



Fast Read:

Threshold-based hearing testing doesn't identify the main problem for many adults: difficulty hearing speech in noise. Diagnosing these patients requires assessing speech in noise, word/speech recognition in quiet, and listening and communication—per best-practice models.



BEYOND THE AUDIOGRAM: Whole-Brain Hearing and Listening

Difficulty hearing in noise often drives older adults to seek help, but most hearing screening tests for loudness, not clarity. Both measures are needed for fully informed diagnosis and treatment.

BY DOUGLAS L. BECK

In popular discourse, the terms “hearing” and “listening” are often tossed about as if they were synonyms. They are not. To professionals in communication sciences and disorders, hearing, hearing loss, listening, language, comprehension, and cognition have very specific meanings.

For the purposes of this article, *hearing* is simply perceiving or detecting sound, whereas *listening* is the ability to comprehend or apply meaning to sound. Of course, to listen, one must first hear. However, simply perceiving, detecting, or hearing sound is not enough. Not at all. Dogs, cats, and many other mammals generally hear better than humans do. We are not at the top

of the food chain because of our ability to hear. Rather, we are the top of the food chain due to our unparalleled ability to listen—to apply meaning to sound.

Humans have created thousands of languages to communicate about intricate thoughts, feelings, science, religion, technology, sports, the future, the present, the past, and more. At a rudimentary level, most animals communicate through sound (for instance, barking, purring, or shrieking). However, alerting and warning sounds are not the limits of human communication. We have unfathomable depths of expressive and receptive language ability, most of which are not captured, reflected, or revealed through an audiogram.

A meaningful hearing evaluation requires measures of both loudness



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and clarity. Measuring hearing thresholds/loudness in isolation does not adequately indicate how one processes information or comprehends the real world. This is the essence of the often-debated and not-yet-resolved problems with limiting audiological testing to hearing, based on loudness-only measures (“hearing screenings” or audiograms). Unfortunately, only about 15–20% of audiologists perform routine speech-in-noise (SIN) testing, multiple surveys indicate (bit.ly/BP-standards).

Yes, threshold testing can be important to identifying hearing loss, particularly in children. However, of the 38 million people in the U.S. with hearing loss (bit.ly/HL-prevalence), most have mild-to-moderate sensorineural hearing loss (SNHL). Of note, these common SNHLs are often unrealized, despite elevated high-frequency thresholds, because thresholds generally degrade slowly, and most people do not notice the change.

The literature supports the position that threshold-based testing for adults provides only a partial picture, failing to reveal what is most often the primary problem: difficulty hearing speech in noisy situations. To fully identify the problem, we need to administer word/speech recognition in quiet, SIN testing, and listening and communication

assessments—per the best-practice models of ASHA, the American Academy of Audiology, and the International Hearing Society. Gathering the complete audiometric information, beyond the pure-tone audiogram, positions us to provide an accurate diagnosis, set realistic expectations, and achieve a maximal outcome for each patient.



CLARITY VERSUS VOLUME

When older adults start having trouble hearing speech in noise, they often blame it on other people mumbling in noisy environments—commonly referred to as the “cocktail-party effect.” This phenomenon has been recognized for more than 70 years and continues to cause significant frustration today (see sources). The reality is, when adults finally do seek hearing solutions, it is generally not due to elevated thresholds, or that they are not hearing loudly enough.

Rather, the most significant reason they seek help is they cannot hear clearly, particularly in noisy situations (see sources). Importantly and unfortunately, hearing clarity is not measured in hearing screenings, which (by definition) instead engage only loudness detection of pure tones, speech sounds, whispers, or watches ticking. All health care providers acknowledge, “Diagnosis first, treatment second.” Best practice



assures us that we have done due diligence. When we do less than that, we know less and are forced to make assumptions and guesses, which may be right or wrong.

In 2018, Andrew Vermiglio of East Carolina University showed discrepancies between the patient’s real-world perception of their own hearing status and their pure-tone measures on an audiogram (bit.ly/SR-diagnosis). Two years later Daniel Shub of Walter Reed and colleagues characterized the audiogram as a relatively *insensitive* measure of SIN ability, based on their study of 5,487 people performing “hearing-critical” tasks (bit.ly/predict-SIN).



