Telepractice in Audiology

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Telepractice in Audiology: A Model for Development and Implementation  It is no longer a question of whether using telepractice for hearing health care is a viable delivery method for service, but when will it be widely available?
By Devin McCaslin and Anne Marie Tharpe

Future Trends in Objective Evaluation of Auditory Processing of Speech Stimuli One way to assess auditory processing of speech stimuli is to capture potentials evoked by the speech stimuli and construct spectrograms based on this activity.
By Vishakha W. Rawool

A Simple Device to Enhance Hearing  This article describes a simple technique to take advantage of the natural anatomic amplification system of the human ear, which could provide a more economical, disposable, and natural alternative for patients with mild-to-moderate hearing loss.
By Aina Calimano, Jo Ann Lederman, and Agustin Arrieta

Screening for Cognitive Disorders in Older Adults in the Audiology Clinic  Audiologists might be reluctant to administer cognitive testing for fear that they may wound the patient’s ego, therefore, it may be useful to unobtrusively incorporate a screening measure for cognitive impairment as part of the audiological and communication needs assessment.
By Robert W. Sweetow

They Say “I Can’t Hear in Noise,” We Say “Say the Word Base”  An individual’s ability to understand speech-in-noise provides valuable insight when recommending a hearing aid technology level, need for assistive listening devices, and in establishing realistic expectations.
By George Lindley

Academy Research Conference (ARC) 2015—In Review  ARC is a one-day conference designed to bring scientists and clinicians together so that current topics in science can be discussed from multiple translational perspectives. This year the topic was Vestibular Assessment and Rehabilitation. ARC 2016 will focus on CAPD topics and will be held April 13 in Phoenix, AZ.
By Devin McCaslin
EDITORIAL MISSION
The American Academy of Audiology publishes Audiology Today (AT) as a means of communicating information among its members about all aspects of audiology and related topics.

AT provides comprehensive reporting on topics relevant to audiology, including clinical activities and hearing research, current events, news items, professional issues, individual-institutional-organizational announcements, and other areas within the scope of practice of audiology.

Send article ideas, submissions, questions, and concerns to amiedema@audiology.org.

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PRESIDENT’S MESSAGE

Moving Toward Synergy

As my year as president-elect ended in June, there has been a lot of learning and interaction with Academy members from all over the world. I am ready, privileged, and honored to serve as your 26th president of the American Academy of Audiology. I am also committed to building on the momentum of all those who served in this position previously and moving the profession of audiology forward.

In thinking of the path forward for the Academy, the word “synergy” springs to mind in the way the Academy and its staff, partners, and committees work together with the shared understanding that as audiologists we make a major difference in the lives of people with hearing loss, balance problems, and tinnitus.

Synergy also describes the way our Academy management works both as individuals and as a team toward the betterment of the organization as a whole. Working in synergy, the organization’s parts interact jointly to produce an effect greater than the sum of the individuals acting alone. Positive or negative synergies can exist, but in our case, I have seen only positive effects such as improved efficiency in operations, greater exploitation of opportunities, and improved use of resources.

Let me first thank our past president, Dr. Erin Miller, for her positivity, critical decision-making, and leadership over this past year. It was a challenging transition for the Academy staff and leadership, and thanks to her leadership, I believe we are now in a stronger position to continue the work of the Academy. In addition, I would like to thank those board members who have completed their terms on the Academy Board: Drs. Carol Cokely, Tish Gaffney, and Richard Roberts. Thank you colleagues for your insights, input, and leadership. I want to also thank our committee chairs who have completed their commitments in leading and guiding our committees: Drs. Mindy (Brudereck) Tanner, Dan Brown, Erica Friedland, Gloria Garner, Terri Ives, Karen Jacobs, Kara Leyzac, Helena Soladar, and Sarah Sydlowski. Last but not least, I want to thank our volunteer committee members who rotated off committees.

Finally, I want to thank the past presidents for their ongoing support and input. I have heard from many of you offering ideas and assistance. Thank you for helping us to build on your legacy to strengthen our collective voice on behalf of the profession of audiology. I look forward to this year at the Academy.

Moving into the new year, I want to welcome back to the Board of Directors our new President-Elect, Dr. Ian Windmill, whose past leadership with ACAE and the Board of Directors promises to continue the vision of the Academy. We welcome new board members: Drs. Holly Burrows, Virginia Ramachandran, and Sarah Sydlowski; our new committee chairs: Drs. Trey Cline, Mike Dybka, William Eblin, Lindsey Jorgensen, Kelly King, Kate Marchelletta, Joscelyn Martin, Emily Nairn-Jewell, and Jennifer Shinn. Additionally, I would like to welcome our SAA President Kaitlyn Kennedy, who will be joining us on the board as an ex-officio member as part of our ongoing leadership training program.

I especially want to express my appreciation to our Executive Director Tanya Tolpegin, for her long hours and commitment to helping the board understand the infrastructure of the Academy so we are better positioned to prioritize our programs, manage our initiatives, and guide our future.

Most importantly, a big thank you to our Academy membership, for without your collective voice and belief of what we do as audiologists, we cannot exist. Many of our Academy members in private practice have shared concerns about the challenges and issues that face the solo practitioners in this climate of changing health-care delivery. The Academy heard your concerns and is excited to offer the first of several, specialty conferences. Join us September 11–12 in Baltimore, MD, for the Practice Management Specialty Meeting. Our program chair Karen Jacobs promises to bring a discussion of the issues, solutions, and ideas to the two-day program.

Larry Eng, AuD
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In the competitive and increasingly transparent market we face today, we continually ask ourselves: What is the key to winning over our patients and maintaining their loyalty? We have heard everything from a hearing aid battery loyalty program to a captivating front-office experience. These are certainly important, but according to a reoccurring topic in current news, there is one important thing that may help to seal the deal. Social responsibility—when people and organizations behave ethically and sensitively toward social, cultural, economic, and environmental—is on the rise for businesses both big and small. According to businessdictionary.com, social responsibility is “the obligation of an organization’s management towards the welfare and interests of the society in which it operates.”

The ease at which news can spread with social media and other technologies makes the viewing of natural, political, and corporate disasters a regular occurrence. Boycotts of those corporations viewed responsible, i.e., a gas company being targeted during an oil spill or a fast-food company being held responsible for obesity, have certainly shown that poor business image translates into lost profitability. Dr. Thomas Ngniatedema, a business professor at Kettering University in Flint, Michigan, found “a relationship between environmentally conscious corporate operations and financial performance” exists among the top 500 publicly traded companies in the United States. (Ngniatedema, 2014)

As a result, the emerging trend indicates that today’s generation is looking for more than just a good product or service. For example, in a survey by the branding company Landor Associates, 55 percent of consumers said they paid attention to social responsibility when making purchases (Knowledge, 2012). Upcoming generations may be even
more inclined, with 85 percent of youth claiming they pay attention to corporate behavior and 50 percent saying they make purchasing decisions based on social responsibility (Kielburger, 2011).

Both local and global businesses with reputations for being socially responsible are often spotlighted in the news, such as Ben and Jerry’s Ice Cream, which, starting as a small independent business, donated 7.5 percent of annual profits to local community projects in the 1990s. (Dembosky, 2010) The rankings of the most socially responsible corporations are published each year.

Give-back models are also evident in audiology. Most of the largest hearing aid companies have charitable foundations. Independent practitioners can join community-service models, such as Entheos Audiology Cooperative (www.entheoshearing.com), that guide the inclusion of humanitarian efforts into practices.

What can you do to incorporate the good vibrations of social responsibility into your practice?

Get Employees on Board

Before reaching out to the broader community, it is important to get employees on board with new visions first. Implementing a socially responsible vision is a great way to bring your organization together toward common good and encourage employees to feel good about their job.

Do It For You

While the rewards of social responsibility could be great for business (i.e., free publicity, increased patient loyalty, etc.), do it for yourself and not because of what others will think. Morality shouldn't need incentive to do the right thing or to offset a “bad” act. In addition, it will likely help increase enthusiasm for what you are doing, prevent burnout, and help you sleep better at night.

Conclusion

No matter how big or small your business, socially responsible initiatives can help you do more with less. There are many facets for audiologists to contribute to social, cultural, economic, and environmental issues. Working toward greater good is a way to bring teams together. Patients will likely take notice of your organization for being socially responsible, and reward these practices with praise, loyalty, and their valued business.

Erica Hansen, AuD, is an audiologist at Adobe Hearing Center in Tucson, AZ, and an instructor for the College of Health Sciences at Northern Arizona University. She is a member of the Academy’s Business Enhancement Strategies and Techniques (BEST) Committee.

References


We Want to Hear From You!

What do you want to see more or less of on the Academy’s social media pages?

Email your thoughts to marketing@audiology.org.

July 14
eAudiology Web Seminar
Coding and Reimbursement Series: ICD-10’s—T Time and Counting
www.eaudiology.org

July 23–25
Meeting
Kentucky Academy of Audiology Conference, Lexington, KY
www.kyaudio.org

July 29
eAudiology Web Seminar
Developing Therapies to Prevent Drug-Induced Hearing Loss
www.eaudiology.org

August 6–8
Meeting
Florida Academy of Audiology Annual Convention, Lake Buena Vista, FL
www.floridaaudiology.org

August 19
eAudiology Web Seminar
Successful Aging: Linking Hearing and Memory to Social, Psychological, and Health Factors
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Challenge yourself to do at least ONE of these today.

1. Write to your congressional representatives in support of audiology legislation. Use the Legislative Action Center at http://capwiz.com/audiology. This takes less than two minutes!

2. Put letters at your front desk or waiting area for your patients to sign. Patients make great advocates.

3. Give to the Academy’s Political Action Committee (PAC).

4. Get involved in both your state and national audiology association.

5. Visit your congressional representatives when they are in their home offices—often a personal visit is more memorable than a letter.

Visit www.audiology.org and search keyword “PAC” to learn more.
The last 15 years have seen remarkable advances in technology, some of which have been incorporated by audiologists in daily practice to improve patient care. It is no surprise that those with hearing loss rely heavily on technology and benefit from the availability of these developments. From the incorporation of smaller and faster microchips for processing sound by hearing aids and cochlear implants, to the wireless capabilities of assistive listening devices, patients with hearing loss are benefiting from these rapid technological innovations. However, one transformational development is not a technology that a patient wears, but rather a technology that brings together health-care providers and their patients anywhere there is access to the Internet.

Today, it is not uncommon for a health-care provider to interact with a patient who is not in the same building or even the same continent. The development of more efficient and reliable telecommunications technologies has opened up a new frontier for our profession that is just beginning to be explored. This remote provision of health care is known as telemedicine, telehealth, and telepractice.

It is no longer a question of whether using telepractice for hearing health care is a viable delivery method for service, but when will it be widely available?

It is no longer a question of whether using telepractice for hearing health care is a viable delivery method for service, but when will it be widely available? Telepractice will undoubtedly change the way we, as audiologists, identify and manage hearing loss in the future.

The delivery of audiological services at a distance is frequently referred to as audiology telepractice (AT). There are numerous reports detailing the presumed advantages of AT and several have documented proof of concept in different areas (Lancaster et al, 2008; Hughes et al, 2012; Hayes et al, 2012). The idea that audiologists can provide care to underserved communities where medical resources are scarce, or deliver care to patients who are unable or prefer not to leave their homes, is very appealing. However, little empirical data exist showing the actual financial costs, outcomes, and patient and
Telepractice in Audiology: A Model for Development and Implementation

Identify Area of Need
There are a number of factors to consider before any investment is made in infrastructure for an AT program. First, a detailed needs assessment should be undertaken. This process involves identifying and targeting not only the patients who do not have access to hearing services, but which services can and should be provided, and where there might be remote-site support for such services. In many instances, there are obvious factors that can lead to a subpopulation of patients not receiving appropriate or timely care. For instance, residing in a rural community where the patients must travel long distances to health care providers is the most commonly cited factor for AT need (Bush, 2015). In these cases, remote services are a natural choice because decreased travel time to appointments reduces the burden and cost to the patients. However, patients do not necessarily have to reside in a remote area in order to derive benefit from telepractice services. AT can also benefit patients who have difficulty traveling any distance even if they live in metropolitan areas with available services (e.g., sick or elderly patients). Additionally, AT offers the ability to provide specialty services to patients with unique needs. For example, some patients might not have access to providers trained in specialty areas such as cochlear implant programming or diagnostic and intervention services for infants with hearing loss. Another application could be that such services are locally available but an audiologist requests remote support or consultation for particularly difficult cases.

For our remote newborn hearing screening program, we target rural areas with high loss-to-follow-up rates. We examined statewide statistics on loss-to-follow-up rates and identified several counties that met that criterion. Next, we needed to find some assistance with implementation of our proposed program.

Find Project Partners
Identifying the right partners for a remote audiology service can make or break a remote program. Once the area of need is identified, contact health-care providers in the targeted region to determine their interest in partnering with the AT program. There are several advantages for parties to work together. For the remote site, the continuum of care will be better for members

FIGURE 1. Six recommended steps in developing and implementing an audiology telepractice.
Telepractice in Audiology: A Model for Development and Implementation

of their community who will no longer have to travel far from their homes to receive the services that are being delivered remotely. In some cases, there are audiologists available in the remote area who may not have training in specific service areas. In those situations, the hub site can provide coaching to the remote site until such time that the remote site can function independently and the AT equipment can be moved to another community.

In the case of Vanderbilt’s remote newborn hearing screening program, we partnered with the Tennessee Department of Health (TDOH) that has outpatient health care clinics located throughout the state. In consultation with their newborn hearing screening program, we identified one of the counties in northwest Tennessee with a high loss-to-follow-up rate that is also located in close proximity to one of TDOH’s clinics. This clinic provided an opportunity for us to set up and store our AT equipment and utilize assistance from TDOH staff. The clinic provided a comfortable, private, and safe room staffed by personnel who understood patient confidentiality and privacy concerns. In addition, there was a clinic staff member available who we trained on the techniques needed to prepare babies for testing.

In addition to our TDOH partners, we reached out to other audiologists and speech-language pathologists in the targeted region to work with us to provide services to babies we identified with hearing loss. Finally, because our center is part of an educational institution, we partner with federal agencies who are interested in providing training to our audiology students in the provision of AT.

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To learn more, visit www.audiology.org. Search key word UPGRADE.
These training grants provide funding support for some of our equipment needs.

**Set Goals**
Once an area of need and partners are identified, the next step is to outline the goals of the program with the project partners. Different partners might have different goals but all can be accomplished with good communication and planning. The goals need to be codified, measurable, and reasonable for the time period of examination.

For our remote newborn hearing screening program, the long-term goal for all project partners is to reduce the loss-to-follow-up-rate for infants who failed a hearing screening at their birth hospital in the geographical catchment area. Step-wise goals towards this primary goal are to:

1. Reduce the drive time from where families typically go for follow-up screening or testing versus traveling to our remote clinic.
2. Educate families about AT and ensure they are aware that face-to-face services are available elsewhere, if desired.
3. Regularly monitor and examine patient satisfaction with services.

**Operationalize Process**
Because the implementation of AT will likely require partnerships with individuals associated with institutions and/or agencies other than your own, it is imperative that everyone’s roles be clarified to ensure that all tasks are accomplished with a high likelihood of success. Such tasks vary depending on the AT services to be provided but examples of responsibilities to be assigned include:

- Who refers patients for AT services? Who schedules the patients and notifies them of appointments?
- Who provides the space and equipment for the remote testing?
- Who trains the personnel at the remote site in preparing patients for testing or other services?
- Who communicates the results to patients or families?
- Who provides the IT support for the program?

The TDOH and our center created a no-cost contract that outlines all responsibilities of both parties. This contract is renewed on an annual basis. Other partnerships with professionals in the remote area are managed through ongoing informal communications.

**Determine Technical Needs**
Telepractice can provide asynchronous (i.e., store-and-forward) or synchronous (i.e., live) interactions. Asynchronous telepractice involves the uploading of health information (e.g., x-rays, photos) from a remote site and transmitting to a hub location where a provider can review the data at a later date. With this model, providers and patients do not interact face-to-face. An example of asynchronous AT is the review of audiograms for hearing conservation programs. Audiograms are obtained on employees and reviewed later by an audiologist from anywhere in the country to determine whether a significant change in hearing has occurred. The synchronous model requires that the provider and patient are connected in real-time during the interaction. Given the bandwidth available for cellular telephone technology, the asynchronous telepractice application would likely work with great success because of its immunity to signal delay, loss or fade. Telepractice performed in real-time will be forced to deal with the realities of available bandwidth, signal loss, fade or delay.

![FIGURE 2. Mileage between families’ homes and the remote site versus their birth hospital.](image-url)
Depending on the requirements of an AT program and the type of interaction desired, different levels and types of technology are required. It is necessary to have a thorough understanding of the technology demands of a remote program before purchasing equipment. For example, tinnitus and hearing aid counseling can be delivered through the Internet using only audio (i.e., a speaker) in a patient’s home. However, to screen a newborn’s hearing remotely, an audiologist must use a virtual private network (VPN) to gain control of the computer at the remote site and conduct the screening.

