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Pure-Tone Audiometry and Masking: Interview with Maureen Valente, PhD

Douglas A. Beck, AuD, speaks with Dr. Valente about her new book and more.

Academy: Hi, Maureen. Thanks so much for your time today.

Valente: Hi, Doug. Good to speak with you again!

Academy: Maureen, if you don't mind, as I was reading the preface to your new book, *Pure-Tone Audiometry and Masking*, I noticed it seems to be the first of the Core Clinical Concepts in Audiology (CCC-A) series? Of course, I've seen that acronym somewhere before...

Valente: Yes, it is familiar! In this case, it stands for the Core Clinical Concepts in Audiology series. The series is meant for clinicians, students, instructors, and other readers who may be professionally involved in each topic. Therefore, the books are intended to be practical, concise, focused toward in-depth information on a particular concept, and a little less expensive than traditional textbooks. They may be used individually or in a series.

Academy: Excellent idea. In addition, I believe the series editors are James W. Hall III, PhD, and Virginia Ramachandran, AuD?

Valente: That's right. In addition, the series is being published by Plural Publishing.

Academy: Okay, appreciate that, thanks. I really enjoyed reading the book. I have to admit, most of the things in the book were very familiar, but I had forgotten some of the rationales over the last 25 years or so!

Valente: Exactly. I'm so glad to hear that! That's what the book is supposed to do. You know after a few decades of practice, we each do things a certain way, or we were taught things a certain way—and it's kind of fun to go back and review those same issues to learn more about them and to get a better or deeper understanding as to how clinical practice evolved over the years. There are some very difficult introductory concepts for students to learn, such as dB references, calibration, audiogram interpretation, and masking. It's important for the student to gain a firm foundation, too, before progressing further.

Academy: Well, I certainly learned a few things. One thing that caught my eye early on in the first chapter or two was that there are apparently five different types of audiometers (Types I, II, III, IV and V). Frankly, I always just thought of two types: screening audiometers and diagnostic audiometers!

Valente: Right, briefly, the elaborate diagnostic audiometer with so many intricate features is most often a Type I and the limited-function pieces of equipment may be considered Type V. While there may be numerous minimum and maximum feature requirements for a Type I unit, few if any exist for a Type V. One reason I included that information in the book had a lot to do with my understanding of the equipment as I re-read the ANSI standards from 2004, related to calibration issues.

Academy: That is interesting. Again, I must have slept late the day we covered that in my master's program! You have a nice up-to-date discussion about headphones and inserts. I guess the standard headphones are now the TDH-49 or TDH-50?

Valente: Audiologists certainly select a variety of equipment for clinics, and I am not sure we can ascertain which is more standard, but as long as they are well calibrated, that is the key. This is so important with respect to calibration because you cannot simply unplug a TDH-39 and plug in a TDH-49 or TDH-50 or a pair of inserts. The transducers are different and each has its own reference equivalent threshold SPL levels or correction factors in converting from HL to SPL. The chapter called Preparation for Pure-Tone Testing reviews these issues in detail.

Academy: I recall the Voss and Herrmann article a few years back (2005, *Ear and Hearing*, December 26(6): pages 636-50) where they talked about some other basic issues. For example, we calibrate the transducers, but then we use them on all ears—tiny, small, medium, large, and extra large. Of course, as the physical size and acoustic properties of the ear canals vary, so, too, will the SPL at the eardrum—even if they are all perfectly calibrated! If I recall correctly, inserts had more variation than headphones because when correctly inserted in the infant's ear, the residual volume is tiny, whereas that same calibrated insert placed in an adult male may produce a 5 to 10 dB lower SPL at the eardrum.

Valente: Good point—imagine if the audiometer is not calibrated properly with regard to the inserts or headphones or if there is improper transducer placement; the variability could potentially be huge. So each audiometer has to be calibrated to the specific transducer (insert or specific headset), according to all procedures outlined via ANSI standards.

Academy: And these issues are important, too, even with portable screeners.

Valente: Sure...unfortunately some clinicians or students might just grab a pair of headphones and swap them out with their screener

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or even diagnostic units. If the specific transducer (headphone or insert) has not been calibrated for that specific audiometer or if the audiometer itself has not been calibrated, it is likely to introduce artifact into the testing session.

Academy: Maureen, do you actually calibrate your own equipment?

Valente: No. I enjoy having access to the technology and knowing the information, but we actually have a service come in to calibrate and certify our equipment. I definitely feel it's important to include extensive calibration content and hands-on experiences within our educational programs.

Academy: Good—the statement about hiring a service makes me feel better! I haven't calibrated an audiometer since graduate school. I suspect it would take me a solid week to calibrate a simple screening Type V audiometer! However, you are exactly right, we need to understand the basics and the theory, but perhaps the annual calibration is best left to the people that do that every day!

Valente: Yes, I have to agree, that is my preference.

Academy: Another fun fact that I think some audiologists neglect when creating their own audiograms is that there is a proper and designated scale to audiograms, such that each octave should have the same dimension as 20 dB. Therefore, if the distance from 500 to 1000 Hz is 5 mm on the audiogram, the distance from 20 to 40 dB should also be 5 mm.

Valente: That is referred to as the "aspect ratio." Of course, it makes it easier to interpret audiograms when they are all scaled to the same standard.

Academy: Do you think we will ever change the core essence of the audiogram? In other words, two things come to mind; the first is that because hearing aids specs are in SPL, do you think we will ever transfer to SPL measures rather than HL measures on audiograms? In addition, what about the fact that as hearing loss increases (goes to a higher number of dB), the audiogram represents values going south on the page!

