

**SPECIAL POINTS
OF INTEREST:**

Article by Michelle
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Hearing Loss, and
Hearing Aids Article—
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NCRAR Newsletter

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Message from the Director: Stephen Fausti Ph.D.



As we enter our 11th year, the National Center for Rehabilitative Auditory Research (NCRAR) continues to influence multidisciplinary research and education in the field of auditory dysfunction. The dramatic increase in auditory disabilities, affecting nearly one million individuals per year, has focused attention on this escalating problem. The NCRAR remains at the forefront to address the urgent need for treatment strategies and rehabilitation techniques. The severity of this problem has prompted the collaboration of the Department of Defense (DoD) and the Veterans Health Administration (VHA) to provide treatment and rehabilitation for these individuals, and NCRAR has been enlisted as a central resource in these efforts.

To optimize the care of individuals with auditory dysfunction and to provide seamless levels of care for Veterans, recent legislation directs that DoD will establish a center of excellence in the prevention, diagnosis, mitigation, treatment, and rehabilitation of hearing loss and auditory system injury. This legislation affirms that the center established by DoD will collaborate with VHA, institutions of higher education, and other appropriate public and private entities (including international entities) to ensure optimal care. A comprehensive plan will be implemented by DoD to develop a registry of information to track the diagnosis, treatment, and follow up of each case incurred by active duty personnel. This registry, called the “Hearing Loss and Auditory System Injury Registry”, will enable the VHA to access and add information pertaining to

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Music, Hearing Loss, and Hearing Aids by Michelle Molis, Ph.D.

Due to the importance of speech understanding for activities of daily living and social interaction, hearing aid design and fitting is typically optimized for speech inputs. However, some individuals with hearing loss may also feel that listening to music makes a significant contribution to their overall quality of life. The differing fundamental characteristics of speech and music suggest that distinct amplification strategies may be appropriate for the two types of input.

Because they are both auditory signals, speech and music share many characteristics; however, there are several significant differences. A major difference between speech and music is intent. At the core, the function of speech is to communicate information. The purpose of music is not well-defined. Although music may incidentally convey an emotion, mood, or feeling, for many, listening to music is merely an enjoyable leisure activity. Another difference between music and speech is variability. Relative to music, speech is a well-controlled and somewhat predictable signal. Speech is more predictable than music in both the range of frequencies and

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Meet Jane Gordon, Research Audiologist

I grew up in Washington, Illinois and I still love the Midwest to this day. My father built a private membership 25 meter swimming pool and kiddie pool when I was ten years old. I have fond memories of Neptune Swim club where I initially learned to swim, and later life guarded, taught swimming lessons, and worked in all the other jobs that come with running a swimming pool, restaurant establishment. I have returned just about every summer to visit mom and dad and swim a few laps. I loved the lightening bugs and the dramatic thunder storms. Tornado drills were a standard in the school system.

I received my Bachelors Degree at the University of Colorado in Boulder, Colorado. I was interested in medical science and service and Audiology was a good blend of those principles. I met my husband-to-be, Sam, on a camping trip high up in the Rocky Mountains at a little ghost town called St. Elmo. Sam was an engineering major at Boulder, but we would not likely have met on a campus of 30,000 students with departments located four miles away. Our friends who introduced us broke up but we fell in love and got married in 1974. We moved to Oregon for Sam's new job at Tektronix in 1975 and I later completed my Masters Degree at Portland State University in 1985.

I have worked as a Research Audiologist at the NCRAR for ten years. I have worked on grants involving hearing loss in diabetics, hearing aids and FM systems, ototoxicity monitoring, and presently a drug intervention study using alpha-lipoic acid in the possible prevention of hearing loss due to treatment with cisplatin. One of the things I most enjoy about my job at the NCRAR is working with the veteran population. I really love getting to know the veterans and find their lives and life stories rich and full of history and sacrifice for our freedom.

We live out in the country on five acres on a small mountain in Yamhill County.



Although it involves a long, windy commute, we really enjoy the quiet peacefulness and the view. About living in the country, Sam jokingly says the first happiest day of our life was when we got a horse for our oldest daughter and the second happiest day of our life was several years later when we found a new home for "Charlie(horse)".

