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Review Article

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The emerging relationship between cognition and audition: why cognitive screenings are beneficial for audiology patients and why comprehensive audiometric evaluations are recommended for people with mild cognitive impairment, cognitive decline and dementia

Abstract

The relationship between hearing loss and the exacerbation of cognitive decline is well-documented. Multiple reports have presented evidence that as hearing loss increases, so too, does the potential for cognitive decline. In this report, we will explore the emerging relationship between cognition and audition and why it is important to suspect, test, document and manage these relationships as early as possible. Indeed, there often exists an opportunity to alter the trajectory of cognitive decline, if early intervention is facilitated.

Volume 14 Issue 1 - 2022

Douglas L. Beck Au.D
Vice President of Clincial Sciences, Cognivue Inc. Victor, USA

Correspondence: Douglas L. Beck Au.D., Vice President of Clinical Sciences, Cognivue Inc, Victor, New York. Adjunct Professor of Communication Disorders, State University of New York at Buffalo. Senior Editor of Clinical Research at The Hearing Review, USA, Tel 585-203-1969, Email dbeck@cognivue.com

Received: February 28, 2022 | **Published:** April 11, 2022

Introduction

Multiple studies in The Lancet (for example,[1,2]) have identified hearing loss as the single most significant modifiable factor with regard to reducing dementia risk. Indeed, Livingston, et al.[2] identified and addressed 12 modifiable risk factors which significantly impact the risk of dementia. Their list contains; excessive alcohol consumption, head injury, air pollution, less education, hypertension, hearing impairment, smoking, obesity, depression, physical inactivity, diabetes, and infrequent social contact.

Unfortunately, hearing "screenings" do not provide any information about auditory processing, linguistic ability, comprehension, speech-in-noise ability or listening skills. Therefore, to diagnose, manage and work toward realistic expectations, a comprehensive audiometric evaluation is the tool of choice. Indeed, testing hearing sensitivity (i.e., screening) while inferring listening ability is analogous to missing the forest for the trees. In this article, we address these and related topics and the rational for cognitive screening tests in adults over age 55 years and all adults who report speech-in-noise and hearing difficulties with or without hearing loss.

Goals: hearing *and* listening

Hearing and listening are not synonyms. Professionals and the lay public often use the terms 'hearing' and 'listening' interchangeably as if they were synonyms. They are not. Hearing is simply the ability to detect or perceive sound. Listening is the ability to comprehend, or apply meaning to sound.[3] Hearing and listening both occur in the brain. However, even though hearing/perceiving/detecting sound is the primary function of a healthy peripheral auditory nervous system, the end goal is significantly more substantial. The end-goal is listening. Listening is a deep cognitive event which results from the integration of hearing with vision, language, memory (short-term, working memory and long-term) emotional, auditory and language centers and more, to derive auditory, linguistic, psychological and emotional (and more) meaning from perceived sounds.

Although 'normal' human hearing is a highly desirable attribute, many animals (i.e., dogs, cats, wolves, lions, whales and many more…) hear better than humans. Human listening, on the other hand (i.e., the ability to attribute meaning to sound) is unique and quite extraordinary. There exist no non-humans with the ability to listen as humans do. Uniquely, humans listen across thousands of languages to communicate about the present, the future, the past, time, space, religion, politics, science, philosophy, ideas, inventions, emotions, desires and more. Beck & Flexer[3] reported "Listening is Where Hearing Meets Brain." A simple pure tone loudness-based ("press-the-button-when-you-hear-the-beep') hearing test does not thoroughly measure hearing and does not evaluate listening ability at all. This author (DLB) believes the only appropriate occasion for a hearing screening is the tremendously successful Newborn Hearing Screening programs which are (and have been) pervasive across the USA for decades. Indeed, Beck & Danhauer[4] report there are 38 million Americans with hearing loss as measured on a traditional audiogram. However, there are another 26 million Americans with no hearing loss on an audiogram, yet who have hearing difficulty and/or speech-in-noise and other suprathreshold listening disorders. Of note, none of the additional 26 million would be detected or diagnosed via hearing "screenings" as their suprathreshold listening disorders (such as auditory processing disorders, auditory neuropathy spectrum disorder, dyslexia, attention deficit disorders, mild cognitive impairments, neurocognitive disorders, traumatic brain injury etc) do not necessitate hearing loss. To be clear, suprathreshold listening disorders occur in tandem, and in isolation from hearing loss.[5] Beck

