September 2024

NeuroAudiology Newsletter

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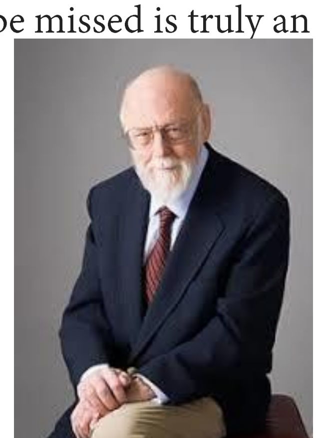
Co-Editors: Frank Musiek, PhD; Amy Bradbury, AuD

In Memoriam: James Jerger, PhD

As most of you know the father of diagnostic audiology passed away on July 24th at the age of 96. His contributions to our field were so enormous they defy measurement. His contributions have and hopefully will be remembered with great appreciation by us all. From a personal standpoint, Jim was a great friend and colleague. He supported me and much of my work for which I will always be grateful. I recall with fondness the many discussions we had about diagnostic audiology and more specifically the central auditory system and the ways its integrity could be assessed. His insightfulness into mechanisms underlying the hearing process and his willingness to share it was indeed most generous and admirable. Jim's limitless knowledge and his willingness to share it was perhaps only exceeded by his encouragement to work hard and believe in one's efforts. That he will be missed is truly an understatement. - FM



AUDIOLOGY TRIVIA

ANSWERS ON LAST PAGE

1) The section of the corpus callosum that contains auditory transfer fibers is termed what?
a) Genu b) Splenium c) Isthmus, d) Tarsell tract

2) Jim Jerger received his Ph.D. from Northwestern University in what year?
a) 1950 b) 1954 c) 1960 d) 1968

3) In a 2024 study by Apple, what percentage of tinnitus patients claimed they perceive their tinnitus to be ultra or very loud?
a) 34% b) 21% c) 15% d) 8%

In Memoriam: Tony Sahley, PhD

Tony Sahley, Professor of audiology and neuroscience in the Department of Health Sciences at Cleveland State University passed away on July 10th. Tony was one of my first Ph.D. students and worked with me while I was at Dartmouth in the late 1980's and into 1990's. Tony was one of the most knowledgeable scientists I knew in the area of auditory neuropharmacology. As a doctoral student, I learned more from Tony than he learned from me! His academic generosity was typified by keeping many of us involved by sharing his high caliber work throughout his research career. Tony was an in-depth thinker with work ethic and diligence not to be exceeded by anyone. His research on the olivo-cochlear bundle and the role played by opioid peptides, glutamate and glutamate-sensitive NMDA receptors in tinnitus and hearing sensitivity earned him high respect among his peers. No doubt, Tony will leave a vacancy in the science community. Moreover, he will be sorely missed as a dear friend and thoughtful colleague- FM

In Memoriam: Charles (Chuck) Berlin, PhD

Chuck Berlin, colleague, friend, audiologist, hearing scientist and pianist passed away on 21, 2024. Chuck was 90 years old and enjoyed a long and productive career at LSU where he established the Kresge Hearing Research Laboratory at LSU, the University's first independently funded laboratory. Chuck was not only an outstanding audiologist and hearing scientist but a wonderful lecturer. His memorable ABR workshops at LSU were attended by many. They were not only highly informative, but an enjoyable learning experience often highlighted by Chuck's talented piano playing. Chuck was a leader in many aspects of hearing science and audiology. Early in his career he published key papers on dichotic listening followed by major contributions in the areas of ABR, high frequency hearing loss, auditory neuropathy (ANSD) and genetics and hearing loss.
Chuck was very talented individual in many ways and our field was advanced markedly in many ways by his remarkable innovation and leadership. - FM

NeuroAudiology/CAPD Corner

Topic: APD or DLD?
Author: Bill Keith, QSO, PhD, MNZAS

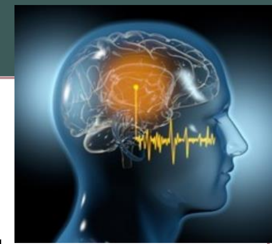
Have you heard the quote about the audiologist, the speech language therapist, the psychologist and the psychiatrist? I was reminded of it by a recent case. Here's the quote.

