The Best of 2009:
Hearing Aids

By H. Gustav Mueller

If my math is correct, our Journal Club is back for our 15th year. Let’s reminisce for a moment. When we started this little club, hearing aid manufacturers were promoting a new, small, “barely visible” product, James Jerger was the editor of the Journal of the American Academy of Audiology (JAAA), and the articles I reported on were questioning if noise reduction in hearing aids really improved speech understanding. Wait, that sounds like today! Well, okay, one thing has changed—I’m no longer sending my article draft to Journal editor David Kirkwood on a floppy disk!

Perhaps the most talked about hearing aid article of 2009 wasn’t even in a journal—it was in the magazine Consumer Reports. Many of you probably believe that the Consumers Union should stick with rating cameras and microwaves, but they had plenty to say about hearing aids, including some not-so-flattering things about how they are fitted. Many of you readers weighed in on this topic—see David Kirkwood’s review in last month’s Cover Story.

Fortunately, there were many articles to talk about from the audiology literature too, so let’s get to it.

GREAT FOR THE CLINICIAN

Most of you readers are busy clinicians, but now and then, between patients, you have time to read an article—providing that it’s not too long or too complicated. Here are a few I think might be just right for those occasions.

An article from 2009 that you can’t ignore was written by Lesli Guthrie and Carol Mackersie and published in JAAA. My Journal Club colleague Brad Stach also mentioned it, as indeed it fits in his topic category. But I want to mention it too for one simple reason: Most of you use word-recognition scores when making decisions about fitting hearing aids. My point is, when word-recognition scores are used for amplification decisions, it’s important to obtain a close estimate to the patient’s PB-Max. Ideally, you conduct a performance/intensity function, but in a busy clinic, there’s often no time for this. These authors report that a couple of commonly used presentation methods don’t work very well for finding PB-Max: the patient’s MCL or using an SL approach referenced to the SRT. That’s probably not big news to many of you, but these outdated approaches do seem to persist in clinical practice (you’ll have to check the article to see what approach is best).

Ever since WDRC hearing aids were introduced, we’ve generally believed that a “good fitting” would make soft sounds audible, average sounds comfortable, and loud sounds loud, but not too loud. Seems reasonable. However, in a JAAA publication, Peter Blamey and Lois Martin question if this is the best approach if listening comfort is an important factor for your patient’s overall hearing aid satisfaction. Using a self-assessment scale that they developed, the Environmental Sounds Questionnaire (ESQ), which is an expanded version of the Profile of Aided Loudness (PAL), they assessed loudness judgments and satisfaction with loudness for different environmental sounds. They found there was greater “satisfaction with loudness” when loud environmental sounds (sounds that would be perceived as “loud” by normal-hearing individuals) were perceived as comfortable, rather than loud. But don’t forget, this fitting approach may not lead to maximum satisfaction for understanding speech, which is also an important patient concern. It does help explain, however, the frequent comments from patients regarding loud sounds being too loud, even when the hearing aids have been carefully fitted to keep loud sounds below their LDLS.

When a patient has a severe-profound hearing loss in the higher frequencies and it’s impossible to apply enough gain/output in this region to obtain useful audibility, one option is to use a frequency-lowering algorithm. This could be either frequency transposition or frequency compression. Articles on this technology are beginning to emerge in the peer-reviewed literature, and one that I selected was published in the International Journal of Audiology and written by Danielle Glista and her colleagues from the Canadian National Centre for Audiology. They used a prototype, non-linear, frequency-compression device, similar to what is now commercially available, with 13 adults and 11 children. They report that on average this algorithm was successful in improving high-frequency audibility, which resulted in better high-frequency speech sound detection and recognition. They note, however, that there was considerable individual variation and that degree and configuration of the hearing loss were significantly related to benefit (average hearing loss in the high frequencies was ~80 dB HL). Children were also more likely to benefit than adults. I suspect we’ll see many more publications on this topic in the upcoming years.

At what age is it okay to fit young children with hearing aids with directional technology? Six years? Three? Any age? This is a tough call that is faced by many clinical audiologists. In
a publication in the *Journal of Speech, Language, and Hearing Research (JSLHR)*, Teresa Ching and her colleagues used real-world head-orientation data and STI measurements to predict the efficiency of directional technology. They conclude that this technology is not detrimental and can be fitted at an early age (implemented with automatic switching) when accompanied by appropriate counseling for caregivers regarding ways to maximize benefit.