Our project is rich in audio and video formats, and we have synchronous interactions with the remote end. The audiologist must be able to talk with the remote assistant as needed throughout the screening. The audio branch of transmission should not be significantly hampered by the typical challenges of a wireless cellular telephone network. We also need clear video so babies can be viewed and monitored throughout the testing while we were transmitting ABR data. We need a reliable environment that is not challenged by the fluctuating levels of service, quality, and availability of bandwidth. Audio communications are typically given priority, so any data or video components of the AT session are affected more than the conversational portion. Suitable bandwidths for different applications must be determined on a case-by-case basis. Having an IT expert on the team during the development and implementation of the program will ensure that the technologies being used are appropriate for the task. Additionally, IT personnel are instrumental in addressing maintenance of the equipment and ensuring that the host and remote sites are able to communicate seamlessly.

Before our remote program was launched, numerous test sessions were completed to ensure that ABRs could

**Telepractice will undoubtedly change the way we, as audiologists, identify and manage hearing loss in the future.**

**FIGURE 3.** Responses from respondents for the question: I would have felt more comfortable talking to the tester in person rather than on a video monitor (n=18).

**FIGURE 4.** Responses from respondents for the statement: I had an overall good experience during the screening (n=18).
be recorded accurately from a distance. These sessions employed the same equipment and protocols used for patients who have in-person appointments at our center. Remote practice runs were performed at different locations inside the center with varying distances between the patient (an infant) and audiologist. Only after the conclusion of this extensive series of trials was it determined that there was no sacrifice in the quality or sensitivity of the recordings. Accordingly, a remote outpost was setup in West Tennessee.

Assess and Reassess

Assessment is an iterative process for any AT program. Once a remote program is deployed, there are undoubtedly unexpected challenges. There should be continuous sampling of patient and clinician feedback. In the event a clinician does not feel comfortable with some aspect of the program or patients communicate that the test did not meet their expectations, concerns need to be validated and corrective action needs to be taken. Some of these challenges are obvious. For example, if an Internet connection is lost or video/audio quality is poor, patients and clinicians alike will be frustrated. Before deployment of our remote screening program, we developed a questionnaire to provide us feedback about patient perception of the program (APPENDIX 1). The questionnaire is administered to the primary caregivers immediately following each hearing screening. We continually monitor the responses to determine if patients felt at ease with this method of testing. To date, we have screened 18 babies remotely. This site only sees babies one morning per month. All families complete questionnaires on their satisfaction with the AT. Recall that one of our goals is to reduce the distance families to travel for follow-up newborn hearing screening or testing. Families who elected to have remote screenings, rather than drive to the nearest alternative facility for face-to-face screenings, saw a significant decrease in required mileage. As seen in FIGURE 2, on average, families would have to drive about twice as far to return to their birth hospitals for re-screens than they had to drive to our remote site.

This savings in travel time likely contributed to the majority of our respondents reporting that they felt comfortable talking to the tester on a video monitor (FIGURE 3) and they had an overall good experience during the screening (FIGURE 4). We suggest that this may be because videoconferencing is a common occurrence with most of today’s mobile technologies.

We are confident that the time is right for expanding our efforts in AT. We are better able to reach those in need of hearing services now than any time before. Remaining challenges include sufficient technology infrastructure in some areas and reimbursement from third-party payers. Currently, it appears that most AT programs are being funded through grants or institutional funds—not third party reimbursement. Vanderbilt’s financial investment in capital equipment alone for remote newborn hearing screening was approximately $115,000. A recent national survey of audiologists (n=278) from 49 states confirms that reimbursement for AT remains a significant challenge (Rogers, 2014).

Respondents noted that their AT efforts were funded primarily by grants and employers, with less than 10 percent reporting insurance reimbursement. Until this challenge is addressed, AT will be stalled from widespread implementation.

FIGURE 5. Responses to the question: How is the telepractice with which you work financed? Respondents were able to select more than one of the choices provided (n=41; Rogers, 2014; reprinted by permission).
Devin McCaslin, PhD, is associate professor and co-director of the Balance Disorders Clinic, Department of Hearing and Speech Sciences, Vanderbilt Bill Wilkerson Center, Nashville, Tennessee.

Anne Marie Tharpe, PhD, is professor and chair of the Department of Hearing and Speech Sciences; and associate director of the Vanderbilt Bill Wilkerson Center, Nashville, Tennessee.

References


### Remote Infant Hearing Screening Parent Satisfaction Questionnaire

A Collaboration between the Union City Regional Health Office and Vanderbilt University Medical Center

<table>
<thead>
<tr>
<th>Question</th>
<th>5 miles or less</th>
<th>25 miles or less</th>
<th>50 miles or less</th>
<th>75 miles or less</th>
<th>Don’t know</th>
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<tr>
<td>How far would you have had to travel for the appointment had the Union City facility not been available for hearing screenings?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Would you have scheduled your appointment at a different location had the Union City facility not been available for hearing screenings?</td>
<td>☐ (Yes)</td>
<td>☐ (No)</td>
<td>☐ (If no, why not?)</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>It was my impression that the hearing test my child received remotely was just as good as having it done in person.</td>
<td>☐ (Strongly Disagree)</td>
<td>☐ (Disagree)</td>
<td>☐ (Neither Agree nor Disagree)</td>
<td>☐ (Agree)</td>
<td>☐ (Strongly Agree)</td>
</tr>
<tr>
<td>I would have felt more comfortable talking to the tester in person rather than on a video monitor.</td>
<td>☐ (Strongly Disagree)</td>
<td>☐ (Disagree)</td>
<td>☐ (Neither Agree nor Disagree)</td>
<td>☐ (Agree)</td>
<td>☐ (Strongly Agree)</td>
</tr>
<tr>
<td>I would have felt more confident about the results of my child’s hearing screening if the tester had been in the same room rather than on a video monitor.</td>
<td>☐ (Strongly Disagree)</td>
<td>☐ (Disagree)</td>
<td>☐ (Neither Agree nor Disagree)</td>
<td>☐ (Agree)</td>
<td>☐ (Strongly Agree)</td>
</tr>
<tr>
<td>I had an overall good experience during the screening.</td>
<td>☐ (Strongly Disagree)</td>
<td>☐ (Disagree)</td>
<td>☐ (Neither Agree nor Disagree)</td>
<td>☐ (Agree)</td>
<td>☐ (Strongly Agree)</td>
</tr>
</tbody>
</table>

Questions for those families who missed their appointment.

I did not bring my baby in for the appointment because:
- ☐ I could not arrange transportation
- ☐ I forgot I had a conflict at the appointment time
- ☐ I could not get time off of work
- ☐ I could not find your facility
- ☐ Other ________________________________

What would have made it easier for you to bring your baby in for hearing testing? ________________________________

Please fax this form to Devin McCaslin at (615) 343-4692.

Vanderbilt Bill Wilkerson Center  •  Department of Hearing & Speech Sciences  •  1215 21st Ave South  •  Medical Center East  •  South Tower  •  Nashville, TN 37232
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<td>Presented by Carol Flexer, PhD, and Jane Madell, PhD</td>
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ONE WAY TO ASSESS AUDITORY PROCESSING OF SPEECH STIMULI IS TO CAPTURE POTENTIALS EVOKED BY THE SPEECH STIMULI AND CONSTRUCT SPECTROGRAMS BASED ON THIS ACTIVITY.

Many current procedures for evaluating processing of speech stimuli rely on asking the individual to respond to the stimuli by repeating the presented stimuli, such as syllables, words, or sentences. The stimuli are either presented in an unmodified format under difficult listening conditions, such as dichotic listening, or are presented in modified format such as filtered or time-compressed speech. When a patient is expected to repeat the speech stimulus, a complex network of neurons is activated that must work precisely for correct processing, for comparison of the incoming stimulus...
to stimuli stored in the memory, and production of the presented stimulus. Defects in any of these and related processes may lead to a response that is inaccurate (FIGURE 1).

Clinicians working closely with the patient usually combine information from a variety of different sources, including speech-language evaluations, to determine if the problem is related to deficient auditory processing or it is related to some other factors such as inattention or difficulty in correctly producing the stimulus. However, it may be more useful to have evaluation procedures that can objectively determine if the auditory processing for speech stimuli is efficient or deficient.

**Decoding Brain Patterns to Evaluate Speech Processing**

One potential way to objectively assess processing of speech stimuli is to capture potentials evoked by the speech stimuli and to construct spectrograms based on this evoked activity. In this case, speech evoked activity is first recorded from the surface of the non-primary auditory cortex in the superior temporal gyrus by using intracranial non-penetrating multiple electrode arrays. The recorded activity is then decoded to allow readout and identification of individual words. More specifically, the recorded neural signals can be used to construct a spectrogram with time-varying spectral energy across 180 to 7000 Hz. The constructed spectrogram is then compared to the spectrogram of the original speech signal to determine decoding accuracy (Pasley et al, 2012). Decoding accuracy in such procedures relies on several factors, including:

1. Accurately placing electrodes on the most informative sites, such as the posterior superior temporal gyrus.
2. Capturing information in the high gamma band (70 to 170 Hz).
3. Having a relatively large number of electrodes.

Available commercial systems such as Enobio from Neuroelectrics have built in capability to provide spectral analyses of raw EEG data.

**Other Potential Uses of Decoding of Brain Patterns**

Besides auditory processing evaluations, captured potentials may be used to allow individuals with “locked-in” syndrome to express their thoughts via computers. Locked-in patients have intact cognition and awareness but are paralyzed and thus cannot move their speech articulators. Such patients can be helped with brain computer interfaces (BCIs) that capture neural activity and translate it into speech.

For example, a wireless intracortical neural prosthesis is being used by a 26-year-old locked-in man for speech restoration. In this case, the electrode is implanted on the border of the left primary and premotor cortex, which appears to be involved in planning upcoming utterances. The specific electrode used in this study is a neurotrophic electrode designed for permanent human implantation. The electrode is comprised of a hollow glass cone at one end containing three Teflon plated gold wires, which are immersed in nerve growth factors and a connector at the other end. The nerve growth factor encourages neurites (axons of dendrites) from surrounding neurons to migrate into the narrow tip of the glass cone. The neurites are converted into myelinated axons within three to four months after implantation. The axons grow towards and through the cone shaped end of the glass tip forming a bridge of tissue that connects to the neurephip thus anchoring the electrode tip within the brain tissue (Bartels et al, 2008). Neural signals sensed by the electrode are sent wirelessly to a speech synthesizer to generate spoken signals in real time (Guenther et al, 2009).

According to the U.S. patent # 7,187,967, B2 the above technique has been refined further to allow recording of the neural signals without penetrating the brain tissue. In this case, two skull screws are inserted on the skull under the scalp. The differential potential between the two screws are detected, amplified, and transmitted to a receiver coupled to a computer which analyzes the signals (Kennedy, 2007).

**Potential Barriers for Objective Evaluation**

There are some potential barriers for the development and application of the previously addressed procedures for auditory processing evaluations. These include the need to perform extracranial recordings, cost, and fear of developing technologies that could allow mind reading or thought reading capabilities. These concerns are addressed below.
Extracranial Recordings
In the procedure described previously, the recordings are made from intracranial electrodes. We need to be able to obtain the same data using extracranial electrodes or other extracranial procedures.

Future trends include the use of new foldable stretchable electrode arrays that can non-invasively monitor neural activity (Rawool, 2015). The electrodes incorporate silicon electronics that are capable of conforming to curved shapes and achieving mechanical properties similar to the skin. The intimate contact of such stretchable electrode arrays allows efficient electrical coupling and high-fidelity measurements with very good signal-to-noise ratio. The stretchable skin-like membranes are like temporary transfer tattoos and include not only electrode arrays but also electronics, power supply, and communication components for interfacing with computers or other devices (Kim et al., 2011). These electronic tattoos are being commercialized by MC10 Inc. as bio-stamps that are attached to the user’s skin using something similar to a rubber stamp. The EEG recordings obtained using such technologies can be combined with ongoing time-stamped recordings of auditory events in the environment of the individual using applications such as AudioNote-Notepad and Voice Recorder for training the computer to link specific auditory signals with associated EEG signals recorded near the temporal gyri.

Recording with Sensors Near the Head
There are other ways of recording neural signals. For example, U.S. Patent # 6,011,991 describes a system and method for monitoring the brain activity of an individual and transmitting the activity in a wireless manner (e.g., via satellites) to a computer at a remote location. At the remote location, the brain activity pattern is compared with pre-recorded brain waveforms to locate a significant match. A significant match between pre-recorded and the captured brain activity allows the computer to determine what the person is trying to say. In this case, the sensors are either attached to the scalp or disposed

FIGURE 1. Illustration of a future possibility (in italics) for objective evaluation of auditory processing of speech stimuli using a highly simplistic model for responding to auditory stimuli.
Future Trends in Objective Evaluation of Auditory Processing of Speech Stimuli

adjacent to the scalp (Mardirossian, 2000). Many individuals with auditory processing deficits can recognize speech stimuli in quiet. Thus the neural patterns associated with speech stimuli in quiet can be used to train the computer to recognize the EEG patterns associated with specific words. Later, neural recordings can be made while the words are presented with low redundancy or under reverberant, noisy, or dichotic listening conditions. The computer might be able to then tell whether the brain was able to decipher the word correctly or if the word was misperceived.

Remote Neural Monitoring
It is possible to record neural events without any sensors or electrodes near or on the scalp. This can be achieved by sending electromagnetic signals of two different frequencies (e.g., 100 MHz and 210 MHz) simultaneously to the brain at two different angles using antennae. The signals independently penetrate the skull and interact with each other to yield a waveform (e.g., 210-100=110 MHz), which is modulated by electromagnetic radiations generated by the brain's neural activity. Thus the subject's neural activity is embedded in the resulting signal, which is radiated into space and can be picked up by an antenna at a remote location. The signal is then demodulated. The demodulated signal represents the monitored brain activity. The brain activity can then be amplified, visually displayed, and analyzed to monitor the subject's thought process. The procedure allows for scanning of the entire brain wave pattern or scanning of select brain areas by changing the scan angle and direction of the antennae (Malech, 1976). The electromagnetic signals transmitted to the brain can be kept at sufficiently low levels to minimize excessive heating of the brain tissue.

Cost Concerns
Some clinicians might be concerned about the cost of multielectrode arrays. However, relatively low-cost electrode arrays are being used in neurogaming applications due to the massive demand for virtual or augmented reality games. These arrays are used to record the user's brain signals to allow the games to adapt to the user's affective states including boredom, frustration and pleasure. Some companies including Neurosky and Emotiv offer low cost EEG-based devices and software toolkits for further development of applications. Consider the crowdsourcing project titled, Trapped In My Mind: Building the NeuroSky iOS Brain Speller. The idea is to record the brain waves and allow the computers to capture the thoughts of the user. The project discusses the possibility of creating communication application for individuals living with conditions such as traumatic brain injury, cerebral palsy, multiple sclerosis, and amyotrophic lateral sclerosis by using an inexpensive ($129) brainwave reading headset that interfaces with a mobile device such as an iPhone, iPad, or Android. NeuroSky hopes that by combining the powerful features of an iPad with the brainwave input capabilities of their EEG headset, an ambitious developer could create simple communication and control software to help patients who cannot speak. Another example is the brain sensing headband called Muse that is advertised as a brain fitness tool. Muse captures brain activity and sends it via bluetooth to the user's tablet or smart phone to provide real-time auditory and visual feedback. Although it incorporates seven EEG sensors, it costs only around $300.

Fear of “Thought-Reading” Capacity
One of the barriers for the development of techniques to objectively evaluate auditory processing of speech stimuli is the fear that such technologies could eventually allow individuals to read thoughts of other individuals. This leads to concerns such as stealing intellectual property directly from the brain signals. Although it may sound like science fiction, this is a real possibility and must be considered during the development of such tools. It is known that some EEG gaming applications can be turned against the user to reveal private and secret information such as bank card and PIN numbers (Martinovic et al, 2012). However, fear is unlikely to stop further development of such tools since the technology has several applications that are considered valuable by some segments of society.

1. Entertainment (neurotainment) and gaming (Neurogaming). The first application is in the entertainment and gaming industries. Many current technology users appear to be more than eager to share private information on social media sites such as Facebook. These users may value games using brain computer interfaces above any costs or risks associated with such games. MyndPlay is an example of neurotainment which has several different associated games and movies. During games, brain activity is monitored through a head band placed on the player. The captured brain activity is then sent to the computer. The movie or game changes adaptively depending on the brain activity. For example, The Great Escape movie allows five interactions, six endings and ten possible alternatives depending on the player’s ability to stay calm and focused to make the great escape.
2. **Health and wellness.** As mentioned previously, some technologies will allow individuals who cannot otherwise express their thoughts verbally to communicate their thoughts through brain computer interfaces. In addition, their thoughts can be used to manipulate environmental stimuli. For example, individuals with paralysis can bring a beverage cup near their mouths. Human focus and cognition can also be potentially improved through neurofeedback. An example of health application is MindLight, which is advertised as a video game designed for children with anxiety disorders who are in the age range of 8–12 years. The game incorporates therapeutic techniques such as neurofeedback and desensitization to assist children in overcoming their fears.