"The 'deeply rooted positions' mentioned above include the different diagnosis and treatment that will result from a referral route through different professionals. For example, a child with identical symptoms may be classed as APD by an audiologist, SLI by a SLT, dyslexic by an educational psychologist, and autistic spectrum by a psychiatrist." (Moore, 2006).

There's certainly evidence that it's difficult to separate developmental language disorder (DLD), previously referred to as specific language impairment (SLI), and auditory processing disorder (APD).

Ferguson et al (2011) studied 88 children who were either diagnosed with APD, diagnosed with specific language impairment (SLI), or mainstream students. The children diagnosed with SLI or APD performed more poorly on a range of assessments than the mainstream students, but the very similar behavioral and parental report profiles suggested that the children identified as having APD or SLI were differentially diagnosed based on their referral route rather than actual differences.

NeuroAudiology/CAPD Corner



Miller and Wagstaff (2011) conducted 18 tests of language, auditory processing, reading, memory and motor speed on 64 children, recruited because they had already been diagnosed with auditory processing disorder (APD) or specific language impairment (SLI). The behavioral profiles were found to be very similar, irrespective of diagnosis. The researchers reclassified the children based on the results of the research tests. The results, shown in their Figure 2, show considerable differences between the original and research study diagnoses. Only one case was reclassified as pure SLI. It's tempting to read the data as supporting the view that auditory deficits are often an underlying cause of language deficits. But that might be exactly the sort of bias that Moore is decrying.

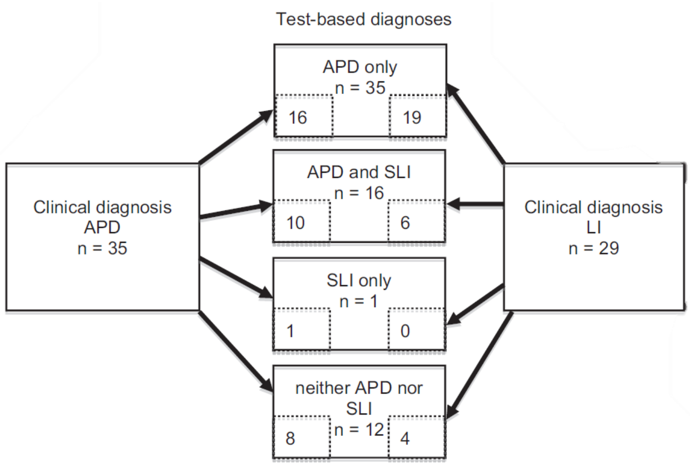


Fig. 2. Numbers of participants with clinical diagnoses of auditory processing disorder (APD) and language impairment (LI) in each test-based subgroup (APD and specific language impairment [SLI]).

Beside the intriguing results, I recommend this classic paper for its objective discussion on whether APD and DLD are independent constructs; two facets of the same disorder; or whether one is a subset of the other.

Ferguson, M. A., Hall, R. L., Riley, A., & Moore, D. R. (2011). Communication, listening, cognitive and speech perception skills in children with auditory processing disorder (APD) or specific language impairment (SLI). Journal of Speech, Language, and Hearing Research, 54, 211-227.

Miller, C. A., & Wagstaff, D. A. (2011). Behavioral profiles associated with auditory processing disorder and specific language impairment. Journal of communication disorders, 44(6), 745-763.

Moore, D. R. (2006). Auditory processing disorder (APD): Definition, diagnosis, neural basis, and intervention. Audiological Medicine, 4(1), 4-11.

Additive or Multiplicative Effects of Distortion?
Author: Harvey Dillon

The previous issue of NeuroAudiology Newsletter contained an interesting piece on whether multiple distortions or deterioration of a signal cause additive or multiplicative changes in speech understanding. The following gives a better way to think about how different issues, including deficits in auditory processing, combine to affect speech understanding.