We have two children and we are excited that both just recently became engaged. The oldest, Sarah, 26, a graduate of the University of Washington is a policewoman working in the Seattle area and her fiancé, Brett, is a Deputy Sheriff. They have two pugs, Frank and Bean, that we get to enjoy during family visits from time to time. Elizabeth, 24, is a third year medical student at Vanderbilt University School of Medicine in Nashville, Tennessee. Her fiancé, Daniel, is also a third year medical student. They are trying for residencies on the west coast and we are keeping our fingers crossed they make it. Just think, two girls, two weddings, and we are hoping they are not super close together!

I enjoy swimming and swimming and swimming! I also enjoy gardening, reading and crafting scrapbook albums for us and for the girls. I love the fact that they will be able to take their pictorial history of our times together as a family with them as they move into their new lives.

Music, Hearing Loss, and Hearing Aids (Continued from Page 1)

The Physical Properties of Sound and Their Perceptual Correlates

All sounds can be described using a number of physical properties, such as, intensity, frequency, temporal characteristics, and spectrum. Each of these physical descriptors has a perceptual correlate: loudness, pitch, rhythm, and timbre. Hearing loss will have an impact on each of these properties. Figure 1 shows their relationship to each other.

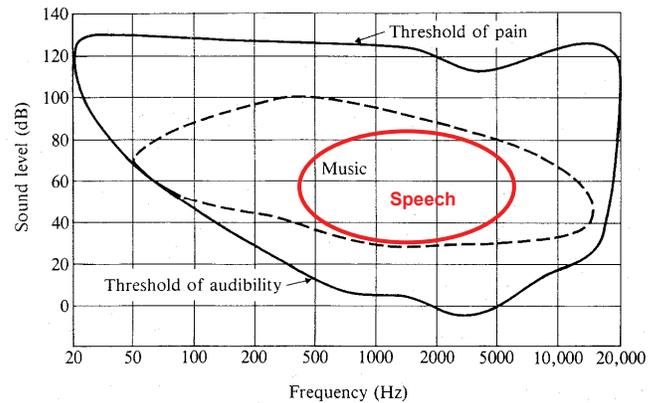
Loudness is the perceptual correlate of intensity. The average level of conversational speech is about 65 dB SPL at a distance of one meter. The average level of music is harder to pin down, but is often higher than for speech. Level can also be described in terms of the crest factor or the difference between the intensity peaks and the average intensity. The crest factor for speech is typically lower than for musical instruments, meaning that the moment-to-moment intensity changes are more varied for music than for speech. A higher crest factor makes music more susceptible to distortion when heard through a hearing aid.

A hearing loss will make all sounds softer and may make already quiet sounds inaudible. Hearing impairment may also result in a decreased tolerance for very loud sounds. Both of these effects can reduce the usable range of loudness for hearing impaired listeners.

Pitch is the perceptual correlate of frequency and is experienced as the “highness” or “lowness” of a sound. We don’t often hear isolated pure tones except for whistles or the electronic beeps of kitchen appliances. Most of the sounds that interest us, like speech and music, are made up of many frequencies. There is a wider range of pitches for some musical instruments than for human voices.

A hearing loss may produce a reduced range of audible frequencies and often higher frequencies become inaudible. There is also reduced frequency resolution that

Figure 1. Relationship between pitch and intensity



The approximate range of variation in frequency (pitch) and sound level (loudness) for speech and music (Adapted from the *Science of Sound* by Rossing)

makes it difficult to hear out different pitches from one another and reduced pitch strength that makes sounds seem noisy or less distinct.

Rhythm is related to various temporal characteristics of a signal including the relative durations of sequences of sounds and fluctuations of amplitude. Music and speech are not continuous, unbroken changes in pitch—musical notes have durations and speech is filled with breaks and pauses.

The perception of rhythm and timing may not be affected much by hearing loss because the beat of music is often low frequency; however, finer details may be lost.

Timbre (pronounced TAM-ber) is a complex, multifaceted property that incorporates aspects of pitch and loudness. It is the distinctive quality of a sound source that makes it distinguishable from other sources. For example, notes of the same pitch but played on

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Director’s Message (Continued from Page 1)

additional treatments, procedures, and outcomes for Veterans who received treatment through VHA. The DoD center will provide notice to the NCRAR and to the VHA on each member treated to ensure the coordination of the provision of ongoing auditory system rehabilitation benefits and services by the VA after leaving active duty.