3. **Research applications.** Neurotechnologies may also allow further detailed exploration of differing conditions such as stuttering and aphasia. For example, in cases of neurogenic stuttering, the disfluency problem could possibly occur during any of the stages of processing shown.

   Using the technologies described here, EEG recordings may allow researchers to distinguish the stage during which disfluency first becomes apparent and design personalized treatment schedules. If the disfluency is apparent at the auditory processing stage when the stutterer is asked to repeat spoken messages, the most effective treatment approach can be focused on improving auditory processing. If the disfluency is apparent during the transfer to motor areas of speech production or later, the effective treatment approach will be focused on achieving fluency during these stages. Further research applications may be accessed from videos of the Brain Tech Israel 2013 conference presentations (http://conference.israelbrain.org/conference/videos).

4. **Military, defense (neurowarfare) or crime prevention.** The ability to read thoughts may allow detection of the intent of war, terrorism, or dominance by enemy groups. Consider the 2011 Small Business Innovation Research (SBIR) proposal invitation titled Anomaly Detection and Multiple Scales (ADAMS) by the Defense Advanced Research Projects (DARPA) agency of the United States. The major goal of this proposal is to allow detection of suspicious and malicious behavior to mitigate harm. Another potential application of remote neural monitoring is to allow computers to correct potential errors caused by mis-hearing commands. For example, if the command to an air force pilot is to turn a plane to 090 degrees right and he mishears is at 080 degrees, a special helmet equipped to measure his brain waves will correct the error and re-inject the correct command of 090 degrees to him (Pasternak, 2000) or, if attached to a computer through a brain computer interface, the computer could turn the plane correctly.

5. **Legal applications.** In some cases, the amount of worker compensation for hearing loss is partially based on the worker’s ability or inability to recognize speech. Work-related exposure to ototoxins can lead to not only cochlear damage but primary or secondary damage to auditory pathways leading to auditory processing deficit (Rawool, 2012). Thus in some cases, workers can claim that they have difficulty understanding speech. This assertion is difficult to confirm by simply presenting speech stimuli and asking the worker to repeat the stimuli. A worker can easily give no responses or wrong responses to perceptible speech stimuli. Determining the accuracy of speech processing by capturing the EEG patterns at the auditory cortex may provide a way of confirming the disruption in speech processing or refuting such claims. Brain scanning data is already used to prove toxic solvent encephalopathy in worker compensation cases to document brain abnormalities and to exclude other potential causes of brain abnormalities. In Rhilinger vs Janciscs case (1998, WL 1182958, Mass. Super. 1998), the court rejected the motion to exclude expert testimony using SPECT scan to show brain abnormalities and noted that the SPECT scan is scientifically reliable and useful in diagnosing toxic solvent encephalopathy. In Hose vs. Chicago and NW Transport Co. (70 F.3d 968 (8th Cir. 1995), the court upheld the use of PET scan and magnetic resonance imaging (MRI) to exclude other potential causes and to support manganese exposure as the cause of encephalopathy.

6. **Neuromarketing.** Neural monitoring can also be used for marketing purposes. Neuromarketing firms can measure the responses of the brain to different types of products or advertisements to assess if the response is positive. Using fMRI to predict the relative popularity of music has been tested. In one study, the fMRI of 14 girls and 13 boys in the age range of 12–18 years was measured while they listened to 15 second clips of songs from relatively unknown musicians. The children also rated the familiarity and likability of the music. For three years following scanning, the popularity of the songs was measured by song sales.
Activity in the ventral striatum/nucleus accumbens (one of the reward related regions of the brain) was significantly correlated with the number of units sold, while subjective likability could not predict future sales. These results suggest that the neural responses to music of a few individuals may be able to predict future purchases by the general population. For example, with a sale figure hit threshold of 15,000 units, it is possible to correctly classify 80 percent of the non-hits and 30 percent of the hits. Non-hits were associated with relatively low activity in the reward related regions. One of the proposed reasons for inability to predict future sales based on initial subjective likability is that likability ratings require effective use of cognitive strategies including effective auditory processing of the stimuli, referencing the song to other previously known songs, and predicting future continuous likability with repeated exposure to the same song. In contrast, brain responses may tap into subconscious processes that are less influenced by cognitive ability (Berns and Moore, 2012). The authors suggested that neuroimaging tools may be useful in helping record labels use limited marketing resources efficiently, since only about 10 percent of new releases yield profits (Vogel, 2007).

**Conclusion**

In conclusion, cost effective, objective, and more precise approaches for assessing speech processing in the auditory system appear possible in the near future due to the following reasons:

1. With further refinements of current techniques, reconstruction of spectrograms from speech-evoked cortical activity to allow comparison of the reconstructed spectrogram to the spectrogram of the original words presented to evoke the cortical activity. A good match will indicate efficient processing of speech.

2. Availability of flexible stretchable sensors (bio-stamps) consisting of electrodes, power supply, electronics, and communication components for interfacing with computers and other devices.

3. Capabilities to allow neural monitoring by placing sensors near or around the head or to allow remote neural monitoring via electromagnetic radiations.

4. Availability of cost-effective technologies due to the massive demands for neurogaming applications.

The previously stated developments are expected to have several advantages:

1. Objective measurement of speech perception from newborns to older adults.

2. Objective measurement of speech perception in workers claiming worker compensation due to poor or degraded speech perception.

3. Better insights into speech processing at the cortical level.

4. Development of built-in protections in neuro-gaming platforms to prevent anyone from hacking into the player’s brain to steal sensitive information.

5. Development of legal rights to protect own thoughts or intellectual properties (brain privacy).
Future Trends in Objective Evaluation of Auditory Processing of Speech Stimuli

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References


A Simple Device to Enhance Hearing

BY AINA CALIMANO, JO ANN LEDERMAN, AND AGUSTIN ARRIETA

This article describes a simple technique to take advantage of the natural anatomic amplification system of the human ear, which could provide a more economical, disposable, and natural alternative for patients with mild-to-moderate hearing loss.

Hearing loss is the third most common chronic condition reported by elderly people (Lin, 2011). The estimated prevalence of significant hearing impairment among people over the age of 65 years old is approximately 40 to 45 percent, and among people over the age of 70 exceeds 83 percent of elderly individuals with significant hearing impairment obtain hearing aids (Lin et al, 2011). Approximately 290 million people worldwide are hearing impaired, including 48 percent of Americans aged 60 or older. The prevalence is expected to increase in aging populations (Lin et al, 2011). Hearing loss and the ability to discriminate sounds becomes worse as we age. The average hearing thresholds of men are typically poorer than those of women in the high frequencies, with men exhibiting a sharply sloping hearing loss in the moderately severe range in the high frequencies, and the women exhibiting a more gradual sloping hearing loss in the moderate range in the high frequencies. The Articulation Index theory predicts that recognition of average conversational speech (60 dB sound pressure level) will be reduced among people with age-related hearing loss as a result of the limited audibility of high frequencies acoustic cue (Ballachanda, 1997). Age-related hearing loss is a significant public health concern.

**FIGURE 1.** A picture of the adhesive hearing device.
health concern, compounded by a failure to make use of treatment options (Lin et al, 2011).

Hearing aids provide a significant benefit to patients with moderate to severe hearing loss. However, due to cost, cosmetic concerns, and maintenance issues many patients do not use hearing aids. This underutilization is even more prevalent in patients with mild hearing loss. Individuals in this mild hearing loss category would benefit from just a small increase in acoustic gain, which could be provided by the pinna and ear canal. The shape and orientation of the pinna increases the efficiency with which sound is collected (Ballachanda, 1997).

The purpose of this study is to demonstrate the increase in acoustic gain provided by manipulation of the pinna using a simple adhesive device behind the pinna. (FIGURES 1–2) Demonstrate a simple technique to take advantage of the natural anatomic amplification system of the human ear. This could provide a more economical, disposable, and natural alternative for patients with mild to moderate hearing loss. Because the external ear canal plays an important role in sound transmission by amplifying incoming sounds at certain frequencies real ear measurements can analyze the ear canal resonance and demonstrate the gain distribution (Yu et al, 2011). A study found that hearing aids were used in 40.0 percent (95 percent confidence interval: 35.1–44.8) of adults with moderate hearing loss, but in only 3.4 percent (95 percent confidence interval: 0.8–6.0) of those with a mild hearing loss. For individuals with mild hearing loss, hearing aids were used in 3.4 percent of adults (Lin et al, 2011). Among individuals with hearing loss, only 19.1 percent reported using a hearing aid. Rates of hearing aid use differed substantially by hearing loss severity with only three percent of individuals with mild hearing loss reporting hearing aid use versus 41 percent in those with moderate or worse hearing loss (Lin et al, 2011).

Methods

Participants

Participants were recruited using the convenience method for a total of 24 subjects in the sample over six months. The patients provided consent and underwent an otoscopic examination. A total of 47 ears were tested after exclusion of one ear secondary to anatomic abnormalities or ear canal obstruction. The age range of the participants was from 30–68 years. No audiological testing was performed prior the experiment.

Procedure

This study was conducted using a simple adhesive device applied to the pinna and an Audioscan RM 500 series Real-Ear Measurement and Hearing Aid Test System. A real-ear measurement was made for each ear to complete an objective measure of the characteristics of the

FIGURE 2. Participant with the adhesive hearing device applied to right ear.
A Simple Device to Enhance Hearing

participant’s ear and the resonance of the ear canal. Real-ear measures are taken without the device (real-ear unaided response) and then with the device behind the ear (real-ear aided response). The difference between the real ear unaided response and the real ear aided response is the insertion gain. A single microphone probe tube is placed by an otorhinolaryngologist and an audiologist in the ear canal at 5 mm from the tympanic membrane and connected to the measurement system (Dillon, 2001). The audiologist marked the probe tube with the appropriate distance (e.g., 30 mm) from its open end and inserts the probe tube into the ear canal until the mark approaches the intertragal notch. Correct placement of the probe was confirmed with otoscopic visualization (see FIGURE 3 for visual reference). Using a signal generator, a measurement of the sound-pressure level (SPL) at the tympanic membrane is made for a constant input SPL first with the pinna and ear canal in their normal state. This represents the classically measured free-field to eardrum transfer function (Hawkins, 1987). The adhesive device was placed on the mastoid and posterior pinna, acting as a strut and deflecting the pinna away from the mastoid. A second measurement of SPL was then taken with the Real-Ear system. The results were then recorded and graphically represented using Microsoft Windows Power Point and Microsoft Excel.

Results

Statistical Analysis

The insertion gain of 47 ears was obtained using the method of real-ear measurement. With the Microsoft Office Excel program the mean (average), median, mode (numbers that were repeated in the data), range, maximum values, and minimum values were calculated. The average gain (mean) obtained in the real-ear measurements was 5.77 dB for 1–2 kHz and 10.40 dB for 3–8 kHz. (TABLE 1) The median was 5 dB for 1–2 kHz and 10 dB for 3–8 kHz; this value divides the ordered data set. (TABLE 2) The 50 percent of the tested ears reported 5 dB gain or less and 50 percent reported 5 dB gain or more for 1–2 kHz. The 50 percent of the tested ears reported 10 dB gain or less and 50 percent reported 10 dB gain or more for 3–8 kHz. The mode is 5 dB for 1–2 kHz and 10 dB for 3–8 kHz. For 1–2 kHz the range was 19 dB, with a maximum value of 19 dB and a minimum value of 0 dB. For 3–8 kHz the range was 25 dB, with a maximum value of 25 dB and a minimum value of 0 dB. The frequency with the highest average gain was 4 kHz. (FIGURES 4–6) No patients experienced skin changes or irritations.

Discussion

The auditory system is composed of the outer or external ear, the middle ear, the inner ear, the auditory nerve, auditory brainstem, and auditory cortex. For our purposes, we are going to focus on the external ear. The three main components of the external ear are composed of the auricle or pinna, the external auditory meatus or ear canal, and the tympanic membrane or eardrum. All of those aspects of the external ear act like a resonator which enhances incoming sound (Ballachanda, 1997). The pinna is the cartilaginous structure attached to the external ear canal on the side of the head, and it includes the cavities that lead to the entrance of the ear canal. The outer ear collects and resonates sound, which also helps with localization of the sound. The outer ear also acts as a protective mechanism for the middle ear (Ballachanda, 1997).

The pinna and ear canal play a major role in transforming acoustic signals from free field to the tympanic membrane. They act as a filter to reduce low frequencies,
### TABLE 1. Insertion Gain in dB in Frequency Ranges 1–2 kHz and 3–8 kHz After Application of Hearing Device for Ears 1–24

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### TABLE 2. Insertion Gain in dB in Frequency Ranges 1–2 kHz and 3–8 kHz After Application of Hearing Device for Ears 25–47

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A Simple Device to Enhance Hearing

The external ear can be considered an acoustical horn that captures sound and couples it to the eardrum.

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A Simple Device to Enhance Hearing

A resonator to enhance mid to high frequencies (2.0 to 7.0 kHz), and a direction-dependent filter at high frequencies to augment spatial perception. The amount of sound pressure gain in the mid to high frequencies is directly related to the anatomical dimensions of the external ear (Ballachanda, 1997). The auricle enhances the sound around 4500 Hz and the external auditory meatus enhances around 2700 Hz (Stach, 1998). When the frequency of the sound matches the natural resonant frequency of the ear canal, the sound pressure is enhanced at that frequency. The external ear transfer function is altered by variations in the physical dimension of the external ear either due to individual differences or due to mechanical obstructions such as blockages, hearing aid placement, perforation of the tympanic membrane, and use of insert earphones. Consequently, the characteristics of the sound reaching the middle ear from free field are influenced by the physical dimensions and the response properties of the external ear. It is evident that the external ear and the ear canal augment directionality associated with sounds in free field by adding considerable pressure gain at various frequencies (Ballachanda, 1997). The acoustic gain of the ear can be further increased in the frequencies range between 1k Hz and 3k Hz if the pinna is effectively enlarged by means of a hand cupped behind the ear (Wiener and Ross, 1946). Due to its shape and orientation on the head, the pinna increases the efficiency with which sound is collected by the ear. The amplification results from resonances in the external ear canal and in the cavities of the pinna. Two major parts of the auricle can act like resonators, the cavum concha has a resonance near 5,000 Hz, and the small folds of the helix have even higher resonance frequencies. (Katz, 2009). The external ear can be considered an acoustical horn that captures sound and couples it to the eardrum (Young, 2007).

The external and middle ear captures sound energy and couple it efficiently to the cochlea. Two main aspects of this transformation are important for hearing: (1) efficient capture of sound impinging on the head, and (2) the directional sensitivity of the external ear, which provides a cue for localization of sound sources (Young, 2007). The external ear is ultimately important for monaural spatial perception of sound and for binaural localization (Ballachanda, 1997). Humans use spectral cues to localize sounds in elevation and to disambiguate binaural difference cues, helping to distinguish sounds in front and behind. The directional sensitivity of the external ear is generated by sound reflecting off the structures of the pinna (Young, 2007). The increase in sound pressure at the eardrum over the free-field pressure is caused by a
**FIGURE 4.** Gain obtained per ear in the frequencies 1–2 kHz.

**FIGURE 5.** Gain obtained per ear in the frequencies 3–8 kHz.

**FIGURE 6.** Average gain in 250–8 kHz.
A Simple Device to Enhance Hearing

combination effect of diffraction by the head and pinna and resonance in the auditory canal (Wiener and Ross, 1946). Faint sounds are heard well if one ear is in a particular direction toward the source. The human ear is thus an effective acoustic “amplifier” (Wiener and Ross, 1946).

People usually do not experience problems understanding speech in ideal listening conditions which includes quiet environments and familiar one on one talker, as long as the speech level permits audibility of high frequency information. Difficulties arise when people with hearing loss must follow conversational speech in adverse listening conditions, including noise and reverberation. Elderly listeners with normal hearing, minimal hearing loss, or significant hearing loss perform poorer than young listeners with comparable hearing sensitivity in reverberation across a range of time. Hearing loss among elderly citizens is a prevalent problem that affects their ability to understand speech in quiet, noise, and reverberant environments. Elderly people also experience difficulty understanding rapid speech, heavily accented English, and speech with few contextual cues and/or added memory demands (Gordon-Dalant, 2005).

People with even a mild hearing loss have challenges communicating verbally in the presence of background noise. As a consequence, social gathering may become difficult, quality of life may be reduced as events must be planned around acoustic environments, and relationships may suffer because of communication problems or because activities once enjoyed together are no longer pleasant to the person with hearing loss (Mick, 2014).

Findings revealed that the adhesive hearing device can increase gain overall 5 dB in mid frequencies and 10 dB in high frequencies. Clearly, using the device allows the person to hear the sounds louder. The maximum gain obtained on the people using the device was 19 dB in mid frequencies and 25 dB in high frequencies.

We believe this study demonstrates a simple technique to take advantage of the natural anatomic amplification system of the human ear. This could provide a more economical, disposable, and natural alternative for patients with mild to moderate hearing loss. No subject’s perception of the device comfort or aesthetic concern was measured.