Valente: Well, those are issues that have been discussed and debated, but we are so far into doing it the way we do it, I doubt it will change in our lifetimes! I think it is important to make certain to orient ourselves with regard to terminology—discussing "poorer" hearing as threshold levels in dBHL are becoming greater and as we are moving downward on the page could certainly become confusing to the patient or novice clinician.

Academy: Right—it is not likely that we will see any big changes occur. I recall when the United States tried to go metric in the 70s and 80s—yikes! It seemed so simple to go from inches, feet, and yards to meters and kilometers—certainly seemed to me like a change toward simplicity—but it failed miserably. People like things they are familiar with.

Valente: Exactly. We do use HL and SPL scales as well as different weightings (A, B, C) in hearing aid measurements and calibration, SPL-O-Grams and more. So of course, the audiologist has to be familiar with them, but I do not see standardization in the near future! These different weightings and scales are well embedded in audiology. When one thinks about it, it is so much easier to record and interpret audiograms that are referenced in dB HL and audiometric zero. If they were designated in dB SPL, this recording and interpretation may be challenging, in view of non-linearity of the ear as a function of frequency.

Academy: And you do have a perfect audiogram representation on page 52 of the book. If I were still in practice I would probably scan that, resize it, and steal it for my clinic! Are people allowed to do that?

Valente: Well, I think it's okay as long as they give credit to and receive permission from Plural Publishing and the Division of Adult Audiology within Washington University's Department of Otolaryngology, as they developed and graciously shared that audiogram form.

Academy: Okay, because we certainly do not want to encourage copyright infringement! However, you do show an excellent and well-scaled audiogram without all the icons, letters, bananas, and things that drive me crazy all over the audiogram. Nevertheless, I digress. Okay, I am getting off my soapbox now, but I really do like the audiogram you present on page 52—clean and simple, scaled, and correct!

Valente: Thanks, Doug. It is one of those things where it is evolved quite a bit over the decades and people tend to adapt their audiograms to their needs and their preferences, so we do wind up with quite a variety! For example, some clinicians prefer one-ear audiograms whereas others prefer two-ear audiograms.

Academy: Absolutely. Even pure-tone averages (PTA) have evolved. In the book, you talk about a 3 frequency PTA, and, as you say, it has evolved across the world. Many places use 4 freq PTA and as much as I do not like pictures and letters on audiograms, I do like adding in 3000 or 4000 Hz in the PTA to better represent the F2 sounds and to recognize the importance of the human ear canal resonance at about 2700 Hz or so.

Valente: Sure, that makes sense. In addition, I agree many audiologists do include higher frequencies in their PTAs, too, and when they do that, it's important to define the components of your PTA somewhere, so people reading that PTA will better understand what it represents. On the other side of the coin, there are times when it becomes necessary to calculate a 2-frequency PTA. Many audiologists look for optimal agreement between this PTA and speech threshold measures, to help ensure reliability of measures during the testing session and ascertain how the patient is receiving (not necessarily recognizing or understanding) speech.

Academy: Of course, that makes sense. I want to also acknowledge you have a great chapter on masking. I suspect most audiologists writing basic audiology textbooks tend to break out in a cold sweat when they have to write up their personal explanation of masking.

Nonetheless, your chapter was well written, practical, and reminded me of many of the reasons we do what we do, again including theoretical and practical issues. Further, you have chapters on unconventional pure-tone techniques, hearing screenings, a section or two on high frequency audiometry, tuning fork tests, nonorganic evaluation and many sample audiograms for review purposes.

In addition, Maureen, although it is getting a little late and I have to let you go...there is one last thing that I really liked. In the book, you talked about "hearing loss" for adults defined as being 26 dB or worse, but importantly, you agreed with Marion Downs from decades ago (and many others!) that for children, the upper limit of normal hearing is 15 dB. If a child has a PTA of 16 dB or greater—that is a hearing loss that may warrant consideration of medical treatment, amplification, and/or other (re)habilitative measures.

Valente: Yes, I totally agree. Children with minimal or mild hearing loss are simply at a great disadvantage with regard to speech and language development, as well as so many related problems such as paying attention, reading, spelling, vocabulary and more. Some audiologists may consider thresholds of 16-25 dB HL with adults to be a "slight loss" although remediation strategies implemented may be less aggressive than with children.

Academy: Right, and the reason I like to bring this up with respect to children is so many school screenings occur at 20 or perhaps 25 or 30 dB—and so we may be missing the forest for the trees. There was an amazing edition of *Seminars in Hearing* in May of 2008 on issues related to mild and unilateral hearing loss in pediatrics—and it is one of the most important documents I've ever read on these topics. Thanks so much for your time and for writing a basic and comprehensive guide for clinicians, students, and instructors—I totally enjoyed it and I must admit I learned (and re-learned) lots of great information as I went through the book.

Valente: Thank you, Doug! Among my goals are for the reader to use the information to help transition from theory and classroom to clinical application, and to further develop clinical insights. As a follow-up and final thought to the school screening concept, ambient noise levels in these environments may prevent screening at conservative levels. Perhaps one approach is to screen at 15 dB HL in a sound treated booth, if possible. Moreover, certainly we keep those "minimal hearing losses" in mind when making recommendations after both screenings and comprehensive evaluation.

Thanks again so much for the invitation, Doug, and your interest in the textbook. I appreciate your time, too!

Maureen Valente, PhD, is the director of Audiology Studies in the Program in Audiology and Communication Sciences (PACS), Washington University School of Medicine, St. Louis, Missouri. She is also the author of Pure-Tone Audiometry and Masking, published by Plural Publishing.

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