UNRECOGNIZED AND UNTREATED

Difficulty hearing speech in noise is a common complaint in every hearing care office. However, the estimated 26 million Americans who experience this issue (bit.ly/HD-SIN) often do not have any hearing loss; they have suprathreshold listening disorders, which they understandably refer to as “hearing problems.” If SIN and communication and listening are not assessed in these patients, the audiologic problem that motivated their visit will be invisible to the clinician.

Compounding the problem is a tendency for people not to notice mild-to-moderate hearing decline as they age. In a study of 696 older adults published this year (bit.ly/HL-recognize), a research team led by Ryota Sukarai of the Tokyo Metropolitan Institute of Gerontology found that approximately two-thirds of them had mild hearing loss, and a fifth had moderate hearing loss. None of them knew they had hearing loss,

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Vanderbilt University’s Department of Hearing and Speech Sciences congratulates **Mariah Morton, MS, CCC-SLP**, the winner of the 2022 Rising Star Award. Morton is a third-year PhD candidate at Auburn University and presented *Answering Epidemiological Questions in Voice Research: Efforts Toward Health Equity* as a part of the annual diversity lecture series. Vanderbilt’s annual Rising Star Award was inaugurated in 2021 to celebrate and amplify diversity in communication sciences and disorders research.

For more information about the Rising Star Award and diversity efforts at Vanderbilt Hearing and Speech, visit <https://medschool.vanderbilt.edu/hearing-speech/dei/>.

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and none of them recognized this decline. According to the authors, the participants' undiagnosed, unsuspected hearing loss had contributed to impaired cognition, lower gait performance, and a tendency toward depression. *One does not seek solutions for problems one is unaware of.*

In fact, a growing body of research (see sources) supports a link between hearing loss and cognitive decline and, importantly, indicates that treating the hearing loss early may help mitigate cognitive decline. In a recent study, hearing loss emerged as the most significant of 12 modifiable risk factors for dementia (bit.ly/preventing-dementia). Others include obesity, low social contact, depression, and cardiovascular disease. According to the study, when mild cognitive impairment is screened and diagnosed early, and when patients subsequently address their hearing loss and other dementia risk factors, they may decrease their dementia risk by some 40%.



'WHAT WE DO WITH WHAT WE HEAR'

Understanding hearing loss as a whole-person issue, not just an audiogram-specific issue, is not new. Psychologist Helmer Myklebust wrote about it in the *Journal of Speech and Hearing Disorders* in 1949 (on.asha.org/aud-psych),

arguing that a whole-person approach should include components such as language, psychology, cognitive status, auditory processing, executive function, and more.

Similarly, Jack Katz, my mentor at The State University of New York at Buffalo, described auditory processing disorders (APDs) as “what we do with what we hear.” Those simple, yet brilliant, seven words remain prescient, as they encapsulate our ever-expanding understanding of our ability to apply meaning to sound: in other words, to listen. Lending support to Katz's observations is the high number of Americans with *normal thresholds* who report hearing difficulties and/or trouble hearing speech in noise—26 million of them, according to a 2019 review I co-authored with Jeffrey Danhauer of the University of California Santa Barbara (bit.ly/HD-SIN). These difficulties often co-occur with other diagnoses related to cognition, attention, and auditory processing. Clearly, hearing loss and receptive communication difficulties can often masquerade or parade as each other. An individual can have either, neither, or both.

The question is, why are other assessments besides the audiogram not a standard part of audiologic evaluation? At least part of the answer is systemic, in

that reimbursement is not tied to audiologic assessment. Consider that other medical professionals like otolaryngologists, neurologists, and optometrists simply do not conduct tests on patients without being reimbursed. One can argue we had the best intentions by offering free hearing screenings decades ago, but this has resulted in unintended negative consequences, including devaluation of our screening and diagnostic services.