reported[6] that screening loudness detection pure-tone thresholds, without a measure of listening clarity in noisy/challenging listening situations is inefficient, clinically inappropriate and can be highly misleading. He stated the only way to know if someone has a suprathreshold listening disorder is to test for it. Beck noted that if we're to have useful auditory screenings, two measures need to be employed; a loudness detection measure (perhaps pure tones or vowel-consonant-vowels, VCVs or similar) and a clarity in noisy/challenging listening situations measure (such as a speech-in-noise or digits-in-noise test) thereby availing a loudness and a clarity measure.

Literature review

Kricos[7] cautioned many symptoms of hearing loss and cognitive decline are actually the same, may be similar and may overlap; neither is a silo. Hearing loss, suprathreshold listening disorders and neuro-cognitive decline may occur in tandem, or in isolation. She cautioned that hearing (and listening) problems may (and often do) parade as cognitive problems and vice versa, thus potentially leading to an incorrect diagnosis and inappropriate (or no) treatment.

Kim, Betz, Albert et al.[8] report subjective self and proxy-reports of hearing loss are widespread but often do not accurately characterize the actual severity or degree of hearing loss for adults with and without cognitive decline. The authors report 3,326 self-rated and 520 proxy-rated hearing assessments. For cognitively normal adults self-rated sensitivity was reported at 71%, specificity was 86%. For people with MCI the rates were 61% and 85% (respectively) and for people with dementia they were 53% and 81%. Proxy-rated sensitivity and specificity for people with MCI were 66% and 83% (respectively) and 73% and 60% for people with dementia. The authors note that for people with cognitive impairment, hearing loss may go under-reported and unaddressed. Kim, Betz, Albert et al. recommend the incorporation of objective (comprehensive) audiometric evaluation.

Glenney[9] reports hearing and listening are different matters. Glenney reiterated hearing is the foundation of listening and listening is the foundation of learning.[3] Glenney underscored hearing is a sense, whereas listening is a learned skill. Further, multisensory-integration is also a learned skill, and she questioned (wisely!) whether multisensory-integration was being tested in children (or adults, for that matter!). Multisensory-integration is the ability to simultaneously receive, interpret and comprehend sensory input such as auditory, visual and language cues. Multisensory-integration is of vast importance as people try to understand conversational speech in challenging (noisy and reverberant) acoustic environments. The McGurk Effect and the importance of correctly integrating audition and vision is aptly and dramatically demonstrated online https://www.youtube.com/watch?v=2k8fHR9jKVM (McGurk effect - Auditory Illusion - BBC Horizon Clip).

Cocktail party effect (speech in noise)

Although it may appear counter-intuitive, the most common reason people present to the audiologist is not due to decreased pure tone thresholds or because they wish to hear louder. The most common reason people seek audiologic assistance is their inability to understand speech-in-noise (i.e., "the cocktail party effect"). In particular, Edwards[10] reported the primary complaint from people with hearing loss is "an inability to function in complex everyday acoustical environments and demanding (i.e., noisy) listening situations." Edwards notes these complaints are indicative of the effects of hearing loss on "higher-order cognitive functioning" which manifest as increased listening/cognitive effort. As such, for an individual with hearing loss to improve their ability to understand speech-in-noise and to improve performance on challenging auditory tasks, an increased allocation of cognitive resources is necessary.

Moore, et al.[11] report older adults declining cognitive processing ability is associated with a reduced ability to understand speech in noise. They report subjective reports of hearing difficulty often do not align with objective measures. The authors state cognitive factors play a major role in speech perception. Further, for middle-aged people with poorer SIN ability, their SIN difficulty could be a "first warning of a need for intervention."

