

## AS I HEAR IT...

Audiologists express opinions on related topics. Please note that opinions reflect the thoughts and ideas of the individuals writing them, not necessarily those of the Academy.

### Stupendous and Earth Shattering?

By Mead Killion

Most of us find our eyes glazing over when we see buzz phrases like “quiet revolution” or “a dramatic increase in ability to hear in noise”. Those and other phrases have been used so often to describe gnat-size improvements (or no improvements at all) that we’ve learned to suspect that many advertising people love to stretch the truth if not lie outright.

Under those circumstances, when two amazingly unbelievable, fantastic, revolutionary, mind-boggling improvements come along, the best thing to do is probably announce them quietly. So it is in what follows.

#### OPINION

I was asked for my opinion, however, and since I assume I am among friends, I will give it: **The ability to rapidly test for the amount of loss in ability to hear in noise, and the ability to restore many hearing aid wearers to normal ability to hear in noise will ultimately be considered the two most important developments in the 90’s.** A corollary, perhaps, is that we may find it useful in the future to spend a little less time on air-bone-impedance testing and far more time on testing the thing that most hearing aid wearers complain of: their reduced ability to hear in noise.

#### DOING HALF OUR JOB

We need the information on the audiogram. How else to choose the gain and frequency response of the aids we order? But the hearing impairment that troubles those with hearing loss is often not “I can’t hear quiet sounds.” What they tell us more often is “I can hear but I can’t understand in noise.” For lack of a simple tool, we spend most of our time testing what is convenient but less important: loss of sensitivity to quiet sounds. At one time, this seemed excusable because we knew that those with greater threshold loss often had greater loss of ability to hear in noise. Once we start measuring that latter ability, however, we find it is only poorly correlated to the audiogram.

One of the reasons so much hype has been written about hearing in noise is probably that the story cannot be adequately told in a few hot phrases. Telling the true story requires the reader to pay attention for longer than the presumed attention span of most readers to whom the typical advertising seems to be directed. Assuming you, the gentle reader, are above that level, it is reasonable to tell more of the story than usually is told.

#### THE OTHER LOSS

To talk about the loss of ability to hear in noise requires that we need to define some sort of measurement of signal-to-noise ratio. We audiologists seem to prefer acronyms over anything greater than one-word descriptors, so we will use the standard acronym SNR. At a typical party, normals conduct conversations at a signal-to-noise ration of about 2 dB: the background noise may be 85 dB, for example, and the speaker arrives at the ear at 87 dB, an SNR of 2 dB.

Some recent combined data of Niquette, Bentler, and others, indicate that the average person who buys hearing aids has a 4.5 dB loss of ability to hear in noise. In the example above, this would mean that such a person would need to have the speaker raise his or her voice to 91.5 dB, or else convince the crow to quiet down to 80.5d B, in order to understand the conversation.

Those sound levels may seem high, but they are quite conservative. In a typical audiological party where a band is playing, the noise levels are more likely to be 95 dB, so the talkers have to produce 97 dB! (It often amazes people to see on a sound level meter the levels they produce at such parties. It always amazes me that audiologists routinely hire bands that won’t play within OSHA limits.)

#### WHEN DO HEARING AIDS HELP?

Up until recently, most hearing aids could not help their wearers hear better at those high levels. Hearing aids basically make things more audible: Once the sound levels are high enough that everything is audible without a hearing aid, conventional hearing aids don’t help. This statement is supported by dozens and dozens of studies — both of analog and digital hearing aids and of high-level hearing in noise — and the conclusion is now beyond question.

Conventional hearing aids can’t help in noise, you say? Never said that, never will. They nearly always help in low-level noise. A typical fine restaurant will have background levels of 60-65 dBA. That corresponds to 45-50 dB HL. Conversations carried on at those levels may be completely inaudible to someone with a 50-55 dB unaided hearing loss.