First, consider the psychometric function shown below in the solid blue line. The person to whom this applies can understand 50% of words in sentences at a signal-to-noise ratio (SNR) of -5 dB. Around this SNR, each 1 dB change in SNR results in a 10-percentage point change in understanding, which is typical for sentence-in-noise tests. At much better or much worse SNRs, a 1 dB change in SNR causes much smaller changes in SNR. Let's apply this to the example given in the last newsletter. When speech was filtered, understanding dropped from 100% to 88%, which for this typical psychometric function is equivalent to a 6 dB decrease in SNR. When speech was instead interrupted, understanding dropped to 93% which is equivalent to a 4 dB reduction in SNR. So, what should happen when the speech is both filtered and interrupted? Applying simple additivity to the decibel equivalents, the combination should be equivalent to a 10 dB reduction in SNR, which the psychometric function predicts would lead to 60% correct understanding, which compares well to the experimental result of 64%. So the two effects are additive, but it is the equivalent changes in SNR that must be added.

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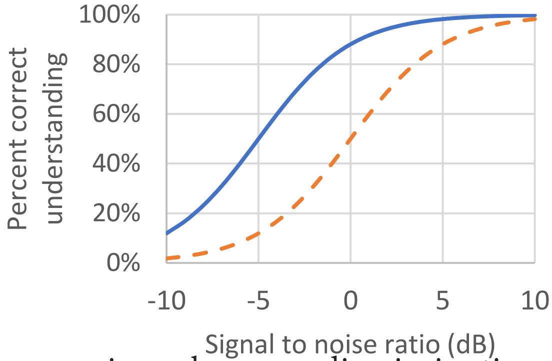
Additive or Multiplicative Effects of Distortion?



Now let's apply this to someone with a deficit in speech understanding in noise, of a degree quantified by the dashed orange psychometric function. The deficit might be caused by deficits in any of cochlear functioning, central auditory processing, phoneme discrimination ability, language ability, or cognitive ability. Irrespective of the cause, this person has a deficit equivalent to a 5 dB change in SNR. That is, they need an SNR 5 dB better than the typical person of the same age to understand the same amount. Suppose both people are initially listening in an environment where the SNR is 10 dB. Both understand 100% of the words. Then some background noise starts, reducing the SNR to 0 dB. The typical person still understands 88% of the words, but for the person with the deficit, the additive effects of their 5 dB internal deficit plus the 10 dB reduction in SNR causes understanding to reduce to only 50% correct.

The important practical point of all this is that anything that degrades understanding (like noise, reverberation, rapid speech, or poor enunciation) for a person with typical speech understanding ability can cause a much greater degradation for someone who has an intrinsic deficit in understanding, irrespective of what causes their intrinsic deficit. Another practical implication is that we can usefully quantify a person's deficit in terms of how many dB of SNR the deficit is equivalent to. Even when conditions are good enough for a person to understand close to 100% of the words, the deficit expressed in equivalent dB SNR gives us insight into the additional listening effort involved for that person, and hence the decrease that causes in cognitive spare capacity to make use of the message. Additionally, in principle, where a person has several underlying causes for their deficit, the effects of each underlying deficit can also be quantified in terms of its equivalent SNR deficit. Research in this area is current.

The Learning Corner

Key points: The first two articles add to the growing body of evidence that those with autism may be at risk for CAPD as demonstrated by both behavioral and electrophysiological measures. The third article relates information on a new game that can screen for auditory processing disorder in school age children.

- Goncalves, A. M., & Monteiro, P. (2023). Autism Spectrum Disorder and auditory sensory alterations: a systematic review on the integrity of cognitive and neuronal functions related to auditory processing. Journal of Neural Transmission, 130(3), 325-408.
- Seymour, R. A., Rippon, G., Gooding-Williams, G., Sowman, P. F., & Kessler, K. (2020). Reduced auditory steady state responses in autism spectrum disorder. Molecular autism, 11, 1-13.
- Gabaldón-Pérez, A. M., Dolón-Poza, M., Eckert, M., Máximo-Bocanegra, N., Martín-Ruiz, M. L., & De La Cruz, I. P. (2023). Serious game for the screening of central auditory processing disorder in school-age children: development and validation study. JMIR Serious Games, 11(1), e40284.

Author Contributions:

Bill Keith (pictured left)
Harvey Dillon (pictured right)

AUDIOLOGY TRIVIA ANSWERS

1) The section of the CC that contains auditory transfer fibers is (C) the isthmus.

2) Jim Jerger received his Ph.D. in (B) 1954.

3) (D) 8% of tinnitus patients claimed their tinnitus to be ultra loud.

PAST NEWSLETTERS: Past newsletters can be found at: hearinghealthmatters.org/category/pathways-society/