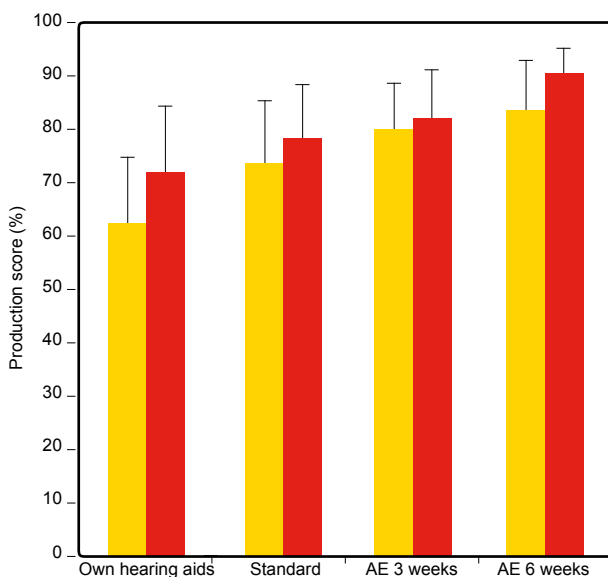
A major advantage of the Audibility Extender over other frequency lowering methods is that it preserves the temporal structure of sounds. This is important for the identification of vowels. To identify vowels correctly you need to be able to detect the formants, which are the peaks in the frequency distribution. If the internal relationship between the formants is changed, hearing-impaired listeners may have trouble identifying vowels correctly.

A PROVEN CHOICE FOR BOTH CHILDREN AND ADULTS

Since the introduction of the Audibility Extender, the clinical efficacy of the feature has been investigated extensively through clinical trials and case studies. Over the past years, data has been collected from studies with both children and adults, all documenting that the use of the Audibility Extender over time improves the perception and production of speech^{3,4,5,7,8,9}.

The general finding of the studies with adults is that the Audibility Extender is very effective in terms of helping hearing aid users perceive and produce high frequency sounds. The results indicate that the highest benefit is found in connection with the consonants that have the highest amount of high frequency energy – namely fricatives (e.g., /s/) and affricates (e.g., /sh/).

Several studies have examined the use of the Audibility Extender with children^{3,4,9}. The general finding in these studies is that the Audibility Extender can be very useful for children with steeply sloping high frequency hearing loss. One study showed a significant improvement in vowel and consonant recognition and a significant improvement in the production accuracy of high frequency consonants after only 6 weeks of use⁴. Based on the evidence, it is clear that the Audibility Extender can facilitate language development, which is a matter of special importance in paediatric audiology.



Accuracy of the /s/ and /z/ production measured on a reading task (yellow) and a conversational task (red). Reproduced from Auriemma, 2009.

ACCLIMATISATION

Studies with both adults and children have shown a clear effect of training and acclimatisation in relation to the Audibility Extender. Several studies have found that training improves the utilisation of the newly available sound cues, and that training and acclimatisation are essential in order to make full use of the possibilities offered by the Audibility Extender. Along with training and acclimatisation, counselling on what to expect when using the Audibility Extender has also been found to increase acceptance^{3,5,6,7,9,10}.

CONCLUSION

For people with steeply sloping or severe to profound high frequency hearing loss, inaudible high frequency sounds can be made audible by the Audibility Extender. Several studies have documented the positive effect on language perception and production of especially high frequency consonants in adults and children fitted with the Audibility Extender. These positive effects have been found to further improve through acclimatisation, counselling and training.

For more information on the Audibility Extender program in Widex mind440, please visit our website at www.widex.pro/KOM

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