Some years back the FDA stated that hearing aids could never help in noise; helping people hear in noise was not one of the “intended uses” of hearing aids. That was a serious error in fact, as they say politely in Washington. With or without the FDA, hearing aids have always helped their wearers hear in low-level noise. Without hearing aids, neither the low-level speech or the accompanying noise was properly audible. The really good hearing aids made both audible; the brain was provided a rich flow of information so that it could perform its speech-extraction magic. An important development of the late 80’s was the introduction of wideband, low-distortion hearing aids that improved their wearer’s ability to hear in low-level noise and did not reduce their wearer’s ability to hear in high-level noise.

Unfortunately, making everything audible is not enough. To take an extreme example, assume a person has normal hearing through 1.5 kHz and is totally deaf at 2.0 kHz and above. We have simulated that for normal-hearing listeners with “brick-wall” filters. When you remove all audible sound above 1600 Hz, those with normal hearing will suffer an 8 dB loss in their ability to hear in noise. In other words, a complete loss of high-frequency speech cues will cause an 8 dB “SNR loss” even if the rest of the ear is normal. A person with the above audiogram will have at least an 8 dB SNR loss, and perhaps slightly greater if there is subtle damage to the cochlea in the “normal” region. By our assumptions, no amount of amplification will restore the speech cues in the region above 1.5 kHz.

In more practical cases, only a partial loss of hearing occurs at any frequency. Surprisingly enough, however, we have found a subject with only a 30 dB pure-tone average loss who has a 14 dB SNR loss (he scores only 50% on NU-6 in quiet), while other subjects with 55-60 dB pure-tone average loss have shown less than a 2 dB SNR loss. As long as things are loud enough, they do quite well in noise. (I now believe that the wonderful letters we received from early K-AMP wearers, telling us they could now hear essentially normally in noise, told more about the minimal SNR loss of those people than the well-known wonderful properties of the K-AMP circuit.)

#### A NEW TEST

The findings above make it clear that it would be a good thing to have a simple test for SNR loss. We have developed an experimental test we call the “Quick SIN” test (Quick Speech-In-Noise test). Each test block consists of 6 sentences at progressively poorer SNRs. If the patient responds immediately, it takes less than one minute to administer a block and about 30 seconds to count the number of words correct and subtract from 25 to obtain the patient’s SNR loss. A single block should give SNR loss within +/- 3 dB (95% confidence). Using the average of two blocks gives a feel for the consistency of the test result and reduces the uncertainty to +/- 2 dB.

EXAMPLE: The subject gets all of the 5 key words in the first three sentences (15 correct), 4 in the next, 2 in the next, and none in the last. The total correct is 21, so the SNR loss is  $25 - 21 = 4$  dB. (Theoretically, you should subtract from 25.5 dB, but 25 dB is good enough for our purposes.)

NOTE: The typical clinical audiogram gives a threshold within +/- 7 dB (95% confidence). An uncertainty of 2 dB out of a possible 20 dB SNR loss is only slightly greater, proportionally, than an uncertainty of 7 dB out of a possible 110 dB threshold loss.

#### WHAT DO I DO WITH THE TEST RESULTS?

Every reader in Illinois surely knows by now that the better directional-microphone hearing aids can provide a 4.5 dB improvement in SNR in typical restaurants and at parties, and double that in some outdoor (and test-booth) tests. Thus one might argue that one should simply order directional-microphone hearing aids for everyone— which is not such a bad idea — and skip the test, which is a bad idea.

The main purpose of testing SNR is counseling. Every study on satisfaction has concluded that one of the most important factors in consumer satisfaction is that the product met their expectations. With the SNR loss in hand, it becomes possible to counsel according to the likely results: Someone with a 15 dB SNR loss will need an FM system or hand-held microphone to function normally at parties, while someone with a 3-4 dB SNR loss can expect normal or near-normal function with the better directional-microphone hearing aids that are available.

#### WHEN WILL THE QUICK-SIN TEST BE AVAILABLE?

The final version should be available sometime this year or next. An “alpha” version is now being circulated for trial and comment.

**Do you have an opinion you would like to share? Please submit any entries by faxing them to Tracy Simonson at (847)433-9148.**