Holder, et al.[12] report 81 adults with normal hearing and normal cognitive function. The subjects completed multiple speech-in-noise (SIN) tests. They noted older adults (despite normal hearing) had greater deficits in SIN than did younger adults. The authors report the pure tone audiogram does not capture, indicate or account for these deficits. They too, report a hypothesis such that decrements in central auditory processing degrade the acoustic stimulus, thus requiring allocation of compensatory (i.e., central) mechanisms. The authors state typical age-related declines in cognition, notably working memory, present significant implications for older adults SIN ability.

Regarding the importance of speech-in-noise (SIN) testing, Stevenson, et al.[13] report more than 82 thousand dementia-free participants, 60 years of age and older, who were observed for 10 years (median) via the UK Biobank cohort. The researchers investigated whether SIN impairment is associated with an increased risk of incident dementia. Resultantly, 1,285 participants developed dementia. Of those, it was determined that participants with insufficient and poor SIN abilities had an increased risk of developing dementia compared to those with normal SIN ability. The Hazard Ratio for dementia, for those with poor SIN ability was 61 percent. The authors report SIN hearing impairment is independently associated with incident dementia.

Roup, Custer & Powell[14] examined self-perceived hearing ability and binaural speech-in-noise performance in young to middle-aged adults with normal pure-tone hearing. In agreement with Beck & Danhauer[4] the authors note that when patients present for a hearing evaluation due to hearing complaints, hearing difficulty or speech-in-noise complaints, a normal audiogram does not conclude the diagnostic process. A speech-in-noise test should be obtained to provide the clinician a simple and efficient measure to identify suprathreshold listening disorders in adults with normal pure-tone sensitivity. Roup, Custer & Powell reported self-perceived hearing ability had only a weak-to-moderate relationship with binaural speech-in-noise performance. They concluded speech-in-noise tests should be obtained on all adults, with and without audiometric hearing loss.

Audiology, education, psychiatry and psychology

Myklebust[15] addressed the vast, vital and intricate interactions between audiology, special education, psychiatry and clinical psychology. More than 70 years ago he observed "that to deal effectively with the individual it is necessary to consider the whole person." Of course, the term "patient-centered-care" hadn't yet been developed when Myklebust wrote these words, yet his writings were prescient. He noted audiologists cannot simply view the patient based on their hearing loss. Rather, he suggested we must appreciate the whole person; perhaps including their language, psychology, auditory processing, cognitive ability, state of mind, executive functional capacity and more.

Beck and Clark[16] noted the interaction and co-dependence of cognition and audition is of paramount concern for hearing care professionals. They framed their discussion in terms of sensory

systems providing reduced, incorrect or impoverished information as "bottom-up" pathways to the central nervous system. Further, when bottom-up information is in error, the resultant "top-down" (cognitive) system has to work harder to untangle, process and understand the same information, requiring additional effort, energy and cognitive resources. Beck and Clark noted "people with hearing loss must dig deeper into their cognitive reserve and abilities to make sense of a world delivered to them via compromised auditory input…"

Lin, Metter & Ferucci[17] sought to determine whether hearing loss is associated with dementia and Alzheimer's Disease (AD). Their study was a prospective study of 639 dementia-free participants. Based on a median follow-up period of 11.9 years, 58 cases were determined to have all-cause dementia and 37 of those were AD. Importantly, the authors reported the risk of all-cause dementia increased with the severity of the baseline hearing loss. As compared to people with normal hearing the Hazard Ratio (HR) for all-cause dementia for people with mild hearing loss was approximately 1.9, for people with moderate hearing loss the HR was 3.0 and for people with severe hearing loss the HR was approximately 5.0. The authors stated "hearing loss is independently associated with incident all-cause dementia."

Jupiter[18] explored relationships between hearing impairment and cognitive function using the Mini Mental Status Evaluation (MMSE) cognitive screening tool. Her exploration involved 101 nursing home residents ages 65-108 years and revealed a significant difference in cognitive function for residents with mild hearing loss, compared to those with more significant hearing loss. She reported that based on hearing screenings using distortion product otoacoustic emissions (DPOAEs) 100% of the residents failed. Regarding pure tone screenings, 97% failed screenings at 30 dB HL, 90% failed using 40 dB (pass/fail) criteria. Jupiter reported residents with higher cognitive function demonstrated a greater likelihood of passing the 40 dB HL screening.