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References


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SIEMENS
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SCREENING FOR COGNITIVE DISORDERS IN OLDER ADULTS IN THE AUDIOLOGY CLINIC

BY ROBERT W. SWEETOW

Audiologists might be reluctant to administer cognitive testing for fear that they may wound the patient’s ego, therefore, it may be useful to unobtrusively incorporate a screening measure for cognitive impairment as part of the audiological and communication needs assessment.

The relationship of cognitive status to hearing aid success has been among the most frequent topics in the audiology and amplification literature in the past few years. Interest in this subject has been fueled by a series of papers from Johns Hopkins University detailing large scale studies, which have crossed over from the medical literature to the audiological world (Lin et al, 2011; Lin et al, 2013). These studies report demographics that underscore a number of factors linking cognition to hearing. For example, two-thirds of people age 70 and older have hearing loss (Chien and Lin, 2012). Older adults with hearing loss have a 24 percent higher risk of cognitive impairment when measured on non-verbal tests of memory and executive function (Lin, 2011). Numerous factors may account for these findings, including the “common cause” hypothesis (shared neural pathways), necessity for additional resource expenditure, and isolation resulting from hearing loss.

In addition, it is known that even in the absence of hearing loss, older subjects require 3–5 dB higher SNR than young listeners (Schneider, et al, 2005), and that older subjects with normal hearing perform approximately the same as young hearing impaired subjects (Wingfield and Tun, 2001). In fact, cognitive function has been cited as the strongest predictor of individual performance differences, not the audiograms (Humes, 2007). The perceptual deficits that occur with aging include negative changes in speed of processing, working memory, capacity shared between processing and storage, and attentional difficulties, including executive control (Wingfield and Tun, 2005). Furthermore, older adults with hearing loss and poor working memory are more susceptible to hearing aid distortions from signal-processing algorithms, suggesting that cognitive skills should be taken into account in the hearing aid fitting (Arehart et al, 2013).
Screening Measures to Detect Mild Cognitive Impairment

A number of validated screening measures designed to assist in the detection of mild cognitive impairment exist. Examples of screening measures include:

Montreal Cognitive Assessment (MoCA)

Despite being a screening measure, it assesses numerous skills such as visuospatial executive function, naming, memory, attention, language, abstraction, delayed recall, and orientation. Scoring can be complicated, however. A copy of this measure can be downloaded at www.mocatest.org. The MoCA takes approximately 10 minutes. (Nasreddine et al, 2005)

Clock Drawing

The patient is instructed to draw a clock, put in all the numbers, and set the time to 10 minutes after 11. In one method of scoring, one point is allocated for each of the following three criteria:

- **Contour (1 pt.):** The clock face must be a circle with only minor distortion acceptable (e.g., slight imperfection on closing the circle).

- **Numbers (1 pt.):** All clock numbers must be present with no additional numbers; numbers must be in the correct order and placed in the approximate quadrants on the clock face (Roman numerals are acceptable); numbers can be placed outside the circle contour.

- **Hands (1 pt.):** There must be two hands jointly indicating the correct time; the hour hand must be clearly shorter than the minute hand, and the hands must be centered within the clock face with their junction close to the clock center. (Shulman et al, 1986).

A Medline search reveals impressive mean sensitivity (85 percent) and specificity (85 percent) of the clock-drawing test (Shulman, 2000). The clock test also shows a sensitivity to cognitive change with good predictive validity. However, the best method for scoring (there are several suggested in the literature) has long been debated (Watson et al, 1993; Sunderland et al, 1989).

Letter-Number Sequencing (LNS)

This is a working memory test, part of the Wechsler Adult Intelligence Scale, (Wechsler, 1958) that provides information about temporal processing at the cognitive level and is strongly associated with rapid speech understanding (Vaughan et al, 2008). A series of letters and numbers are presented in random order, and the participant must...
reorder the stimuli by first repeating the numbers in ascending order and then the letters in alphabetical order. The LNS can be administered in ten minutes.

**Reading Span Test**

This test purportedly measures simultaneous storage and processing capacity. It is usually administered as a visual (reading) test rather than an auditory test, so that results will reflect cognitive capacity and not be contaminated by hearing loss. The participant views a sequence of sentences, which are shown one-to-two words at a time on a computer screen. Examples include, “The snail crept slowly,” and “The fish drove a car.” After each sentence, the participant is asked whether the sentence made sense (that response isn’t scored, its primary purpose is to engage cognitive processing by forcing the listener to assign meaning to the sentence).

After several sentences have been presented, the participant is asked to recall the first or last words of those sentences. The number of sentences presented prior to recall increase during the test, and the final score is the percentage of correctly recalled words. The average score for hearing aid candidates is about 40 percent. Average score for college students is about 70 percent. Patients with scores below 40 percent reportedly have poor working memory, patients with scores above 40 percent purportedly have good working memory. Unfortunately, the computerized Reading Span Test takes about 20 minutes to administer and score (Daneman and Carpenter, 1980).

**Cognitive Screening Tests and Audiological Evaluations**

While few audiologists would doubt the important relationship between cognition and amplification prognosis, the manner in which we can screen for cognitive declines remains elusive, primarily because of a legitimate concern of “insulting” the patient who has come to audiology for hearing difficulties, rather than fears about cognitive deficits. Given the time constraints that audiologists have, a short screening method of detecting patients with, or at risk of having, cognitive impairment that could be incorporated into the audiological examination would be very useful.

**A Tool for Audiologists: The 6-CIT**

A validated screening measure that could meet these criteria is the 6-CIT (Cognitive Impairment Test; Kinghill Version (Brooke and Bullock, 1999). This simple six-question test proceeds as follows:

The examiner asks:

1. **What year is it?** (score four points if incorrect)

2. **What month is it?** (score three points if incorrect)

   Now, the examiner asks the patient to repeat the following name and address: Arthur/Jones/42/High Street/Detroit (Note: the name and address has five components to it.)

3. **About what time is it?** (score three points if wrong by more than one hour)

4. **Please count backward from 20 to 1.** (score two points if one mistake; score four points if two or more mistakes)

5. **Say the months of the year in reverse.** (score two points if one mistake; score four points if two or more mistakes)

6. **Repeat the name and address discussed earlier.** (score two points for each mistake; maximum score 10 for five mistakes).

Note: The original 6-CIT Kinghill Version Test used John, Smith, 42, High St, Bedford as the five-component name and address; but I’ve taken the liberty to change this name and address to make it more “U.S. friendly,” while still maintaining the five-component concept to Question 6. It is highly unlikely that this change will alter the validity of the test.

**Scoring**

The 6-CIT uses an inverse score method, and questions are weighted to produce a possible total of 28 points. The interpretation is as follows:

- 0–7=normal
- 8–9=mild cognitive impairment
- 10–28=significant cognitive impairment

Patients scoring more than eight to nine points should be considered at risk for mild-cognitive impairment. Patients scoring 10 points or higher should be referred to an appropriate specialist.

**Advantages to the 6-CIT**

There are several advantages to this screening measure.
Screening for Cognitive Disorders in Older Adults in the Audiology Clinic

- The time required is only three to four minutes.
- The test has high sensitivity (78-90 percent) without compromising specificity (100 percent) even in mild dementia.
- It is easy to translate linguistically and culturally.
- Scoring may be initially challenging; however, with practice it is quite simple. In addition, a computerized version of the 6-CIT with automated scoring is available.
- The Kinghill Research Centre, Swindon, United Kingdom, owns the copyright, but unlike some tests that are owned by publishers or institutions, free usage is allowed to health care professionals.

Incorporating the 6-CIT

One approach to incorporating the 6-CIT into the audiological evaluation would be to embed the 6-CIT into speech recognition/discrimination testing. This could be done using auditory alone, auditory visual, or visual only testing. The patient should be instructed that he/she is going to be asked to repeat certain words/sentences, and also to answer some questions. The six questions can be presented together, or, the first two questions can be asked, and then there can be a delay until question 3. However, once the patient is asked to repeat the name and address (just before question 3), the time differential between that instruction and the remaining four questions should be consistent with the time it would take to present the name and address, and then questions 3–6, in order to preserve the validity of the measure. If too much time passes between the repetition of name and address and question 6, the scoring could be invalidated.

By taking either of these tactics, the patient will believe these questions are part of the hearing assessment. In addition, by presenting the questions either face to face (with visual cues) or at an intensity level judged to produce PB max or maximum intelligibility, the likelihood that the question was missed because of hearing loss, would be greatly minimized.

Conclusion

Cognitive effects on hearing aid success in older adults have been well documented. However, audiologists might be reluctant to administer them for fear that they may wound the patient’s ego by calling his or her cognitive state into question. Therefore, it would be useful to unobtrusively incorporate a screening measure for cognitive impairment as part of the audiological and communication needs assessment (Sweetow, 2007). The 6-CIT cognitive screening test has potential as a quick, easy, and non-offensive measure if it is integrated into the speech recognition evaluation process. Future studies using the 6-CIT cognitive screening test in clinical situations are needed to evaluate its potential utility and success in the audiology clinic.

Robert W. Sweetow, PhD, is a professor of otolaryngology at the University of California, San Francisco.

References


Screening for Cognitive Disorders in Older Adults in the Audiology Clinic


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An individual’s ability to understand speech-in-noise provides valuable insight when recommending a hearing aid technology level, need for assistive listening devices, and in establishing realistic expectations.

The impact of hearing loss varies substantially from person to person. Degree and type of hearing loss, lifestyle, age, and personality are a few factors that play a role. Difficulty in background noise, however, remains a near universal trait exhibited by individuals with hearing loss. Despite the commonality of this complaint, few audiologists routinely obtain a speech-in-noise measure during an audiological or hearing aid evaluation (Lindley, 2006; Mueller, 2003). An individual’s ability to understand speech-in-noise provides valuable insight when recommending a hearing aid technology level, need for assistive listening devices, and in establishing realistic expectations.

Limitations of the Audiological Evaluation
Most patients undergo audiometry and word recognition testing in quiet, as part of the traditional test battery. These measures can have important
They Say “I Can’t Hear in Noise,” We Say “Say the Word Base”

diagnostic and rehabilitative implications. However, there are limitations in relying primarily on these measures when making treatment recommendations. While it is likely someone with poor word recognition in quiet will demonstrate poor speech understanding in noise, the inverse is not necessarily true. Many patients that demonstrate good word recognition ability in quiet can exhibit significant deficits in noise.

Audibility, or lack thereof, is the primary driver of speech understanding when unaided, both in quiet and noisy situations (Humes, 2007). Once audibility is restored, supra-threshold deficits play a relatively larger role in continued difficulties (Humes, 2007; Summers et al, 2013). The nature and severity of these deficits varies from person to person, and is not accurately predicted from audiometric and word recognition in quiet results alone (Walden and Walden, 2004).

Traditional audiological measures also have limitations when used in establishing realistic expectations. In one of the surveys cited previously, participants cited “unrealistic expectations” as the most common reason patients returned their hearing aids (Lindley, 2006). Establishing realistic expectations for speech understanding in background noise ideally takes place early in the fitting process, and plays a role when recommending appropriate technology and communication strategies. Without actually measuring the patient’s ability, establishing these expectations is difficult.

Potential of Modern Technology

The nature and severity of an individual’s suprathreshold deficits has implications for the level of technology recommended. As hearing aid technology evolves, the potential for providing not only improved audibility, but an improved signal-to-noise ratio has increased incrementally. Different levels of technology have the potential to provide a varying degree of signal-to-noise ratio improvement in complex listening environments (e.g., independent, fixed directionality versus binaurally implemented, adaptive directionality). Thus, speech-in-noise test results can be considered when making technology recommendations, along with lifestyle, needs, and budget.

An individual with a mild speech understanding in noise deficit may not necessarily need the highest level technology available, although this patient will likely notice incremental improvements when “going up a level.” An individual with moderate difficulty in noise may function adequately with higher level hearing aids, but continue to struggle using more basic technology. A patient with a severe deficit in background noise,

![FIGURE 1. Mean audiometric threshold data for the right and left ears. Error bars represent one standard deviation.](image1)

![FIGURE 2. Percentage of patients who fell in each SNR loss category. Testing conducted while aided.](image2)
however, will likely perform poorly even with the highest level technology available. Assuming the individual has budgetary constraints, he or she may be better served with a more basic hearing aid used in conjunction with assistive listening technology.

Speech-in-Noise Measurement Issues
There are a variety of clinically friendly options for assessing an individual's ability to understand speech-in-noise (Wilson et al., 2007). Testing can be done using monosyllabic words or sentences, in speech noise or in babble. The metric can be a percent correct obtained at a given signal-to-noise ratio or a measure of signal-to-noise ratio loss (i.e., how much of an improvement in SNR is required for the individual to perform similarly to someone with normal hearing). In either scenario, the patient’s performance can be compared to a normal baseline.

One example of a clinically friendly speech-in-noise test is the QuickSIN. Developed and available from Etymotic Research, the QuickSIN is quick and easy to administer (Killion et al., 2004). The stimuli are sentences spoken by a female speaker. The first sentence is presented at a 25 dB SNR and with each subsequent sentence the noise level is increased 5 dB. The final sentence is presented at a 0 dB SNR. The sentences are pre-recorded at these levels so the test can be administered via a single channel.

Key words are scored and a formula is used to derive a signal to noise ratio loss. Four categories of SNR loss have been proposed by the developers of the test (0–3 dB loss=normal/near normal, 3–7 dB=mild loss, 7–15 dB=moderate loss, >15 dB=severe loss). An individual with a 5 dB SNR loss would require an improvement in the SNR of approximately 5 dB to function similarly on the test as someone with normal hearing. Research has suggested it is more sensitive at detecting issues related to suprathreshold deficits (Grant and Walden, 2013; Wilson et al., 2007) making it a good candidate for use as a pre-fitting measure.

Testing protocol should reflect the purpose of obtaining the measure. An unaided speech-in-noise measure, obtained with the stimuli presented at a conversational level, can provide insight regarding how the individual performs in daily life when unaided. However, given the time constraints inherent in clinical practice, this may not necessarily provide additional insight beyond what already provided by the patient during their case history.

If a speech-in-noise measure is obtained for the purposes of establishing realistic expectations and recommending a technology level, a primary goal is reducing the effects of audibility. While different levels of hearing aids may restore an equivalent amount of audibility, their ability to improve the signal-to-noise ratio can vary. A useful piece of information not assessed in a traditional audiological evaluation concerns how large a deficit continues to exist once audibility is restored.

This can be accomplished by presenting the stimuli at a higher presentation level or by testing under an aided condition. Unless the stimuli can be custom shaped for the individual’s hearing loss, the latter option is likely more relevant in a clinical environment. Walden and Walden (2004), for example, found an average 1.7 dB improvement in QuickSIN scores when individuals were tested while aided versus unaided using a high (70 dB HL) presentation level. Demonstration hearing aids can easily be programmed for patient usage while undergoing speech-in-noise testing. As an added benefit, the patient is introduced to amplification with modern hearing aids as part of the evaluation itself.

Speech-in-Noise as a Pre-fitting Measure
The author routinely obtains speech-in-noise measures as part of the audiological work-up when the individual is a candidate for amplification. In this section, speech-in-noise data obtained from 48 individuals is presented. These individuals were tested as part of their initial visit to the office. Their average age was 68.2 (range 30–91 years). The mean word recognition is quiet score was 85.25 (range 60–100 percent) and 86.75 (range 52–100 percent) for the right and left ears respectively. The average degree of hearing loss was in the mild- to moderately-severe range (see FIGURE 1).

Once the traditional audiological evaluation was completed, a set of demonstration hearing aids (typically receiver in the canal style with appropriate speaker/dome combination) were programmed based on the individual’s audiogram. The hearing aids were generally set to the manufacturer’s default algorithm choosing an experienced or 100 percent to target setting. The QuickSIN was chosen given the benefits described above. On a more practical level specific to this office, this test is built into the audiometer (Interacoustics Affinity) eliminating the need for administration with a CD player.

Testing was conducted in the sound field at zero degrees azimuth using a 50 or 55 dB HL presentation level depending on the severity of the hearing loss. Two lists of six sentences were administered. Under this setup, the impact of directional microphones is not measured. However, the goal is to assess how much difficulty an individual has once audibility has been restored to a degree that approximates the actual fitting. Once the testing is complete, the individual was provided the option of...
leaving the hearing aids in place while all test results are reviewed.

Figure 2 shows the percentage of patients who fell into each SNR loss category. Approximately three quarters of the patients demonstrate near normal or a mild SNR deficit when aided. Less than five percent demonstrated a severe deficit. There are limitations in generalizing these results to the adult population of individuals with hearing loss. A large percentage of these individuals had not worn hearing aids previously. In addition, this sample is weighed more heavily with individuals having fair-excellent word recognition ability. Patients who presented with poor word recognition in quiet were not then tested in noise. Nevertheless, one may be surprised to find that many individuals with hearing loss perform fairly well on speech in noise tests once audibility is at least partially restored.