The NCRAR is well positioned to accomplish the goals laid out by this legislation and to pave the way for expanding the scope of care for auditory dysfunction. Plans for future collaboration between VHA and DoD will continue with research on noise-induced hearing loss, auditory effects of blast trauma, and the diagnosis and treatment of central auditory processing disorders. In addition, NCRAR is currently working in collaboration with DoD on a joint

initiative to provide education about hearing conservation. The U.S. Department of Veteran’s Affairs publication *Vanguard* Nov./Dec. 08 edition highlighted NCRAR research efforts. The NCRAR was also selected to participate in the filming of a VA R&D program overview video that will promote the research projects and programs to be shown at VA medical facilities throughout the country and to Veteran Service Organizations. The video will be premiered during VACO R&D kickoff activities in Washington, D.C. in April. As NCRAR moves into its second decade, it continues its expanding role as a national resource for the advancement of treatment and rehabilitation strategies for auditory dysfunction.

Upcoming NCRAR Events



Medical Center, Columbia, MO., Title: TBA

May 1 2009: David Stapells, Ph.D., Professor, School of Audiology & Speech Sciences, University of British Columbia, Canada., Title: TBA

March 6 2009: James W. Hall, Ph.D., Clinical Professor and Associate Chair in the Department of Communicative Disorders University of Florida., Title: Auditory Processing Disorders (APD) in Adults: Identification, Diagnosis & Management.

April 10 2009: Bonnie Wakefield, Ph.D., Director, Health Services R&D, VA

June 19 2009: Frank Musiek, Ph.D., University of Connecticut., Title: TBA

Most NCRAR seminars are broadcast live via v-tel to other VA facilities. Contact deborah.halfman@va.gov for information.

Seminars are held from 12 to 1 pm in PVAMC Building 101 Room 109, unless noted.



Announcements

Welcome to:

- Garnett McMillan, NCRAR's new Biostatistician.

Goodbye to:

- Kimberly Owens who has moved to Nashville, TN. She is coordinating cardiology device trials for the St. Thomas Hospital Research Institute in Nashville, TN.

Other:

- Christine Kaelin obtained a certificate from the Society of Clinical Research Associates for Certified Clinical Research Personnel.
- Look out for an interview with Samantha Lewis in the January Issue of AudiolgyNow.

NCRAR Grants submitted 10/08 to 1/09

Billings, CJ. Neural encoding of signals in noise: effects of hearing impairment & age. CDA-1 Award, VA RR&D.

Dille, M & Gallun, FJ. The Effects of Aging and Hearing Loss During Rapid Sound Processing. VA RR&D.

Henry, JA. Research Career Scientist Renewal VA RR&D.

Jacobs, P, Konrad-Martin, D, Wan, EA & Emens, J. Use of Medial Olivocochlear (MOC) Reflex to Estimate Attention, Depth of Consciousness, and Sleep Depth. Acoustical Society of America Innovation Grant

Leek, MR. Hearing Loss and the Perception of Complex Sounds, NIDCD.

Lewis, MS. Auditory Rehabilitation from the Perspective of the Significant Other. CDA-2 VA RR&D

Pope, DS & Gallun, FJ. Protocol design for valid and reliable measurement of noise in hospitals. Pioneer Grant, Robert Wood Johnson Foundation.

Saunders, GH, Folmer, RL & Griest SE. A Hearing Loss Prevention Program (HLPP) for Veterans. VA RR&D

Saunders, GH & Abrams H. Evaluation of Approaches to Auditory Rehabilitation for Mild TBI. VA RR&D.

Turbin, PI, Randomized Clinical Trial of Peer Groups for Veterans with Dual Sensory Loss, VA RR&D.

NCRAR Presentations & Publications October 2008 – January 2009

Publications:

Caldwell, M, Saunders, GH, Lawson, N, Thompson, K, Brown, D, Richardson, J, **Pope, D,** Gates, N, Saiz, J. (2008) Signal Intensity and Noise Evaluation (S.I.N.E) in a Critical Care Unit. Article in the NCRAR Quarterly Newsletter 8 (4), 1, 3.

Folmer, RL, Griest, SE, Martin, WH, Obsessive-Compulsiveness in a Population of Tinnitus Patients. *Int Tinnitus J* 2008;14(2).

Folmer, RL, CDC Adds "Noise-Induced Hearing Loss" to Its List of Important Health Topics For Children and Adolescents. *Spectrum* 2008; in press.

Folmer, RL. Guest Editor: Special issue of *Noise & Health* 2009; in press.