Amieva, et al.[19] report a large (3,670 participants) prospective population-based study of people ages 65 years and older. Hearing loss was determined based on questionnaires and self-perceived reports. 137 subjects reported major hearing loss, 1,139 reported moderate hearing loss and 2,394 reported no hearing loss. The Mini-Mental State Examination (MMSE) was used to determine cognitive decline across follow-up visits for 25 years. The authors report hearing loss was significantly associated with lower baseline MMSE score and greater MMSE decline over the 25-year follow-up period. These results were determined to be independent of age, sex, and education. With regard to people with hearing loss who did or did not use hearing aids and people who reported no hearing loss, the people with no hearing loss and people with hearing loss who wore hearing aids had less and slower cognitive decline than did people with hearing loss who did not use hearing aids. The authors concluded self-reported hearing loss is associated with accelerated cognitive decline in older adults and hearing aid use appears to attenuate the rate of progression and depth of cognitive decline.

Glick & Sharma[20] report Age-Related Hearing Loss (ARHL) is associated with cognitive decline as well as structural and functional brain changes. The authors report 28 adults with untreated, mild-moderate ARHL and 13 age-matched normal hearing (NH) controls. They evaluated cortical visual evoked potentials (CVEPs), cognitive function and speech perception abilities. Participants with ARHL were fitted with bilateral hearing aids and re-evaluated after 6 months. At that time (i.e., 6 months later) a reversal in cross-modal re-organization of auditory cortex by vision was observed. The ARHL group treated with hearing aids also demonstrated gains in speech perception and cognitive performance. The authors provided supporting evidence that well-fit amplification may be beneficial with regard to cortical re-organization and may offer cognitive benefit. Sharma & Beck[21] revealed that following 6 months with well-fitted hearing aids, reversal of the cross-modal recruitment of auditory cortex for visual processing occurred as did gains in auditory speech perception abilities, improvements in global cognitive function, executive function, processing speed, and visual working memory performance.

Cognitive screenings

Balogh, et al.[22] report obtaining the correct diagnosis is the foundation of health care. The correct diagnosis defines the problem and implies/suggests/directs subsequent health care decisions. The authors note the diagnostic process is complex and collaborative. They report diagnostic errors persist across all healthcare practices, locations and professions and these errors harm an unacceptable number of patients. They report most of us will experience at least one diagnostic error sometime with "devastating consequences." The authors note diagnostic errors may prevent or delay appropriate treatment, potentially resulting in (medical, surgical,) psychological or financial repercussions. Balogh, Miller, Ball report improving the diagnostic process is a moral, professional, and public health imperative. Although not specifically addressed to hearing care professionals, the authors report diagnostic processes hinge on intra-and-interprofessional collaboration, including primary-care clinicians, physicians, nurses, pharmacists, technologists, therapists, social workers, patient navigators, and many others. They report some health care professionals involved in the diagnostic process (for example hearing care professionals) are overlooked and arguably insufficiently recognized.

Many clinical and casual observations, chief complaints and associated problems overlap among people with hearing loss, suprathreshold listening disorders, mild cognitive impairment, dementia and cognitive decline. In accordance with clinical medical practice, the reasonable, efficient and best path forward might be summarized as "diagnosis first, treatment second."

Cheney[23] reports the Emergency Care Research Institute (ECRI) "Top 10 List" primarily focuses on the continuum of care, due to the importance of professional collaboration regarding patient care. He reports an accurate diagnosis allows a "complete clinical picture of the patient's relevant circumstances." To no one's surprise he adds "It takes time to obtain an accurate history and perform a comprehensive physical, and clinician-patient communication is crucial." He reports early recognition of behavioral health needs via education, training, retraining and behavioral health assessment for patients is also key.

Roebuck-Spencer, et al.[24] examined cognitive screening tests as compared to comprehensive neuropsychological test batteries. They report screening tests are generally brief and narrow, yet can be administered (quickly and efficiently) during a routine clinical visit which might be helpful for identifying individuals requiring a more comprehensive assessment. They suggest some screeners may be helpful for repeated tests to monitor progress or treatment outcomes. The authors report cognitive screenings will likely play an increasingly important role in identifying cognitive impairment. Screening tests may serve as the basis of a referral for a diagnostic neuropsychological assessment upon which a comprehensive neuropsychological assessment is used to identify the nature and severity of a person's cognitive difficulties.