In an effort to determine if a patient’s QuickSIN score could be predicted based on data commonly collected in a clinical setting, a forward stepwise regression analysis was conducted on this dataset incorporating a large number of predictor values (see Table 1). Age and gender were not significantly correlated with the QuickSIN scores. Not surprisingly, word recognition in quiet and audiometric threshold data were significantly correlated with the QuickSIN scores.

For this dataset, the model with the best predictive capability included just two variables (word recognition score in the left ear and the average hearing loss when including all frequencies in the right ear). Together these variables accounted for 54.5 percent of the variation in QuickSIN scores. Despite differences in protocol and population tested, this is roughly in line with the Walden and Walden (2004) finding that 49 percent of the variation on the QuickSIN was predicted using an audibility based model.

These findings demonstrate that while routinely obtained clinical measures can assist in predicting speech in noise ability, roughly half the variation cannot be explained by these measures alone. There is value in actually measuring speech in noise capability rather than trying to infer it based on traditional measures. When using the regression model from this dataset to predict a given patient’s actual QuickSIN score, approximately half the time the deviation would exceed 2 dB, one third of the time it would differ by more than 3 dB, and one quarter of the time it would differ by more than 4 dB. Technology recommendations and counseling would likely differ when dealing with an individual who demonstrates a 6 dB SNR loss versus a 10 dB SNR loss.

### Case Examples

The following cases from this dataset illustrate how this data can be applied. Case 1 is a 65-year-old with a moderate to severe sensorineural hearing loss and fair word recognition ability. He exhibits a 22 dB SNR loss when aided. This individual has budgetary constraints. Upon review of this data, the patient would likely be better served using lower-level hearing aids in conjunction with wireless assistive technology. Even if the patient is unwilling to use accessories, he would likely prefer to spend $2,500 on a pair of hearing aids versus $5,000 when the outcome in noise is equivalent. Counseling on realistic expectations and communication strategies could begin before the hearing aids are fitted.

Case 2 is a 52-year-old with a mild-to-moderate sensorineural hearing loss and fair-to-good word recognition ability. Aided QuickSIN results were normal. This individual could reasonably be expected to function adequately in noise with any well-fitted hearing aids. However, she would likely notice additional benefits from higher-level technology, depending on her lifestyle/needs.

Finally Case 3 is an 81-year-old with fair word recognition in the left ear and good word recognition in the right. Her SNR loss is 9 dB. Hearing aids incorporating basic directionality may help, but not provide sufficient benefit in certain situations. She may be a good candidate for higher-level technology (e.g., binaural implementation.

### Table 1. QuickSin Score Predictor Variables in the Regression Analysis

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<td>PTA Left (.5, 1, 2, and 4 kHz)*</td>
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*significant correlation with QuickSin score
of directionality) to get a few additional dB of SNR improvement.

**Conclusion**

When attempting to establish realistic expectations and determine appropriate technology recommendations, information obtained from a traditional audiological workup provides an incomplete picture. Adding a speech-in-noise measure to your test battery will help fill some gaps and allow you to personalize the recommendations. If hearing aids are used as part of the testing, the patient is provided with some initial exposure to comfortable, cosmetically pleasing hearing aids in an acoustically friendly environment.

The protocol described in this article takes approximately five minutes from programming the hearing aids through testing. Many experienced hearing aid users comment that they have never been tested in noise before and wondered why nobody had thought to do so previously. Even patients with poor results appreciate having a better understanding of what we are up against and are often more open to trying assistive technology out of the gate, as opposed to waiting until failing with the hearing aids alone. Patients are often surprised when lower-level technology is recommended, even when budget is not an issue. There is an increased trust level and, in the author’s opinion, patients are more likely to refer others to the office. In an era where big box and online hearing aid sales increasingly threaten the viability of a private practice, testing in noise provides another tool for differentiating one’s self from the competition and provides an added value to the patient.

**References**


George Lindley, PhD, AuD, is an assistant professor at the George Osborne College of Audiology at Salus University. He also owns a private practice in Emmaus, Pennsylvania.
The Academy Research Conference (ARC) 2015 was held on March 25 in San Antonio and was attended by over 260 audiologists. This event brought together world-class experts from around the globe to provide contemporary research findings on a diverse set of topics related to the vestibular system. The organizing committee was instrumental in finding presenters who are leaders in their particular area of study. The ARC Program Committee consisted of Dr. Neil Shepard, Mayo Clinic-Rochester; Dr. Kamran Barin, emeritus, The Ohio State University; Dr. Matthew Scherer, Andrew Rader U.S. Army Health Clinic; Dr. Larry Lundy, Mayo Clinic-Jacksonville; and Dr. Gary Jacobson, Vanderbilt University Medical Center, Bill Wilkerson Center.

Organizational assistance was provided by Dr. David Brown, the Academy’s Research Committee chair; Meggan Olek, Academy’s director of professional advancement; and Dr. Jennifer Shinn, University of Kentucky, principal investigator of the ARC grant provided by the National Institute on Deafness and Other Communication Disorders. Their experience and knowledge was invaluable in guiding and directing the organization of the program.
Epidemiology of Age-Related Vestibular Loss

Yuri Agrawal, MD, assistant professor, Division of Otology, Neurotology and Skull Base Surgery, Department of Otolaryngology-Head and Neck Surgery, Johns Hopkins University School of Medicine

Leading off the conference was Dr. Agrawal with a presentation about the epidemiology of age-related vestibular loss. He discussed how aging can affect the vestibular system and disturb normal balance control and locomotion. Histopathologic and physiologic evidence shows a decline in both semicircular canal and otolith function associated with aging.

Moreover, large-scale epidemiologic surveys and population-based studies suggest that age-related vestibular loss may be fairly common in the U.S. population. This loss of vestibular function that occurs as a part of the normal aging process is associated with reduced gait speed and increased fall risk. Recent evidence also suggests that age-related vestibular loss is linked to decline in cognitive function, specifically with respect to visuospatial cognitive function. Age-related vestibular loss is also associated with a reduced health-care quality of life in older individuals, equivalent to nearly two quality-adjusted life years of reduced life expectancy.

Finally, Dr. Agrawal discussed how the loss of vestibular function associated with normative aging has significant clinical impacts in older individuals and impairs their quality of life.

Dearangement in Perception of Motion Stimuli

Benjamin T. Crane, MD, PhD, associate professor of otolaryngology, bioengineering, neurobiology, and anatomy at the University of Rochester, and director of the human vestibular perception laboratory at the University of Rochester

Next, Dr. Crane reported his findings on derangement in perception of motion stimuli. Although there is a wide body of work that has focused on vestibular reflexes and detection thresholds, there is little work on supra-threshold perception. Mechanisms of supra-threshold motion perception include aftereffects, vection, and heading estimation. After effects have been extensively described in the visual system and a classic example is the waterfall illusion. This is where, after viewing a waterfall, the patient shifts attention to nearby fixed object and may cause him or her to appear to move upward.

An analogous mechanism has recently been described in the vestibular system and may be a method by which movements are filtered so the most salient movements are perceived. They seem to differ from other sensory after effects in that there is greater frequency specificity. Vection is an illusion of self-motion induced by a visual stimulus. This can be quantified using magnitude estimation techniques or using inertial nulling to compare the motion perception to an inertial stimulus. The inertial nulling technique has the advantage that it can be used to compare perceptions between individuals. Significant variation between individuals in studies of vection is common. Recent data suggests that some of this variation may be explained by migraine history. Vestibular migraine is a common cause of dizziness symptoms that may be explained by abnormal motion perception. Patients with migraine are more likely to interpret visual motion as self-motion through a fixed environment.

Primates, including people, are very good at discriminating whether a heading is to the left- or right-of-straight ahead with both visual and inertial stimuli. Discriminating left or right relative to an oblique reference heading is much more difficult. This is likely because there are many more central neurons that are tuned such that discrimination is best about straight ahead. However, when a population vector decoder (PVD) model is applied to this distribution of neurons, it predicts that the lateral component of oblique headings will be over-estimated (e.g., a heading 10 degrees to the left might be perceived as 20 degrees to the left). Some recent human experiments determine that these over estimations actually occur. Further studies demonstrate that visual headings are perceived in retina coordinates, thus when subjects look right 20 degrees, they perceive that they are moving through an environment that is shifted 20 degrees to the left. Vestibular headings are in body coordinates and are not influenced by head or body position.
Clinical Assessment of Otolith Organ Function

Owen Murnane, PhD, core investigator in the Vestibular/Balance Research Laboratory of the Auditory and Vestibular Research Enhancement Award Program and associate chief of staff-research at the James H. Quillen VA Medical Center at Mountain Home, TN, and professor in the Department of Audiology and Speech-Language Pathology at East Tennessee State University

Dr. Murnane presented his laboratory’s work on the clinical assessment of otolith organ function to include an overview of anatomy and physiology of the otolith organs, techniques for clinical assessment of otolith organ function, otolith organ test findings in clinical populations, and illustrative case studies. Specifically, he described the background, methods, and interpretation of the subjective visual vertical test during unilateral centrifugation, cervical vestibular-evoked myogenic potentials, and ocular vestibular-evoked myogenic potentials.

Patient Care and Modification in Vestibular Testing

Robert O’Reilly, MD, division chief otolaryngology, Division of Otolaryngology, Department of Surgery, Nemours/Alfred I. DuPont Hospital for Children

Dr. O’Reilly discussed key elements in the patient/caregiver history, modifications to vestibular testing that are necessary to optimally evaluate children, and the spectrum of disease seen in this population, using illustrative cases. Although pediatric balance disorders are uncommon, even children diagnosed with balance disorders do not complain. In contradistinction to adults, children have a lower incidence of BPPV and a higher incidence of migraine-related dizziness. The presentation reviewed relevant aspects of maturation of the vestibular reflexes and the primacy of visual input during transitions periods in balance. Central plasticity and its role in vestibular compensation was highlighted in the talk. With the advent of bilateral cochlear implantation, new interest has emerged in balance function in children.

Adaptation and Compensation Related to the Vestibular System

Michael C. Schubert, PT, PhD, associate professor in the Department of Otolaryngology Head and Neck Surgery at the Johns Hopkins University School of Medicine

Dr. Schubert presented on the adaptation and compensation as related to the vestibular system in two parts—(1) an update on the literature regarding describing mechanisms of recovery of gaze stability after injury to the vestibular system, and (2) new research on VOR gain adaptation.

In the first part, he presented evidence illustrating that both the vestibular slow phase eye (VOR gain) and saccadic eye rotations (compensatory saccades) can be enhanced to reduce eye position error associated with head motion in vestibular hypofunction. He provided examples of the unique types of compensatory saccades (overt and covert) that are recruited in vestibular hypofunction and discussed common methods used to capture these data. He also discussed the role of and illustrated gaze stability exercises used in treating patient with vestibular disorders.

In the second part, he discussed his research investigating ipsilesional VOR gain adaptation. Part of this included a review of the VOR adaptation literature using whole body rotation. His research is showing that neural circuitry exists within the human vestibular pathways to enable unilateral VOR gain adaptation in healthy controls, and ipsilesional VOR gain adaptation in patients with vestibular hypofunction at head velocities of functional relevance.
Technology Behind Video-Head-Impulse System

G. Michael Halmagyi, MD, staff neurologist and clinical professor, Neurology Department, Royal Prince Alfred Hospital and Vestibular Research Laboratory, School of Psychology, University of Sydney, Sydney, Australia

Dr. Halmagyi presented his laboratory’s work on the technology behind the recently developed video-head-impulse system (vHIT). He described an extensive overview of how the semicircular canals sense angular accelerations of the head and send neural signals through the vestibular nuclei to other brainstem nuclei, to the spinal cord and to the sensory cortex.

Until recently, impulsive testing could only be accurately done using scleral search coils. Recent technological advances, developed in part by Dr. Halmagyi’s laboratory, now allow accurate measurement of the vestibulo-ocular reflex from each of the six canals using video-oculography. His presentation provided a thorough review regarding the current clinical application of video-head-impulse testing. Technical details of vHIT developed in Dr. Halmagyi’s lab have been recently published in Balance Function Assessment and Management (Plural Publishing, 2014).

Conclusion

Rounding off the conference was Jessie Patterson, AuD, and PhD student, University of Nebraska-Lincoln, the recipient of the 2014 Vestibular Research Student Investigator Grant. Dr. Patterson presented on the visual acuity test in collegiate athletes. This exciting look into the assessment of college athletes demonstrated some of the contemporary work that her lab is doing in the area of concussion.

Finally, the poster session was a well-attended addition to the conference and featured 11 ARC NIDCD travel scholarship recipients. During this session, students and faculty alike presented their data in the area of dizziness.

This year’s Academy Research Conference (sponsored in part by Interacoustics and Otometrics) was an exciting and informative event that provided a snapshot of some of the most cutting-edge translation research that is going on around the globe. We hope attendees currently doing research garnered new information and ideas to consider as they move forward with their studies, as well as to inspire students to contemplate a career in vestibular research.

Devin McCaslin, PhD, is an associate professor with Vanderbilt University Medical Center, Bill Wilkerson Center, and was the program chair for the Academy Research Conference 2015.
CSI: AUDIOLOGY

WELCOME BACK to an ongoing series that challenges the audiologist to identify a diagnosis for a case study based on a listing and explanation of the nonaudiology and audiology test battery. It is important to recognize that a hearing loss or a vestibular issue may be a manifestation of a systemic illness. Being part of the diagnostic and treatment “team” is a crucial role of the audiologist. Securing the definitive diagnosis is rewarding for the audiologist and enhances patient hearing and balance health care and, often, quality of life.

—Hillary Snapp, Investigator-in-Chief


Hearing Is Believing

Case History
A 15-year-old female presented to the clinic complaining of gradual onset of left ear hearing loss with constant tinnitus for two years. She reported a history of recurrent vertigo attacks, which increased in frequency over the previous six months. Vertigo increased in severity with turns to the right or working out, and episodes were always accompanied by fluctuations in hearing. The patient was accompanied by her mother, who reported that previous evaluations by the patient’s pediatrician resulted in no evidence of hearing loss and referred the patient to a cardiologist whose findings were unremarkable for pathologic dizziness. The patient’s mother also reported suspicion that the patient was feigning her symptoms. The patient had recently been removed from the high school volleyball team due to sudden decrease in academic performance and reported behavior issues. As a result, the patient’s mother chose to seek a second opinion from an ear nose and throat (ENT) specialist.

A strong family history of hearing loss was reported with a maternal great uncle being born deaf and her maternal grandfather having Ménière’s disease. There was no history of previous serious ear infections, previous ear surgeries, head trauma, exposure to ototoxic medication, prematurity, or other risk factors of hearing loss.

Differential Diagnosis
1. Ménière’s disease
2. Vascular loop compression syndrome.
3. Congenital perilymphatic fistula

To further investigate the differential diagnosis, a battery of tests was ordered including imaging studies, audiogram, videonystagmography, rotary chair test, vestibular evoked myogenic potentials, auditory brainstem response, and electrocochleography.

Findings
• MRI and CT scan were unremarkable.
• The audiogram revealed normal hearing sensitivity and word recognition ability in the right ear and a moderately-severe sensorineural hearing loss with poor word recognition ability in the left ear (FIGURE 1).
• Auditory brainstem response testing resulted in normal
absolute and inter-wave latencies bilaterally.

- Electrocochleography resulted in a normal summating potential (SP) to action potential (AP) ratio in the right ear and an increased SP to AP ratio in the left ear.

- Combined results on vestibular evaluation were consistent with a left peripheral vestibulopathy. Asymmetric vestibular ocular reflex was observed throughout testing and bithermal calorics resulted in a 31 percent left unilateral weakness.

Consider the Facts

- Episodic vertigo lasting minutes to hours, accompanied by fluctuating hearing and tinnitus.

- Familial history of hearing loss and Ménière’s disease.

- Unremarkable imaging studies.

- Active volleyball player; no reports of head trauma.

- Unilateral sensorineural hearing loss.

- Left peripheral vestibulopathy.

- Left positive SP to AP ratio on electrocochleography.

Diagnosis

The patient presents with a classic presentation of Ménière’s disease that is strongly supported by clinical findings. The audiogram demonstrates the typical rising hearing loss configuration for Ménière’s disease with greater degree of hearing loss in the low frequencies (FIGURE 1).

Ménière’s disease is typically associated with fluctuations in hearing and related otologic symptoms such as tinnitus and aural fullness (NIDCD, 2015). Although the patient never had a formal hearing test prior to the ENT appointment, it is possible that whatever screening measures performed at the pediatrician’s office were during a period of fluctuation back to normal hearing. As Ménière’s disease progresses, the hearing loss becomes more severe and eventually progresses to a permanent state. One of the predominating theories of Ménière’s disease is that it is caused by the buildup of endolymphatic fluid in the labyrinth. This ultimately impacts the stimulation of the sensory cells that send signals to the brain regarding auditory and balance inputs (NIDCD, 2015). This abnormal buildup of fluid causes vertigo, hearing loss, tinnitus, and aural fullness (NIDCD, 2015). Electrocochleography measures the SP and the AP in the cochlea. An increase in the SP indicates an overabundance of endolymph in the cochlea and suggests the presence of Ménière’s disease.