**BEST QUICK READ**

The first article I’d like to mention (which won the biggest “n” of the year award at 840 participants) is by Catherine Palme and colleagues, published in *JAAA*. Patti McCarthy also mentions it in her review, so I’ll be brief. In terms of “bang for the buck,” the pre-test they write about just might be the best around, as you only have to ask one question. The question used in this study was: “On a scale from 1 to 10, 1 being the worst and 10 being the best, how would you rate your overall hearing ability?” The answer to this question tended to divide the patients into three groups: those very likely to pursue amplification (ratings of 1–5), those very unlikely to pursue amplification (8–10), and a third group that needed more information (6–7). As the authors mention, this one question might be very useful in developing appropriate counseling strategies.

Have you thought about your “working memory capacity” lately? Resource allocation ability? Buffer size? How about the working memory capacity of your hearing aid patients? As we’ll discuss again in this review, there is a growing interest in the relationship between the patient’s cognition and the processing of the hearing aid. Performance related to cognition could be a helpful way to measure hearing aid benefit or maybe even factor into hearing aid design. Some have suggested that specific algorithms should be individually cognition-driven. If you’d like a review of all this, check out the article by Thomas Lunner, Mary Rudnes, and Jerker Ronnberg in the *Scandinavian Journal of Psychology*.

A final quick read about hearing aid expansion that you might like is from *JAAA* and written by Marc Brennan and Pam Souza. Some of the reading will be quick because the findings are more or less what you might expect; if the expansion kneepoint is too high, consonant audibility and recognition will suffer. The authors suggest that an expansion kneepoint of 30 dB SPL might be best. But do you want the same kneepoint for all frequencies? And if you have a good active DNR, do you really need expansion?

**NOT READY FOR PUBMED**

This is always the toughest category for me to narrow my selections to a few key articles. Of the 150 or more hearing aid articles published in 2009, over 50% were in the Not Ready For PubMed journals, and many of them were excellent.

Let’s start off with some Page Ten articles from *The Hearing Journal (HJ)* that I think you would like. If you’re thinking about expanding the pre-testing you conduct prior to your hearing aid fittings, then you’re going to want to read the review articles written by Patrick Plyler on the Acceptable Noise Level (ANL) test and by Gaby Saunders on the Performance Perceptual Test (PPT). The results of both the ANL and the PPT can provide useful information to assist with counseling, and these articles give you just the amount of background information you need to get started.

Another pair of Page Ten articles from *HJ* that I especially liked were written by Robyn Cox on “low-tech hearing aid verification.” When it comes to verification, “high tech” usually trumps “low tech,” but there is one test Robyn discusses that I think is a useful supplement to your routine probe-mic measures. Bolts, nuts, marbles, coffee cans, and glass jars. That’s about all you need for the HONK—an acronym for the HARL (Robyn’s lab) Obnoxious Noise Kit. She gives you all the details on how you can use these “calibrated” homemade noise makers to make sure you have the hearing aid output set correctly.

As I mentioned earlier, hearing aids with frequency-lowering algorithms have been introduced in recent years, and, like all hearing aid fittings, verification is the key. With this algorithm, it’s critical to measure its impact on the high-frequency speech signal so that the hearing aid setting can be optimized. Danielle Glista and Susan Scollie provide you with just the help you need in their *Audiology Online* publication. There is background information, step-by-step protocols, and illustrative probe-mic screen shots. The article is somewhat specific to a given hearing aid and probe-mic system, but the concepts could easily be transferred.

One of my favorite Not Ready for PubMed articles of 2009 was written by Pam Souza and also published at *Audiology Online*. It’s a tutorial on fitting hearing aids on people with severe hearing loss. Among other things, she includes a thoughtful discussion of the compromise that often needs to be made between maximizing audibility while minimizing speech distortion that just might influence which compression kneepoints, ratios, and time constants you choose for your next patient with a severe hearing loss.