REVEALING SCREENINGS

Reflecting on the research discussed so far, we know that the entire brain is involved in decoding speech sounds, and that many integrated factors affect our ability to listen. We know that these factors include visually redundant speech cues (such as lip reading and hand gestures), body language, background noise, and the emotional impact of the speech content.

We also know that when traditional audiometric results don't explain the patient's signs and symptoms, we need to delve deeper and administer further assessments. It's simply best practice. Which tests do I recommend for the majority of adults with SIN problems?

Speech-in-noise screening.

Measuring “clarity” in the real world is simple, accurate, and quick with available SIN tests, such as the QuickSIN, the Words-in-Noise Test, the Bkb, or the Beck-Benitez (see bit.ly/SIN-tests for a review). Each takes just two to three minutes and does not require a sound booth. Of note, the primary protocol for improving clarity in noisy situations is improving the signal-to-noise ratio (SNR), not making sounds louder. A primary goal of hearing aid fittings is

improving the SNR to bolster speech understanding for the wearer.

Listening and communication

assessments identify the scenarios in which the patient does well and where they need help, despite their audiogram (COSI, IOI, SSQ, and HHIE, bit.ly/HD-SIN).

Cognitive screening. For people experiencing hearing difficulty and/or SIN problems—typically older adults—a cognitive screening is in order, regardless of hearing loss status. Commonly used cognitive screeners include the Cognivue Thrive, Mini-Mental State Exam, Montreal Cognitive Assessment, and Mini-Cog Test. Often, patients with sensorineural hearing loss, suprathreshold listening disorders, and/or cognitive impairment report similar observations: “I can't understand what others are saying in noise,” “I can't recall what someone just said,” or “Everyone mumbles.” Screenings—combined with best-practice-based audiology protocols—help us distinguish and identify people who have communication disorders from those needing further evaluation for mild cognitive impairment, neurocognitive disorders, or suprathreshold listening disorders. We need to assume that the latter disorders are not being managed by other professionals.

With some appropriate professional training, these screenings can be integrated into patient testing with relative ease. And, of course, we don't diagnose or treat cognitive problems; we refer patients to the relevant professionals, just as we do with smoking cessation, diabetes management, depression, unusual tympanic membranes, and other medical issues. We cannot find what we don't look for, and if we

I urge all of us to act in accordance with best practice: Conduct complete audiometric evaluations in quiet and noise, incorporate knowledge of the patient's communication and listening ability, define which part of the communication disorder is audiology-based, and screen for that which is not.



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don't look, no one else will. We are licensed health professionals, and we need to take care of the whole patient the best we can.



EVOLVING WITH OUR PATIENTS

At first glance, it may seem peculiar to provide amplification for the 26 million people with hearing and SIN difficulties that go undetected on an audiogram. But an improved signal-to-noise ratio can ease *listening difficulties* significantly in this population—likely by improving the perceived quality of the sensory signal and by easing the cognitive load. We've seen FM systems provide such benefits in children with APD (and no audiometric hearing loss) for decades. Pocket-talkers, digital remote mics, telecoils/loops, and other hearing assistive technologies also provide such benefits. As of September, Apple has sold approximately 100 million AirPods units, as people seek the vastly improved SNR and reasonably good background noise reduction they offer (see page 32 for more on hearing technology innovation in this space).

The realities of practice in 2022 and beyond are very different from the protocols we learned when I was a student 40 years ago. As a profession and a science, we need to evolve to meet the world how and

where it is. No one likes to change, but it is necessary to constantly evaluate and re-evaluate in an ever-changing world. Science is dynamic, not static, and clinical practice is obligated to follow the science.

And our cumulative scientific knowledge, paired with the need for whole-person care, instructs us to truly understand the separate and overlapping manifestations and management of hearing loss, suprathreshold listening disorders, cognitive issues, and more. I urge all of us to act in accordance with best practice: Conduct complete audiometric evaluations in quiet and noise, incorporate knowledge of the patient's communication and listening ability, define which part of the communication disorder is audiology-based, and screen for that which is not.

We have the knowledge, the education, the clinical skill, and the licenses to expand beyond the audiogram. Our work directly affects real people and their quality of life. Let's do this. 🗣️

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