Something to Consider

Would you have made any additional recommendations or referrals?

The patient’s primary complaint and reason for seeking a second opinion was the sudden decrease in academic performance. She had been labeled a child with “behavioral problems” and at the time of presentation was failing three out of seven classes. Prior to the onset of her hearing loss, the patient had been a varsity athlete with an A-B grade average. The pediatrician’s determination that she did not have a hearing loss, followed by the cardiologist finding no evidence of pathologic dizziness, resulted in the assumption that the

<table>
<thead>
<tr>
<th></th>
<th>Right Ear</th>
<th>Left Ear</th>
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<tbody>
<tr>
<td>Speech Reception Threshold</td>
<td>5 dB</td>
<td>65 dB*</td>
</tr>
<tr>
<td>Word Recognition Score</td>
<td>100%</td>
<td>40%*</td>
</tr>
<tr>
<td>Tympanometry</td>
<td>WNL (Type A)</td>
<td>WNL (Type A)</td>
</tr>
</tbody>
</table>
| Ipsilateral Reflexes    | Present: 0.5, 1, 2, and 4 kHz | Present: 2 and 4 kHz
|                         | Absent: 0.5 and 1 kHz       |

FIGURE 1. Results from audiometric evaluation revealing normal hearing in the right ear and a moderately-severe rising to mild sensorineural hearing loss in the left ear. Within normal limits (WNL), masked response (*).
patient’s sudden change in performance was behavioral in nature. The patient’s mother acknowledged that she, along with the patient’s teachers, believed the patient was feigning her symptoms. This not only resulted in a delay of treatment, but a significant impact to the patient’s academic performance and overall quality of life. Due to the concerns of hearing and academic performance, the patient was referred to the hearing aid clinic for management of her hearing loss.

Hearing Aid Evaluation
At the time of the hearing aid evaluation, the patient had experienced two additional severe episodes of dizziness resulting in further decrease in hearing and word recognition ability of the left ear. The patient’s hearing was monitored with otologic treatment. Following no observable improvement in audibility in the left ear, she was determined to not be a traditional hearing aid candidate. The patient and her mother declined surgical options such as a bone anchored implant, and opted for a trial with a contralateral routing of signal (CROS) hearing aid.

Hearing Aid Selection
The patient was fitted with a Phonak Naida Q 50 in the right ear and a CROS microphone in the left ear. Provided that individuals with normal hearing in at least one ear have normal audibility in quiet environments, the patient was evaluated in noise with speech directed at the hearing impaired ear and noise masking the normal hearing ear to determine benefit with the CROS hearing aid system. SNR loss was evaluated using the QuickSIN™ (Etymotic Research, 2001) in the unaided and aided conditions. SNR loss is the increase in signal-to-noise ratio (in decibels) required to obtain 50 percent correct words, sentences, or words in sentences compared to normal performance (Killion et al, 2004). SNR loss improved from moderate in degree (9.5 dB) in the unaided condition to within normal limits (-0.5 dB) in the CROS aided condition. Based on these findings, the patient and her mother agreed to pursue a trial with the CROS hearing aid system.

Hearing Aid Follow-up
The patient arrived to the clinic complaining of discomfort in the right (normal hearing) ear. She also reported that she could no longer hear from her right ear now that she was using the hearing aid, and that the hearing aid sounded “tinny.”

Troubleshooting
Real-ear measures! There are two issues here. The patient reported inability to hear in her good ear with use of the CROS and that sounds coming from the microphone on the left ear were “tinny”. Any good fitting protocol should include real-ear measures, including CROS hearing aid fittings. Verification of CROS fittings are incredibly simple and can easily be accomplished using any real-ear measurement system. In the simplest of terms, the general goal of verifying a CROS hearing aid is to ensure audibility of the signal from the impaired ear is adequately delivered to the normal hearing ear (Dillon, 2001).

CROS Verification Procedures
The probe microphone is always maintained in the normal hearing ear canal. The reference microphone is located at the same side as the loudspeaker (this will change depending on the measurement).

FIGURE 2A. Example of CROS hearing aid verification step 1 where the right ear represents the normal hearing ear. The probe microphone is positioned in the normal hearing ear with the reference microphone. The loudspeaker is directed at the normal hearing ear at +90° azimuth.

FIGURE 2B. Example of CROS hearing aid verification step 2 where the left ear represents the impaired ear. The CROS microphone is placed on the impaired ear along with the reference microphone. The probe microphone is maintained in the normal hearing ear. The loudspeaker is directed at the impaired ear at -90° azimuth.
Step 1 (FIGURE 2A): Both the reference and probe microphone are on the better ear and the real-ear unaided response (REUR) is measured with the loudspeaker at 45° to 90° azimuth relative to the normal hearing ear. Step 2: Put the CROS hearing aid system on the patient with the hearing aids turned on. The measured response should closely match the previously recorded REUR. Step 3 (FIGURE 2B): Put the CROS hearing aid system on the patient with the hearing aids turned on. The reference microphone is now located at the poorer ear with the loudspeaker at 45° to 90° azimuth relative to the poorer ear. The real-ear aided response (REAR) is measured. The measured response should closely match the previously recorded REUR from the normal hearing ear, confirming lifting of the head-shadow.

An optimal CROS fitting will result in a REAR that matches the REUR for soft, moderate, and loud inputs. If the REAR is reduced compared to the REUR, one can conclude that the signal from the impaired ear is not being adequately delivered to the normal ear. This would trigger the clinician to make adjustments to match the REUR. With that said, CROS hearing aid systems will typically have a small amount of gain prescribed in the high frequencies. Low frequencies have long wavelengths and therefore can easily wrap around the head to be heard by the normal hearing ear, whereas high frequency signals have short wavelengths that are diffracted by the head (Blauert, 1997). This prescriptive method is to overcome the loss of those high frequency cues. In the case of the presented patient, there was a significant increase in high frequency gain over the REUR, which resulted in her perception of sound being “tinny” (FIGURE 3). Through real-ear measures, we were able to objectively identify the problem and reduce the gain to provide a more comfortable signal without decreasing the benefit of the CROS system.

The patient’s other complaint was that she could no longer hear clearly in her good ear. This is likely due to the occlusion effect. Simply by placing an object in the ear canal, a barrier to sound is created. This effect is even more pronounced in a normal hearing ear. Much of the acoustic limitations traditionally associated with CROS hearing aids have been overcome with open fit technology. However, the use of open fit hearing aids does not exclude the possibility of the occlusion effect. The presence of any object in the ear canal will change the acoustic properties of the ear canal and, in turn, impact the delivery of the signal through the acoustic pathway. It is important to account for this in the fitting process. This can be easily accomplished using probe microphone measures as described in steps one and two. Any reduction in the response measured for step two

FIGURE 3. REAR demonstrating the signal delivered from the CROS microphone to the normal hearing ear. The pink line shows the measurement from the CROS microphone, the blue line shows the REUR at the normal ear, and the red line shows the response at the normal ear without the CROS microphone active.

FIGURE 4. Real-ear measures demonstrating the occlusion effect where the blue line shows the REUR at the normal hearing ear and the red line shows the insertion loss that occurs when the hearing aid is inserted into the ear canal.

FIGURE 5. Real-ear measures demonstrating the REUR at the normal ear and the response obtained with the hearing aid positioned in the ear after modification to make the fit more open. The two measurements match, verifying resolution of previously measured insertion loss (Figure 4).
represents a loss in signal due to the insertion of the hearing aid into the ear canal, i.e. the real-ear insertion loss. Measuring the occlusion effect in the described patient resulted in an observable insertion loss (FIGURE 4).

How might you have overcome the fitting obstacle of the occlusion effect for this patient?

Otoscopy revealed the patient to have very small ear canals with obvious occlusion of the canal. The patient was already in an open fitting with the smallest available dome. Custom open fit ear molds were considered, although in very small ear canals this often results in even more mass with greater occlusion. Rather, an attempt to modify the open dome was made in the clinic by cutting the flanges and leaving only the casing to cover the open tip of the ear hook. The patient reported immediate improvement in physical comfort in the ear canal and resolution of the occlusion effect. Repeat probe microphone measures resulted in no objective finding of insertion loss (FIGURE 5).

Discussion

This case highlights a few clinical challenges. First, the patient presented with classic symptoms of Ménière’s disease, which were quickly dismissed resulting in a cascade of deleterious outcomes. Whether due to her age or the fluctuating nature of her symptoms, the patient was determined to be feigning her symptoms. The more she persisted in her complaints, the more readily she became labeled as having behavioral problems. It was not until significant negative impact to her academic performance that her parents sought further investigation. It is likely that had the appropriate referral for a hearing and balance specialist been made based on the patient’s initial complaints, she would have had appropriate intervention early on and perhaps prevented the negative impact to her academics and quality of life. The lesson that can be learned from this is not to pre-diagnose or make clinical presumptions based on the presentation or profile of a patient (i.e. age, ethnicity, cognitive function, etc.). Further, it is important for clinicians to recognize their own professional limitations and take the time to identify appropriate referrals when a patient presents with an issue outside of their scope of practice and/or area of expertise.

The second challenge was ensuring objective benefit of the CROS system and effectively managing the patient’s acoustic complaints. Patients with normal hearing in one ear and severe to profound hearing loss in the opposite ear have long been plagued by the assumption that one ear is good enough. Even as clinicians, it is easy to underestimate the needs of this patient population and bypass standard of care. The importance of verification using real-ear measures in management of hearing loss has been well accepted. Yet this crucial step may be overlooked in the CROS population due to the misconception that there is nothing to verify if the ear receiving the signal is normal. Management of unilateral hearing loss through CROS hearing aids is commonly rejected due to the complaints of poor sound quality and occlusion. This case demonstrates how utilization of real-ear measures can objectively identify such issues and provide a means for resolution so that patients can experience benefit, satisfaction, and successful hearing loss management. In short, all CROS hearing aid fittings should, at minimum, verify the absence of insertion loss (i.e. occlusion effect), and that the device is successfully lifting the head shadow effect. Behavioral measures such as tests of speech-in-noise performance are also encouraged to validate the benefit of lifting the head shadow effect.

Hillary Snapp, AuD, is an assistant professor of audiology in the Department of Otolaryngology at the University of Miami, Miami, Florida.

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The importance of understanding the rationale behind everything we do clinically is something that has been continually stressed throughout my AuD training at Vanderbilt University, both in the classroom and in the clinic. Undoubtedly, the best question I have been asked as a student is not what, as in “What tests should be done with a particular patient?” or “What is an appropriate masking level?” (albeit certainly important and necessary). Rather, the most important question has been why—“Why is this test being conducted?” or “Why is this masking level appropriate?” Because to answer the question why requires understanding the science that serves to support the practice.

Now in my fourth year of the AuD program, I am in the somewhat unique position of completing an externship that is divided equally between Vanderbilt’s audiology clinics and its hearing aid research laboratory. My involvement in both research and clinical practice has offered me an interesting perspective on the field and has been enlightening for a number of reasons. Perhaps most importantly, this experience has encouraged me to give more thought and consideration to the relative youth of our profession, the effect this has had on our adoption of evidence-based practice, and implications for areas of clinical practice where data-driven rationales are still limited.

There is no question that, as a field, our knowledge base is rapidly expanding and continually evolving. With advances in systematic research, the evidence base upon which this knowledge is gleaned will become increasingly strengthened, and so too will our standard of practice and quality of patient care. This is a process that takes time, however. Evidence-based practice was first introduced in the mid-1800s, but its incorporation into the field of medicine is actually relatively recent. Understandably, it is even newer to audiology and the reality is that today, several of our routine clinical decisions are based on a mix of limited evidence and clinical intuition.

Cochlear implants and hearing aids are two areas where much of our practice still relies heavily on expert opinion. Consider cochlear implant mapping, for example. It is not unheard of for programming and processing strategy decisions during a cochlear implant activation to be driven, at least initially, by a mix of practitioner intuition, manufacturer recommendation, and patient feedback. Without a strong evidence base to guide our clinical decisions, determining which settings might yield the most benefit for a given patient or predicting which settings might ultimately be preferred can feel a bit like trial and error. While clinician experience and patient feedback are clearly important, we are greatly limited if they are the only factors informing our clinical decision-making.

Conducting research to evaluate a treatment or a technique takes considerable time; thus, establishing a solid evidence base for clinical procedures and decisions is inevitably a slow process. In audiology specifically, another issue that makes implementing evidence-based practice infinitely more challenging is that much of our clinical work is centered around devices...
that are constantly evolving. Hearing aids and cochlear implant processing, wireless accessories, and a variety of other technologies are likely to be marketed and sold well before their effectiveness is thoroughly evaluated. There may be evidence for effectiveness in a specific situation; however, without independent, peer-reviewed research to inform clinicians who the technology might benefit, in which environments, or whether there are any interactions that might preclude its usefulness for certain listening situations or individuals, we must initially remain cautious.

Although establishing a solid evidence base can be a challenging and slow process, there are certainly areas of audiology where data from systematic research have started to change the field. Fitting to validated prescriptive methods using probe microphone measures is a classic example. Despite years of advocacy by researchers for the use of probe microphone measures for hearing aid verification, its routine use by practitioners in the United States was only around 40 percent in 2010—a percentage that has remained virtually unchanged over the past 20 years (Mueller & Picou, 2010). One possible explanation for the slow adoption of this practice might be that, until very recently, researchers argued for its use without compelling outcome data. Without probe microphone measures, most clinicians would not have a reliable way of determining the precise audibility of signals of varying levels in a patient’s ear. Further, manufacturers’ first-fit settings often differ from that of validated prescriptive methods, and the real-ear gain and output simulations in the fitting software are often vastly different from that measured in the ear (Mueller, 2005b). For some, these reasons may have been compelling enough to adopt probe microphone verification; however, others may still have been questioning whether outcomes are significantly different for those fitted to a validated prescriptive method using probe microphone techniques versus those who are not.

We now have additional data suggesting the answer is yes. Abrams et al. (2012) not only showed that the majority of their 22 participants preferred being fitted to a verified prescriptive method (NAL-NL1) over manufacturers’ first-fit algorithms, they also showed that the subjective benefit scores using the APHAB were higher for the NAL-NL1 fitting. In fact, data from preferred gain and trainable hearing aid studies have shown for some time that, on average, individuals prefer the gain settings specified by validated prescriptive methods (Hornsby & Mueller, 2008; Mueller, 2005a), but the more recent outcome data make the argument for fitting to validated prescriptive methods even more compelling. It will certainly be interesting to see how these data influence hearing aid fittings over the next few years.

The youth of our profession, the time it takes to design and complete quality research, and the quickly evolving nature of technology, all combine to make implementing true evidence-based practice a slow and complex process. Moreover, the inherent delay between the release of a new technology and the supporting evidence for its use can present a personal challenge for clinicians who want to provide patients with the latest technology, yet also be guided by strong data-driven recommendations. Our knowledge base is constantly evolving, and therefore, familiarity with the most up-to-date, peer-reviewed literature continues to be of utmost importance. Given my current experience rooted in both the research and clinical worlds, I can see how clinicians could become entrenched in a particular way of practicing, especially given the time demands often faced in the clinic. I believe having the flexibility to adapt and to adopt new techniques and procedures will be key to continual improvement in patient care. As we move forward, collaborative efforts and communication between researchers and clinical practitioners will be essential in building the evidence base upon which clinical decisions should be made. In so doing, our standard of practice and rationale for clinical decision-making will be strengthened, as will our answers to the question of "why?"

Kristen L. D’Onofrio completed her AuD in May 2015 and is continuing her PhD studies at Vanderbilt University in Nashville, Tennessee.

References


Coding for Evaluation of Auditory Rehabilitation Status
CPT codes 92626 and 92627

The content in this Q&A was compiled in collaboration with the American Academy of Audiology (AAA), Academy of Doctors of Audiology (ADA), and the American Speech-Language-Hearing Association (ASHA).

There has been confusion regarding the appropriate use of American Medical Association current procedural terminology (CPT®) codes related to the evaluation of auditory rehabilitation status. The guidance outlined in this article is based on another article, “Coding Brief: Evaluation of Auditory Rehabilitation Status (92626),” from the July 2014 issue of the CPT Assistant, which is published by the American Medical Association and considered an authoritative source for coding guidance. These codes have coverage and noncoverage applications and audiologists will need to validate coverage with their individual payers.

The codes addressed in this article are

- **92626**: Evaluation of auditory rehabilitation status; first hour
- **92627**: Evaluation of auditory rehabilitation status; each additional 15 minutes

When is it appropriate to use CPT codes 92626 and 92627?

Audiologists may report CPT codes 92626 and 92627 when evaluating the auditory function of a patient either before or after the patient receives unilateral or bilateral hearing devices, including:

- Hearing aid(s)
- Auditory osseo-integrated implant(s)
- Middle-ear implant(s)
- Cochlear implant(s)
- Auditory brainstem implants

According to the CPT Assistant, the "evaluation will determine the need for auditory rehabilitation following the fitting and verification of hearing devices and may also be used to monitor the progress of therapeutic intervention."