Unfortunately, rather than adhering to a complete diagnostic process, practitioners/clinicians might sometimes observe familiar problems, signs and symptoms and assume the same familiar diagnosis applies. Of course, we all understand time constraints, clinical efficiency, reduced reimbursements and increased costs. However, the only reason we actually see patients, is to professionally and responsibly identify and manage their health-related difficulties. When best guesses and approximations prevail, the opportunity to squander money and time increases and the opportunity to effectively diagnose and manage decreases, However, given the realities of an ever-changing world in 2022, health care professionals must often rely on screenings to indicate, confirm or refute that an in-depth, detailed, diagnostic battery is warranted. Fortunately, there are multiple commercially available screeners which implicate or identify MCI, dementia and/or cognitive decline. Cognitive screeners are useful tools to generally rule-out cognitive concerns in people for whom we are suspicious of the same. Screening tools are not diagnostic tools. A positive result from a screener indicates a diagnostic assessment is warranted to accurately identify and manage the area of concern. A negative result from a screener might indicate a low level of probability that the suspected problem requires further investigation at this time, or perhaps that a "watch and wait" approach is advisable.

Early intervention and outcomes

Admittedly, despite the well-founded predictions that dementia will triple (globally) in the next 28 years, few hearing care and other communication disorders professionals have as-of-yet availed themselves to actively identify and mange/refer MCI, dementia and cognitive decline candidates. One of the main obstacles to progress in this arena seems to be the more-or-less ambiguous presumption such as "Why bother to identify MCI, dementia or cognitive decline early? There's nothing that can be done…" to which the literature responds…

Peracino[25] reports the impact of dementia on individuals and the burden imposed on their families and society (in general) is (and can be) devastating. Interventions which delay the onset of dementia by 1 year (per person) would result in a greater than 10% decrease in the global prevalence of dementia in 2050. He reports hearing loss seems to speed up age-related cognitive decline and therefore, treating hearing loss more aggressively could potentially delay cognitive decline and dementia.

Edwards, et al.[10] examined whether or not cognitive training lowered the risk of dementia across ten years. The Advanced Cognitive Training in Vital Elderly study was a randomized controlled trial of some 2800 people. A total of 260 dementia cases were identified via follow-up. Speed Training focused on computerized, visual perceptual exercises to increase the quantity and complexity of information processed rapidly and availed a reduced risk of dementia. Further, each Speed Training session lowered the hazard for dementia by 10 percent. The authors reported Speed Training lowered the risk of dementia by 29% as compared to controls.

Gates, et al.[26] examined 8 random controlled studies. Their analysis included 660 participants with MCI. They investigated whether computerized cognitive training (CCT) is effective in maintaining cognitive function or reducing the risk of developing dementia. Their primary finding was most studies of CCT were of low quality and had significant variables (small sample sizes, methodological problems and more). As such, they could not actually determine the effectiveness of CCT with regard to maintaining cognitive function or reducing the risk of developing dementia.

Rasmussen and Langerman[27] report it may be possible to "prevent or delay" dementia in some part of the population through modification of common risk factors. To this author's knowledge (DLB), the most up-to-date and comprehensive list of risk factors for dementia can be found via Livingston et al.,[2] paragraph one, this article). Rasmussen and Langerman state early diagnosis and treatment to (potentially) delay the onset of dementia are not only beneficial for the patients, their families, careers, etc., but may result in substantial savings to the healthcare system.

Bahar-Fuchs, et al.[28] assessed the effects of Cognitive Training (CT) with regard to outcomes for people with mild-to-moderate dementia and their caregivers, based on 33 randomized controlled trials using CT versus a control/alternative intervention. The 33 trials were published between 1988 and 2018 from 12 countries with sample sizes from 12 to 653 participants. Trial duration varied between 2 weeks and two years. The authors concluded that although the certainty is low, CT is likely associated with small-to-moderate positive effects regarding global cognition and verbal semantic fluency at the end of treatment.