**MOST THOUGHT PROVOKING**

Some thought-provoking things just don’t go away. Let’s go back to 2002 when I reviewed two 2001 articles about binaural loudness summation. The first was by Ruth Bentler and John Nelson, who concluded, “Binaural summation of approximately 6 dB was found independent of stimulus type, filter shape, and spectral content, indicating that a 6-dB correction would be appropriate for binaural fittings.” Okay, 6 dB of summation, you’ve heard that before, right? That same year, Robin Cox and Ginger Gray also published an article on binaural summation. In agreement with Bentler and Nelson, they found that when testing was conducted under...
earphones binaural summation was around 5-6 dB (for inputs at or near the patient’s LDL). But here’s the thought- provoking part: When testing was conducted in the sound field, there was no loudness summation for the same input levels. In many fittings, a 6-dB mistake can be costly, especially if you don’t give the patient a means of adjusting the volume.

With that review under our belt, let’s get back to 2009 articles. In *Ear and Hearing*, Michael Epstein and Mary Florentine examine binaural summation for earphones versus sound field for three input signals: pulsed 1000-Hz tones, recorded spondees, and monitored live voice (MLV), which included watching the audiologist present the words. Just as Cox and Gray reported 8 years earlier, there was significantly less summation for all three stimuli presented in the sound field compared to earphones. The least summation was for the MLV presentation. So, how does this relate to bilateral versus unilateral hearing aid fittings? And how about the bilateral correction factor that is used in your favorite fitting software?

On to thought-provoking things that don’t go away, Part II. For the past 40 years or so, we’ve been conducting research on directional-microphone technology. This research often includes clinical speech testing and real-world patient judgments of benefit. The typical finding has been a clear benefit for directional in the lab, yet often, in the real world, listeners don’t hear much difference. In a well-designed, well-controlled study, this topic was revisited last year by David Gnewikow, Todd Ricketts, Gene Bratt, and Laura Mutchler in *the Journal of Rehabilitation Research and Development*. As expected, performance in the lab showed a significant advantage for directional amplification for two different speech-in-noise tests. Following the real-world use of the hearing aids, several outcome measures were used to assess benefit and satisfaction. In one of these, the participants simply selected a listening preference from among four choices: their old hearing aids, new hearing aids with omnidirectional, new hearing aids with directional, and “no preference.” They selected preferences for three different conditions: quiet, noise, and overall. I’m going to focus on the listening-in-noise condition with the new hearing aids. Of the participants with mild/moderate hearing loss (n=32), 56% favored directional and only 28% favored omni. Makes sense for listening in noise, right? So what did the moderate hearing loss group (n=33) prefer when listening in noise? The authors report that 58% of the participants favored omni and only 30% favored directional. What? Remember the line from the old *Saturday Night Live* skit: “Don’t you hate it when that happens?”

**ALL-AROUND FAVORITES**

Hearing aid technology seems to move ahead in baby steps, and sometimes it’s tempting to think that we haven’t made much progress since the two-channel K-Amp. It’s therefore hard not to like research results that show some good things about more recent technology. You might recall that last year in this section I mentioned a 2008 publication by Ruth Bentler and colleagues that reported some small but significant advantages for digital noise-reduction (DNR) algorithms. There was more good news on this front in 2009. Writing in *JSLHR*, Anastasios Sarampalis and co-workers examined how hearing aid DNR might affect cognitive tasks performed while responding to sentences or words in background noise. The tasks involved either holding words in short-term memory or responding in a complex visual reaction-time task. They report that, as in previous studies, the DNR did not improve speech understanding, but it did increase performance on the word-memory task and faster reaction times. These were normal-hearing subjects, but the results certainly are encouraging. Look for more research of this type in 2010.

**IN CLOSING**

Well, that’s it for another year. I picked out a few highlights, but there are still a lot of good articles out there that you’ll have to track down on your own. In preparing this review, I couldn’t avoid peeking at what has been published so far in 2010. I can see already that it is going to be a banner year for hearing aid articles, with the list of senior authors reading like a who’s who of audiology. As a wise person once said, “Research is simply formalized curiosity. If you are still curious next year, we’ll meet again.”

**ARTICLES CITED**

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Guthrie L, Mackersie C: A comparison of presentation levels to maximize word recognition scores. *JAAA* 20:381-390.