Do these codes capture other services related to hearing aids or cochlear implants?

No. The CPT Assistant is clear that it is inappropriate to use 92626 and 92627 for services other than the evaluation of auditory function to determine the need for rehabilitation. The items below provide guidance on appropriate coding for other commonly reported services related to hearing aids and cochlear implants.

- Hearing aid examination and selection should be coded using 92590 (monaural), 92591 (binaural) or V5010
- Fitting, orientation, and checking of a hearing aid are reported using HCPCS code V5011
- Hearing aid checks are reported using 92592 or 92593
- Hearing aid verification and validation is reported using V5020
Hearing aid dispensing fees are reported using one of the following HCPCS codes: V5090, V5110, V5160, V5200, V5240, or V5241.

Diagnostic analysis and programming/reprogramming services related to cochlear implants are reported with CPT codes 92601 through 92604.

Cochlear implant troubleshooting is reported using 92700 or L9900.

Aural rehabilitation is reported using 92630 or 92633.

Tinnitus evaluations are reported using 92625.

How do I bill these codes if the evaluation lasts more or less than an hour?
The CPT Assistant states that 92626 “...is a time-based code and is reported for the first hour of evaluation. Code 92626 should not be reported for evaluations of auditory function lasting less than 31 minutes. Add-on code 92627 is reported for each additional 15 minutes of evaluation and must be used in conjunction with code 92626 for evaluations lasting longer than 60 minutes. 

“When reporting codes 92626 and 92627, the documented time spent face to face with the patient or family should be used to determine the length of the auditory rehabilitation evaluation.” It is important for providers to clearly document in the patient’s medical record the time spent providing the evaluation service.

If the evaluation is 30 minutes or less can I report 92627 alone or report 92626 with the 52 modifier?
No, the add-on code 92627 cannot be billed independently of 92626 and cannot be used for instances when the documented time spent in evaluation is less than 31 minutes. The reduced service modifier (-52) cannot be used with any time-based procedure codes.

If the time spent for the evaluation is less than 30 minutes 92700 (Unlisted otorhinolaryngological service or procedure) may be reported. However, when filing a claim including 92700, it will be necessary to submit supporting documentation detailing the need for the service, as well as the time, effort, and equipment necessary to provide the service.

When can I use 92626 and 92627 with commercial payers?
Commercial payers may have different guidance and may cover these codes when medically necessary for pre- and post-testing of an implanted auditory device. Coverage will likely vary by individual policy. Billing practices and coverage guidance for these CPT codes should be verified with the commercial payer.

Can I use this code for patient and/or family counseling?
This is not considered an appropriate use of 92626 and 92627. The audiologist’s time spent in counseling is not separately reportable to Medicare. Audiologists should consult non-Medicare payers before separately coding for time spent counseling.
Over the last few years, the Arkansas Academy of Audiology (ARAA) has set the bar in generosity. During the annual ARAA conference, this group holds a fundraising auction, and the proceeds are donated to the AAA Foundation to support national programs that advance audiology. During AudiologyNOW!® in San Antonio, ARAA was recognized for its leadership in state academy philanthropy since they have contributed over $5,400 over the last three years.

Now, however, they are expanding their fundraising efforts beyond the Arkansas state borders with the intention of encouraging a friendly philanthropic competition.

College football fans, and especially the SEC faithful, know that each Thanksgiving weekend the Arkansas Razorbacks and Louisiana State University (LSU) Tigers vie for “The Boot,” the trophy awarded during this annual game that is a regional classic. In the spirit of this rivalry, the ARAA has challenged the Louisiana Academy of Audiology (LAA) to vie for a “philanthropic boot” to see which state audiology organization can raise the largest gift for the AAA Foundation in 2015.

Steve Madix, president of the LAA, stated that the LAA is up for the competition. “Our state academy welcomes the challenge from our ARAA colleagues to the north, especially when the funds will support a great cause, the AAA Foundation’s efforts to fund audiology research, education and public awareness,” announced Madix. “As we say in our neck of the bayou, ‘Laissez les bon temps rouler’...and let the auction dollars flow!”

ARAA’s annual meeting convened in early May, and they held another great fundraiser. Hope Gillison, ARAA vice-president for membership said, “LAA has way more people than we do, so I am quite sure they could blow our number out of the water easily. But we raised more this year than ever, so they have their work cut out for them. It’s all for a good cause, so we wish them much success!”

In audiology, as on the gridiron...may the best team win!

For more information on how your state or local organization can partner with the AAA Foundation, contact Kathleen Devlin Culver (kculver@audiology.org).
Focus on Foundation

Audiology Grants & Scholarships

If you’re interested in participating in future auctions, please contact Rachael Sifuentes at rsifuentes@audiology.org for more information.

Auction 4 Audiology: An Overwhelming Success in San Antonio

The 2015 AAA Foundation Auction 4 Audiology generated $17,000 in winning bids from supporters of healthy hearing at AudiologyNOW! and online. The Foundation would like to thank the many individuals, state audiology organizations, corporate friends, and SAA chapters who donated items to help us reach such an incredible goal!

American Academy of Audiology
American Academy of Audiology North Carolina
American Board of Audiology
American Institute of Balance
Auburn University SAA
AuDBling
Kim Barry, AuD
Bionix Medical Technologies
California Academy of Audiology
Brenna Carroll, AuD
Connecticut Academy of Audiology
CounselEAR
Kathleen Devlin Culver
Veralyn Davee, MA
Pamela Fiebig, AuD
Susan Fusco, AuD
Fu-Tone.com
Hearing Fusion
Hearing Healthcare News
Hearing Healthcare Recruiters
Illinois Academy of Audiology
JFLAC Class of 2010
Patricia Kricos, PhD
Lamar University SAA
Maine Academy of Audiology
Michael Mallahan, AuD
Joselyn Martin, AuD
Eugene McHugh, EdD
Michigan Academy of Audiology
National Hearing Test
New Jersey Academy of Audiology
New York Speech and Hearing Association
Northeast Ohio AuD
Consortium SAA
Northeastern University SAA
Nova Southeastern University SAA
Ohio Academy of Audiology
Osborne College of Audiology
Oticon, Inc.
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Power One Batteries/VARTA Microbattery, Inc.
Virginia Ramachandran, AuD, PhD
Adam Reiver
Resonance Audiology Excellence
ReSound
San Diego State/UC San Diego University SAA
Michael Santucci, AuD
Sy Kessler Sales, Inc.
Elizabeth Thompson, AuD
TIMS for Audiology
Tinnitus Practitioners Association
Christine Ullinski, AuD
University of Cincinnati SAA
University of Iowa SAA
University of North Carolina SAA
University of Southern Mississippi SAA
University of Texas at Dallas SAA
Vanderbilt University SAA
Melanie Vazquez, AuD
Washington University School of Medicine SAA
Wayne State University SAA
Wells Fargo Health Advantage

If you're interested in participating in future auctions, please contact Rachael Sifuentes at rsifuentes@audiology.org for more information.
New Members of the Student Academy of Audiology

Jared Anderson
Kelly Bailey
Jessica Barczik
Dacia Bolt
Kyle Conrad
Chelse Craig
Allison Cunningham
Caroline Dadowski
Daniel Demarest
Rose Dockery
Lauren Fessler
Ellen Foltz
Kerian Giambruno
Kristi Gulbrandsen
Amanda Hager
Engie Hammad
Taylor Hill
Caitlin Hillmann
James Holmes
Lissette Jackson
Phyllip Johnson
Anne Jones
Dooho Kim
Nicole Konecko
Timothy Kuckuk
Kate Landowski
Ashley Long
Ellen Marolf
Marissa Martin
Elizabeth Massey
Samantha Merker
Christy Mitchell
Amanda Musso
Laura Neff
Jennie Noska
Amber Olivas
Kristen Piazza
Katherine Reistroffer
Susan Reynolds
Rebecca Rogers
Stephanie Sandoval
Sara Sims
Chelsea Tisckos
Jessica Toboika
Haley Welker
Jacqueline Weycker
Kathleen Zory

SAA Conference Overview

By Kara Vasil

Members of the Student Academy of Audiology (SAA) were encouraged to “Steer with Success” at the third annual SAA Conference, held during AudiologyNOW!® 2015 in San Antonio, TX. This all-day event featured various case-based lectures by experts in the field of audiology. Over 120 students arrived for the best attendance in the history of the conference, using their clinical skills to decode complex cases and gain knowledge about diagnostics, treatment, and multidisciplinary collaboration.

Dr. Frank Musiek began the event with a riveting lecture on adult diagnostics, with an emphasis on electrophysiologic techniques. With a closer look at early, middle, and late potentials, Dr. Musiek showed students the importance of these assessments, along with imaging, to reach a diagnosis.

Next, Dr. Linda Thibodeau, a renowned expert in aural rehabilitation, spoke about the importance of partnerships with other professionals, including speech-language pathologists, to outline a treatment plan. By reviewing communication strategies, as well as assistive-listening devices, she inspired students to consider the patient’s goals and needs as an important step in the rehabilitation process.

Dr. Eileen Rall, a pediatric audiologist known for her work at the Children’s Hospital of Philadelphia, provided an interactive presentation.
for attendees. Students were able to practice the case-history process, a procedure that is crucial to reaching a diagnosis and gaining rapport with a patient and their family. Dr. Rall gave students insight about appropriate test procedures for children of various ages and how to test children with special needs, such as autism, developmental disabilities, and pseudohypacusis.

During the lunch hour, students enjoyed networking with various professionals within the field of audiology. The American Academy of Audiology Board of Directors, as well as related partner organizations and conference presenters, were invited to sit with students, talk about the profession, and inspire them to reach new heights within their professional careers.

After lunch, Dr. Gail Whitelaw of the Ohio State University presented two cases of adults and their respective diagnostic and treatment plans for a closer look at auditory processing disorders. With a toolbox full of interdisciplinary health professional contacts, speech-in-noise testing, and various auditory processing tasks, a team can pinpoint the patient’s difficulty. Even though APD can be a puzzle to assess and treat, Dr. Whitelaw outlined recommendations for amplification, auditory training, and language evaluation to best suit patients’ needs.

Dr. Sharon Sandridge, an expert in the field of tinnitus from the Cleveland Clinic, continued the day by reviewing her facility’s unique tinnitus management clinic. At this monthly clinic, patients with tinnitus are screened by an audiologist, neurologist, dentist, psychologist, and physical therapist to assess the tinnitus handicap and the possible cause of the issue. By matching the nature of the tinnitus and evaluating a patient’s needs and expectations, Dr. Sandridge shared information about sound generators, self-assessments, and mobile apps to reduce a patient’s handicap and ultimately improve their quality of life.

The final lecture was given by Dr. Rene Gifford, a well-known researcher of cochlear implants. Dr. Gifford demonstrated an impressive image-guided cochlear implant programming, which allows clinicians to view the electrode’s position within the cochlea and estimate excitation patterns for different frequency areas. With an emphasis on personalized medicine, Dr. Gifford stressed the need for hearing preservation and rehabilitation, with the goal of reaching a patient’s full listening potential.

After the interactive case-based lectures, a “new audiologists” panel was featured for the first time. This panel was composed of five audiologists who have been practicing for five years or fewer. With various different clinical and research settings, these audiologists gave students excellent advice on navigating the journey to a career in the field. From applying for a job to negotiating a salary, marketing your abilities, and building a “fan club” of contacts and referrals, these professionals inspired students to advocate for themselves at every turn. Students were free to ask questions and were emboldened to use their experience at AudiologyNOW! to attend sessions, speak with audiologists from around the world, and check out new products in the always-popular exhibit hall.

For the third year in a row, the Student Academy of Audiology Conference has been a great success in uniting students and allowing them to expand their horizons. From electrophysiology to pediatrics to tinnitus management, each lecturer brought new knowledge and inspiration to attendees. Students from around the world were encouraged to think critically about each patient and complete a comprehensive assessment with patient-centered care. This year’s SAA Conference will be difficult to beat, but we hope to see another great turnout at the fourth annual SAA Conference to be held in conjunction with AudiologyNOW! 2016, April 13, in Phoenix, Arizona!

Kara Vasil is currently a fourth-year graduate student at the Northeast Ohio AuD Consortium (NOAC). Her audiological interests include pediatrics and adults, aural rehabilitation, and auditory processing. Kara is completing her fourth-year externship at Heuser Hearing Institute in Louisville, KY.
At this year’s AudiologyNOW!® in San Antonio, a group of 70 audiologists gathered in a mentoring lunch hosted by the American Board of Audiology (ABA). The purpose of the luncheon was to partner audiologists with less than five years of experience with seasoned ABA credentialed audiologists to act as mentors so that the newer doctors could ask questions and learn from them.

Each of the mentors, who generously donated their time and knowledge to help others in the profession, were asked to answer one simple question: “What do you wish you had known in your first five years of practice in audiology?”

Here’s what they shared with us:

**Billing and Coding**  
Deb Abel, AuD,  
Board Certified in Audiology,  
American Academy of Audiology

- To secure a professional mentor... someone to ask questions of, someone with years of experience in patient care and practice management.

- Question coding practices if your knowledge base is different than what you see in your office.

- It may not just be a matter of being correct/compliant, but also one of demonstrating your value and expertise to optimize reimbursement opportunities (and streamline clinical practices).

- You are a valuable professional. Don’t let anyone treat you otherwise!

- If you have any questions, please reach out to the Academy! (There wasn’t one in my early career.)

**Cochlear Implants**  
Bill Shapiro, AuD,  
Board Certified in Audiology,  
NYU Medical Center

For me, the biggest issue is the speed in which technology changes and the amount of continuing education required to keep up with advancements. This impacts the way an audiologist practices his/her profession. My advice is to try to maintain involvement in many different professional aspects for a well-rounded career, e.g., financial, academic, clinical, cutting edge, etc.

**Large Practice**  
David Zapala, PhD,  
Board Certified in Audiology,  
Mayo Clinic

1. **Character counts:** If a young person has an insatiable dedication to finding the truth, and an indomitable spirit, early (inevitable) failures are really invaluable lessons that allow for later success. Never give up!

2. **Collaborate:** When I was younger, I thought I had to do everything by myself—clinical practice, research, playing guitar. I didn’t accomplish as much as I could have. As soon as I started collaborating, my productivity and my sense of awe about life skyrocketed. Find good friends and create good teams!

**Online Sales**  
Dennis Van Vliet, AuD,  
Board Certified in Audiology,  
Starkey Laboratories, Inc.

How important common sense management and business basics are to being a successful practitioner, no matter what setting we are in!
3. **Believe in yourself**: I’m not rich in the material sense (I’m doing okay) and I’m not the smartest audiologist. But over the course of my career, I have helped a lot of people and at the end of the day I sleep well. Don’t let anyone or anything get in the way of you helping others. Particularly don’t let the medical community brainwash you into thinking that you are second class, don’t make a difference, can be replaced, or can’t do what you were trained to do simply because you did not go to medical school. You can do things physicians cannot do. Focus on this—help those who need or seek your help—the monetary rewards and recognition come after you make an impact.

4. **Don’t worry about change**: Relentlessly try to do better today than you did yesterday. Small innovative steps add up. Let everyone else catch up with you.

5. **Aim high**: Most of us are limited only by our beliefs about what we cannot do. It is better to aim high and fail, than it is to squander your potential by thinking small.

### Hearing Instruments Fitting
**Alison Grimes, AuD,**
**Board Certified in Audiology, UCLA Medical Center**

I wish I had known three things:

1. How much of my life would revolve around audiology (professional volunteering, attending and presenting at meetings, the friends I made, the guys I dated, and the man I married).

2. How interesting each and (almost) every patient would be—as people first, and also their hearing loss (pathology, communication impairments, challenges, and successes).

3. The rewards of conducting clinical research and being actively involved in professional organizations and legislative initiatives.

### Auditory Processing Disorder
**Gail Whitelaw, PhD,**
**Board Certified in Audiology, PASC,**
**The Ohio State University**

There’s so much I wish I had known when I started as an audiologist many years ago. I was fortunate to have great mentoring in the area of auditory processing disorders. This helped me to understand that the audiogram is only one tool in our toolbox and that, as audiologists, we had such a significant role in assessing hearing and listening skills while we listened to patients.

Most importantly, I wish I had known how interesting it would be to work with both adult and child patients with auditory processing disorders. Over my 33-year career, I’ve learned about issues like traumatic brain injury, Sucac syndrome, Chiari malformations, and carbon monoxide poisoning. This makes the profession of audiology and audiologists themselves essential to patients.

### Clinical Fee Structures
**Ian Windmill, PhD,**
**Board Certified in Audiology, Cincinnati Children’s Hospital Medical Center**

I wish I had understood the great responsibility that came with being a health-care provider. For example, failure to identify a hearing loss in a newborn could have resulted in delays in communication development. Then that could have resulted in failure to achieve academic milestones, which could have led to economic and social consequences for patient and parents, which then could have long term vocational effects. Similarly, the failure to identify an acoustic neuroma could have resulted in the tumor becoming larger and more dangerous. This could have resulted in greater long term patient morbidities (this happened to me!).