Sabbagh, et al.[29] addressed the pros and cons of early identification of MCI or pre-clinical AD. They report early diagnosis may allow more beneficial treatment for problems which may underlie cognitive impairment such as metabolic or endocrine disorders, mood and sleep disorders, iatrogenicity and more. They queried, perhaps one or more modifiable risk factors[2] are present and can be managed? The authors (in accordance with Rasmussen and Langerman) note early diagnosis allows more time to prepare financially and emotionally for the patient and their loved ones and may allow an economic benefit to healthcare systems.

Martin-Lopez, et al.[30] sought to assess cognitive training effectiveness for people with a well-established diagnosis of dementia of mild-to-moderate severity. They reported three areas of cognitive intervention; cognitive stimulation (group work and social interaction), cognitive rehabilitation (individualized goals focused on activities of daily living) and cognitive training (repeated practice of standardized tasks via pencil/paper or computer, focused on memory, attention or executive functions). They performed a meta-analysis on the benefits of cognitive intervention including 1483 patients. Martin-Lopez, Molina-Linde et al. report cognitive training, when compared to a control group, may have a large immediate positive effect regarding overall cognitive function, delayed memory and language fluency in patients with mild-moderate dementia.

McDonough reported a small survey of 20 patients with Mild Cognitive Impairment (MCI) who were enrolled in Memory Clinics. Eight of the 20 patients self-reported hearing loss, however upon audiologic testing, 17 of 20 had hearing loss (9 had mild-to-moderate hearing loss, 8 had moderately-severe hearing loss). The authors concluded a significant percentage of people with MCI have hearing loss. They stated "…there was no significant correlation between self-reported hearing loss and objective hearing deficits…" Further, the authors report hearing loss has been associated with under-performance on cognitive testing and hearing loss has emerged as the most significant modifiable risk factor for dementia.

Bucholc, et al.[31] report hearing aid use has been linked to improvements regarding cognition, communication and socialization. The authors examined the use of hearing aids as it relates to the conversion time from MCI to dementia. They report people with MCI who use hearing aids were at significantly lower risk of developing all-cause dementia, as compared to people not using hearing aids. They note adults with hearing loss who do not wear hearing aids

have significantly higher rates of depression, psycho-social disorders, anxiety and that hearing loss has been associated with an increased risk of incident dementia. Further, they note hearing aid use has been linked to improvements regarding cognition, psychological, social and emotional functioning. The authors concluded that the conversion time from MCI to dementia, based on the people who wore hearing aids, suggests (early and comprehensive) identification and management of hearing loss may reduce the overall incidence of dementia.

Burns[32] reports neuroplastic change occurs in adults and children. Activity, sleep, social and avocational engagement, physical activity and more help drive neuroplastic change. She notes neuroplastic change is associated with cognitive and academic skills in dementia and other neurocognitive disorders in adults. She reports real-life activities contribute to adaptive neuroplastic changes thus supporting evidence-based technological cognitive and communication interventions.

Sanders,[33] studied the effect of hearing aids on dementia. The authors evaluated some 3060 unique patient records from 17 studies published between 1990 and 2020. They determined the largest benefit from hearing aid fittings was observed regarding the cognitive domain of executive function. Sanders, Kant, Smit & Stegman report hearing loss seems to speed up age-related cognitive decline and therefore, treating hearing loss more aggressively could potentially delay cognitive decline and dementia. The authors underscored Peracino (see above) who noted interventions which delay dementia by 1 year would result in a 10% decrease in the global prevalence of dementia by 2050.

Lancet Public Health[34] estimates there were 57 million people with dementia in 2019 and by 2050 they estimate there will be 153 million cases globally. Of note, from 1990 to 2016 the increased numbers of people with dementia increased by 117%. As such public health planning should include multi-faceted approaches to screening, diagnosis, early intervention, planning and management. As of 2022, there are no clearly successful disease-modifying (pharmacologic) therapies. The authors stress the need to attend to modifiable risk factors, as volitional intervention focused on these risk factors, has been shown to be somewhat successful in delaying the rate of cognitive decline and offers hope and potentially improved outcomes regarding dementia risk reduction and dementia prevention.