Audiologists bring a level of unique expertise that cannot be matched by any other provider in the health-care system. With this unique role comes an equally unique level of responsibility. This responsibility is not focused on conducting a pure tone audiogram or an ABR, but rather in all the decisions that flow prior to and after the test is complete. Understanding this responsibility would have helped me sooner define the patient-by-patient outcomes necessary to fulfill my role.

### Electrophysiology
**Jay Hall III, PhD,**
**Board Certified in Audiology, Audiology Consulting, LLC**

As a biology major at a small liberal arts college, I literally had not met an audiologist or heard the word audiology until I took an Introduction to Audiology course in the first semester of a master’s degree in speech pathology at Northwestern University. What I learned in that course, and a few other elective courses in subsequent semesters, convinced me that audiology would be my life’s work. In a nutshell, I wanted to contribute to a young and growing autonomous health profession that involved diagnosis and rehabilitation of perhaps the most important sensory function across the age span from newborn infants to elderly adults. The constantly evolving profession of audiology was all that I thought it would be...and more.
**Credentialing**

John Coverstone, AuD, Board Certified in Audiology, Sentient Healthcare, Inc.
The accepted pathway for health-care providers, which I was not taught in my training program, is: Academic Training > Clinical Training > Professional Degree > Professional Licensure > Specialty Training > Specialty/Board Certification

I believe we would be better prepared to practice as new audiologists if this is ingrained.

**Private Practice**

Bettie Borton, AuD, Board Certified in Audiology, Audigy Group, LLC

The professional issues that I wish I had known more about include:

1. The personal and professional benefits resultant from involvement in and service to the profession through the American Academy of Audiology.

2. The importance of and responsibility inherent to achieving true professional autonomy.

3. A better understanding of both the rigors and rewards of independent private practice.

4. The importance of the survival of independent private practice to our profession as a whole.

Many audiologists (including myself) wandered into private practice armed with few meaningful resources to meet the challenges we would face. Whether you intend to pursue independent private practice or not, understanding the role of this employment sector in our collective bid for viability and autonomy in the health-care arena is important. Likewise, if you want to have a remarkable career as an audiologist, the importance of understanding and embracing current professional issues by involving yourselves in developing successful solutions cannot be overstated. Finally, take heart: you have chosen a wonderful career! Audiology’s future is very bright, and I urge you to get involved in its exciting, evolving history! ☀

Torryn P. Brazell, MS, CAE, is the managing director of the American Board of Audiology. She is a credentialing practitioner with extensive experience in non-profit management, including the development and implementation of professional certification and assessment-based certificate programs: initial concept, practice analyses, subject matter expert facilitation, program delivery, item writing, and maintenance.
Expanding and Enhancing Audiology Education Globally

By James W. Hall III

This article, the second of a two-part series about global education in audiology, addresses emerging strategies and efforts to expand the availability and enhance the quality of audiology education around the world.

An article in the preceding issue of *Audiology Today* titled “Thinking Globally About Audiology Education” reviewed existing academic models for the education of audiologists. Following a geographical theme, we reviewed the diversity in educational programs found in different regions of the world. In contrast, this article focuses on specific strategies for advancing the education of audiologists and ancillary hearing health-care providers globally. We’ll review options currently available to practicing audiologists interested in furthering their education and also an option for systematic education of hearing care technicians.

As noted in the first article, audiology education is currently expanding in the Middle East region of the world where the demand for hearing health-care services greatly exceeds the supply of Arab-speaking audiologists. Dr. Assel Al-Meqbel of the Hearing and Speech Sciences Department in the Health Science Center at Kuwait University (aseel.m@hsc.edu.kw) has developed a five-year bachelor’s degree audiology program. Dr. Kim M. Smith Abouchacra (ks05@aub.edu.lb) has taken a lead role in creation of an interdisciplinary medical audiology sciences bachelor’s degree program at American University in Beirut Lebanon. Each of these programs is the product of a longstanding successful model for expansion of audiology education in countries. That is, highly motivated individuals who have completed advanced formal audiology education in countries such as the United States, United Kingdom, or Australia, assume a key role in establishing an educational infrastructure in a country where it doesn’t exist. Dr. Al-Meqbel of Kuwait University earned her master’s degree from the University of Queensland and her PhD from Macquarie University, both in Australia. Dr. Smith Abouchacra of American University in Beirut is a graduate of Pennsylvania State University.

Well-known audiologist and hearing researcher William H. Martin, PhD, recently relocated from the United States to Singapore, where he has developed a master’s degree program at National University. In Billy’s words,

The hearing health-care needs in Singapore far exceed the current availability of highly trained audiologists. We recognize that a two-year master’s course will provide general competence in clinical audiology but may not provide the level of training needed in areas of subspecialty. To that end, we plan to offer post-graduate advanced subspecialty certification in areas of clinical need within the country. We also recognize that not all diagnostic services that are needed here require training at the master’s degree level. The current model here employs audiology technicians...
China is a country with enormous unmet hearing health-care needs and a severe shortage of properly educated and qualified audiologists. According to Qi Liang (liang_qi@foxmail.com), an AuD graduate of Salus University and CEO at AIER Education and Consulting in Beijing, AIER offers several educational programs consisting of theory and practical instruction. The core coursework modules are delivered by distance learning using an online platform. AIER is also cooperating with Salus University to deliver online course and on site workshops on hearing assessment and cochlear implants. In addition, AIER is building internationally recognized standards for hearing centers across China.

Three universities in the United States are actively involved in international education of audiologists. Erica Friedland, AuD, chair of audiology at Nova Southeastern University, reports that over 100 audiologists representing a wide variety of countries, including all regions of the United Kingdom, the Middle East, Africa, Asia, and South America, have graduated from the residential AuD program in the United States or an international AuD program based in London. There are 70 international graduates of the distance learning AuD program at University of Florida, including 30 from North America outside the United States, plus 25 from Australia/New Zealand and Asia, 10 from India, and five from Africa, the Middle East, or Europe. Among the current cohort of distance learning AuD students at the University of Florida, 50 percent are from countries outside the United States.

The Osborne College of Audiology at Salus University offers a variety of educational options for audiologists practicing outside the United States who have a degree in audiology recognized in their country. One option is the online Advanced Studies Certificate Programs in three specialty areas of study: Cochlear Implants, Tinnitus and Hyperacusis, and Vestibular Sciences and Disorders. Past and current students hail from all regions of the world (Salus, 2015).

Salus University also offers an International AuD Degree Bridge Program for mid-career master’s level working audiologists who wish to pursue further education and to assume roles as leaders in their profession. Courses covering the breadth and depth of clinical audiology and basic hearing science are taught by a distinguished faculty of subject matter experts representing major universities (Salus, 2015).

In addition, Dr. Giri Sundar (gsundar@salus.edu), director of distance education, is now developing with colleagues at Salus University a comprehensive online master’s degree program that will be available beginning in 2016.

A final option for expansion of audiology services internationally, and really a vital component, is a workforce of systematically educated and trained hearing care technicians who work with audiologists and also physicians. Technicians contribute importantly to efficient and cost-effective expansion of needed services in countries lacking adequate professional person-power. I recently joined forces with colleagues Drs. Jackie Clark, Richard Gans, James Saunders, De Wet Swanepoel, and Jason Galster to develop a 24-course sequence for an entirely online educational program called the International Hearing Care Technician (IHCT) Certificate (www.aicme.com/ihct). Course materials include narrated lectures with video clips and other teaching aids. Technician students measure learning progress with post-tests for each course.

The vast majority of people in the world have no access to hearing health-care services. Fortunately, the problem is now being addressed with an effective long-term solution. Efforts to educate the first generation of audiologists are underway in many countries. These efforts, combined with multiple options for formal post-bachelor’s degree education for practicing audiologists, are sure to improve communication and quality of life for large numbers of children and adults worldwide.

James W. Hall III, PhD, Board Certified in Audiology, has 40 years of experience in audiology as a clinician, administrator, teacher, and researcher. He is a founder of the Academy, and has served on the Academy Board, the ABA Board, and is now the vice chair of the ACAE Board.

**Reference**

2016 HONORS NOMINATIONS

Commend the Superior Achievements of Your Colleagues

THE ACADEMY HONORS COMMITTEE ENCOURAGES ALL ACADEMY MEMBERS TO IDENTIFY THOSE COLLEAGUES THEY BELIEVE HAVE MADE SIGNIFICANT CONTRIBUTIONS TO THE AUDIOLOGY PROFESSION. IF YOU KNOW SOMEONE WHO SHOULD BE RECOGNIZED FOR HIS OR HER EFFORTS, PLEASE TAKE THE TIME TO SUBMIT A NOMINATION PACKET TO THE COMMITTEE FOR REVIEW. ALL NOMINATIONS MUST BE RECEIVED BY OCTOBER 16, 2015.

Nomination Process
Nomination packets need to include a letter of nomination addressed to the committee chair and an up-to-date resume or curriculum vitae of the individual. Self-nominations will not be accepted. The nomination packet should include sufficient documentation as to how the nominee meets the specified criteria for the selected category. Additional letters (three to five) in support of the nomination and any other documentation that will assist the Honors Committee in their decision are required. Nomination packets will be accepted in hard-copy or electronic form. Hard-copy packets should be mailed to Academy headquarters, and electronic nomination packets may be sent by e-mail to Angela Chandler at achandler@audiology.org.

Selection of Honorees
The committee will consider all nominations, and awards will be made to qualified candidates who receive a majority vote of the voting members of the committee pending final approval of the Academy Board of Directors. Not all awards may be given each year. Selected recipients will be awarded at AudiologyNOW! in Phoenix, AZ, April 13–16, 2016.

Award Categories
- Jerger Career Award for Research in Audiology
- Samuel F. Lybarger Award for Achievements in Industry
- International Award in Hearing
- Humanitarian Award
- Career Award in Hearing or Balance
- Distinguished Achievement Award

Send nomination packets to:
Gabrielle Saunders, Chair, Honors Committee
c/o American Academy of Audiology
11480 Commerce Park Drive
Suite 220
Reston, VA 20191

Academy Honors Recipients

2015
Jerger Career Award for Research in Audiology
Joseph W. Hall III, PhD
International Award in Hearing
Harvey Dillon, PhD
Career Award in Hearing or Balance
David Moore, PhD
Samuel F. Lybarger Award for Achievements in Industry
James Kates, EE
Distinguished Achievement Award
Gary Jacobson, PhD
Brad Stach, PhD

2014
Career Award in Hearing or Balance
Timothy Jones, PhD
Distinguished Achievement Award
Carmen Brewer, PhD
William Hal Martin, PhD
Michael Valente, PhD
Humanitarian Award
Paige Stringer, MA
International Award in Hearing
Margaret Kathleen Pichora-Fuller, PhD
Jerger Career Award for Research in Audiology
Richard Wilson, PhD
Samuel F. Lybarger Award for Achievements in Industry
William Cole, BASc
As audiologists and audiology students, we encounter regular advocacy action alerts from our national and state audiology organizations, urging us to contact our congressional representatives or take action on a legislative or regulatory issue.

Some of us respond immediately, sending a letter to Capitol Hill or making a phone call to a congressional office. However, most of us make a mental note to take action, but our intentions to become better advocates fall short as we juggle our busy lives. Others would like to become more involved and just don't know how or where to begin. Speaking to a member of Congress is intimidating and many don't feel comfortable discussing the specifics of legislation. Given these challenges, the question often emerges—how do we inspire our colleagues to make that leap from thinking about advocacy to becoming an advocate?

On May 8, a group of five audiology students from Nova Southeastern University (NSU) turned their interest in advocacy into action. After nearly a year of planning, this group made the trip from South Florida to Washington, DC, to advocate for their profession. The group joined Academy advocacy staff for a full-day on Capitol Hill, beginning with a morning briefing, followed by meetings at House and Senate offices. The group's organizer, Kelly Sharpe, a second-year student from NSU, discusses the inspiration behind this trip to Capitol Hill and the lessons learned from the experience.

What inspired you to plan a trip to DC?
KS: In the fall of 2013, our Student Academy of Audiology (SAA) chapter created a government relations chairperson position. I was interested in this position because I wanted to educate my fellow peers about legislative affairs within our field and how these policies can affect us as future audiologists. Because this was a new position, I looked to our previous SAA advisor, Dr. Patricia Gaffney for direction. It was her suggestion to advocate on the Hill. Being from the Baltimore area, I was very comfortable with the idea of planning a trip to Washington, DC, and got started with that process.

How did you go about planning the trip? How did you prepare?
KS: I was initially advised by Dr. Gaffney to contact the Academy’s advocacy staff to begin the planning process. Advocacy staff assisted with setting up the meetings on Capitol Hill and letting us know what to expect in those meetings. They provided information, including issue briefs, on key pieces of legislation.

I also worked closely with members of our SAA chapter—specifically our President, Amanda Ottochian and our Treasurer, Chelsea Studley—to fine-tune the details of our trip.

In February 2015, I hosted a letter-writing campaign, where students were invited to send e-mails and paper letters to their representatives using the Legislative Action Center portal through the Academy’s Web site. It was a huge success! Over 250 paper letters were mailed and over 300 e-mails were sent.

I also attended the Advocacy Summit at AudiologyNOW! 2015 in San Antonio, TX, which was hosted by the SAA Advocacy Committee. At the summit, we reviewed the current legislative initiatives impacting the profession of audiology. This event also proved to be an opportunity to network with other students interested in advocacy. I was grateful to receive advice from students who had previously advocated on the Hill. Their excitement was contagious!

Five students attended the trip—three second-year students (myself, Shannon McCormick, and Taylor Paige) and two first-year students (Caroline Sosa and Heather Marinello). These students wrote letters of intent, where they explained current audiology legislation in their own
Advance Your Career

The ABA is offering two certification exams on October 24, 2015, in Boys Town, NE.

Pediatric Audiology Specialty Certification Exam

Cochlear Implant Specialty Certification Exam

- Demonstrate to colleagues, patients, and employers that you have a high level of knowledge and expertise.
- Add distinction to your career accomplishments.

Applications due August 24, 2015.
Late applications due September 24, 2015.

www.AudiologyToday.org

words, and described the effects of these legislative affairs as students and future professionals. These students also explained professional autonomy and described how they would advocate for professional autonomy in the future.

What did you expect the congressional meetings to be like versus what were they actually like?
KS: The congressional meetings were much more personable than what I initially expected. I had envisioned these staffers as being no-nonsense, structured individuals who had very full agendas. I was pleasantly surprised to see how empathetic the congressional staffers were. Some staffers even shared personal experiences relating to audiology! It was nice to see that what we were advocating for had an impact on some individuals.

What were you overall thoughts about the experience?
KS: This truly was the experience of a lifetime. I strongly encourage my fellow audiology students to become involved in audiology advocacy and plan their own visits to Capitol Hill. Advocacy begins and ends with the students—we are the future of the profession. The more that we advocate and educate our representatives and senators, the better the outcome for our profession in the long run.

Conclusion

Let the students from Nova Southeastern University inspire you! Congress will be in session in Washington, DC, for the month of July, but will adjourn to their home districts for the August congressional recess. If you can’t make the trip to DC, August is the perfect time to plan a local meeting with your representatives. You can also check in with your state association to learn more about legislative and regulatory issues happening on the state level, and find out how you can become more involved. Turn your advocacy interest into action today!

For more information, visit the Academy’s Web site and search key word “Advocacy.”

Kate Thomas is director of payment policy and legislative affairs for the American Academy of Audiology.
Adult Patients with Severe-to-Profound Unilateral Sensorineural Hearing Loss Practice Guideline Now Available

The specific goal of this guideline is to provide a set of statements, recommendations, and strategies for best practice in the provision of a comprehensive treatment plan for the audiological management of adults with severe-to-profound unilateral sensorineural hearing loss. Specific statements and recommendations were made by initially reviewing the existing scientific evidence published in peer-reviewed and non-peer-reviewed journals. When direct evidence (i.e., evidence directly relating clinical procedures to the principal health outcomes) was not available, both indirect evidence, which involves examining two or more bodies of evidence to relate the clinical procedures to the principal health outcomes, and consensus practice were considered in making recommendations.

This guideline addresses the technical aspects of hearing device selection, fitting, verification, validation, and counseling within the context of a comprehensive treatment plan. In the process of making specific statements, recommendations, and strategies, careful consideration was given to the elements of care that optimize patient outcomes.

Thank you to Michael Valente, PhD, chair of the task force, and his task force members: Kelly H. Baringer, AuD; Kritis Oeding, AuD; Steve Smith, AuD; Hillary Snapp, AuD; Sarah Sydlowski, AuD, PhD; and ex-officio members: Rebekah Cunningham, PhD; Marc Bennett, MD; Devin McCaslin, PhD; Ravi Sockalingam, PhD; and George Cire, AuD.

To access the new guideline, visit www.audiology.org, and click on the Guidelines and Standards graphic on the home page, then look under Adult Rehabilitation and Hearing Aids.
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For more information about the program, contact Alyssa Blackwell at abblackwell@networkmediapartners.com.

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