Conclusion/discussion

People with hearing loss and suprathreshold listening disorders and other communication-based disorders (such as speech and language, linguistic, emotional, cognitive, auditory processing and more) often remain undiagnosed and untreated. Therefore, a comprehensive hearing and listening assessment is of paramount importance for the person presenting with what appears to be hearing and/or listening problems, speech and language problems, as well as suspected MCI, cognitive decline or early-stage dementia. Early and comprehensive audiometric tests indicating hearing and listening ability (i.e., speech-in-noise tests, see Beck and Benitez,)[35] allow professionals to accurately diagnose and intercede early, and perhaps alter or slow the trajectory of hearing loss, suprathreshold listening disorders, speech and language disorders, psychological disorders, MCI, dementia, cognitive decline and other life-changing disorders.

Unfortunately, even highly experienced and skilled psychologists, speech-language pathologists, physicians and audiologists cannot determine, estimate or guess the degree of hearing loss (or other disability) via trained clinical observation, tuning forks, whisper tests or self-report etc. These "screening protocols" are highly unreliable, often misleading and are not in accordance with Best Practices guidelines of the American Academy of Audiology (AAA), the American Speech Language Hearing Association (ASHA) or the International Hearing Society (IHS). Hearing loss and suprathreshold listening disorders are essentially invisible and indistinguishable without comprehensive hearing and listening assessments. Assuming that a clinician can infer the degree of hearing loss or the listening/speech-in-noise ability of a patient through simple observation or discussion is analogous to guessing their CBC, CT or MRI results.

Consistent with Beck, et al.[36] professionals must appreciate that cognition, speech and language, psychology, audition (and more) are integrated, interdependent and intertwined. We must strive to not think in silos. Rather, we must appreciate the intricacies of hearing, listening, cognition, language, psychology and more, and the value of the correct diagnosis based on comprehensive and appropriate information gathering, to arrive at the correct diagnosis and treatment plan.

Although Beck, Weinstein & Harvey advocated universal cognitive screening of patients 70 years of age and older, in light of recent developments (more efficient screeners, less test-time, increasing outcomes-based evidence of the impact of hearing loss, suprathreshold listening disorders and more on psychological, cognitive and emotional well-being and the need for earlier diagnosis and management) the author (DLB) now advocates universal cognitive screenings at age 55 years and older (regardless of hearing, hearing loss, apparent cognitive status etc).

Auditory, speech and language, cognitive, psychological problems and more, are not silos. They may masquerade as each other, they may exist in-tandem, or in isolation. Therefore, it is of utmost importance to use modern, contemporary tools to effectively, efficiently and earlier-than-previously-thought, engage, screen, refer, diagnose and manage hearing loss, suprathreshold listening disorders, speech and language disorders as well as MCI, cognitive disorders and dementia. The impact of hearing loss and suprathreshold listening disorders with regard to MCI, cognitive decline and dementia continues to emerge and be explored. Of note, important new information is revealed often, sometimes daily. Science is dynamic, it is not static. There exists no "finished science." Hearing loss and suprathreshold listening disorders exacerbate cognitive decline in many candidates and as such, hearing loss and suprathreshold listening disorders reach significantly beyond elevated pure-tone thresholds. Hearing loss and suprathreshold listening disorders impact emotion, mood, psychological status, quality of life, health, daily function, and more. As suspicion, diagnosis and intervention time decreases (i.e., occurs earlier) the opportunity to positively impact the trajectory and the personal and clinical outcome increases.

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Citation: Beck DL. The emerging relationship between cognition and audition: why cognitive screenings are beneficial for audiology patients and why comprehensive audiometric evaluations are recommended for people with mild cognitive impairment, cognitive decline and dementia. *J Otolaryngol ENT Res.* 2022;14(1):1–6. DOI: 10.15406/joentr.2022.14.00496

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Citation: Beck DL. The emerging relationship between cognition and audition: why cognitive screenings are beneficial for audiology patients and why comprehensive audiometric evaluations are recommended for people with mild cognitive impairment, cognitive decline and dementia. *J Otolaryngol ENT Res.* 2022;14(1):1–6. DOI: 10.15406/joentr.2022.14.00496