Konrad-Martin, D & Saunders, GH (in Press) Chapter 16: Aging, Hearing Loss and Auditory Rehabilitation. In RH Hull (Ed.), *Introduction to Aural Rehabilitation*. Plural Publishing: San Diego.

Saunders, GH (2008). Combined hearing loss and vision loss: current research and future rehabilitation. Invited article for *The Deaf-Blind American*, December 47(2) 6-10.

Saunders, GH, Lewis, MS, & Forsline, A, (In Press) Expectations, pre-fitting counseling and hearing aid outcome. *Journal of the American Academy of Audiology*.

Saunders, GH & Griest, SE, (2009) Hearing loss in veterans and the need for hearing loss prevention programs. *Noise and Health* 11 (42), 14-21.

Saunders, GH & Griest, SE, (2007) A Multimedia Hearing Loss Prevention Program for older adults: Theoretical Basis and Development. *Journal of the Academy of Rehabilitative Audiology* 40, 47-61.

Turbin, M. (2008). Deafblind people and scientific research. *The Deaf-Blind American*. December 47(2).

Submitted publications:

Austin, DF, Konrad-Martin, D, Griest, SE, McMillan, GP, McDermott, D, & Fausti, SF. Diabetes-Related Changes in Hearing, Submitted to *Journal of Laryngoscope*.

Billings, CJ, Tremblay, KL, Stecker, GC, Tolin, WM. *Sensitivity of human evoked cortical activity to signal-to-noise ratio rather than absolute signal level.* Submitted to *Hearing Research*.

Henry, JA, James, KE, **Owens, KK, Zaugg, TL,** Porsov, E & Silaski, G. Auditory test result characteristics in subjects with and without tinnitus. Submitted to *Journal of Rehabilitation Research and Development* (in review).

Konrad-Martin, D, James, KE, **Gordon, JS,** Reavis, KM, Phillips, DS, Bratt, GW, & **Fausti, SF.** Evaluation of Audiometric Threshold Shift Criteria for Ototoxicity Monitoring. Submitted to *Journal of the American Academy of Audiology*, 2008.

Lewis, MS, Gordon, JS, Lilly, D, Crandell, C, **Fausti, SF.** A Pilot Investigation of Speech Recognition in Noise for Adults in the FM+EM Listening Condition. Submitted to *American Journal of Audiology*, 2008.

Lewis, MS, Lilly, D, Hutter, M, Bourdette, D, Fitzpatrick, M, & **Fausti, SF.** Subjective and

audiometric hearing status of individuals with multiple sclerosis. Submitted to *International Journal of MS Care*.

Melamed, S & Chambers, R, (2008) Auditory middle latency responses in individuals with debilitating tinnitus. Submitted to *NeuroReport*.

Owens, KK, Coffin, AB, Hong, LS, **O'Connell, K,** Bennett, KL, Rubel, EW, Raible, RW, (2008) Response of mechanosensory hair cells of the zebrafish lateral line to aminoglycosides reveals distinct cell death pathways. Submitted to *Hearing Research*.

Reavis, KM, Phillips, DS, **Fausti, SF, Gordon, JS, Helt, WJ, Wilmington, D,** Bratt, GW, **Konrad-Martin, D.** Factors affecting sensitivity of distortion-product otoacoustic emissions to ototoxic hearing loss. Submitted to *Ear and Hearing*.

Souza, PE & **Gallun, FJ,** Hearing aid amplification and consonant modulation spectra. Submitted to *Ear & Hearing*.

Presentations:

Folmer, RL, Tinnitus Treatment and Research: Controversies and Conundrums, National Center for Rehabilitative Auditory Research, Portland VA Medical Center, November 21, 2008.

Gallun, FJ, presented "Towards a clinical measure of binaural processing", Presentation at International Binaural Symposium ("Binaural Bash"), Boston University, October 18, 2008.

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Music, Hearing Loss, and Hearing Aids (Continued from Page 3)

different instruments differ in timbre.

Anything that affects the other properties could also affect the perception of timbre. Timbre is much more important for the subjective enjoyment of music than it is for speech understanding.

Hearing Loss & Music Enjoyment

People with hearing loss may give up formerly enjoyable activities like eating out or attending gatherings. They may also stop listening to music. A handful of survey studies have asked if listening to music is a problem for hearing-impaired listeners and if hearing aids improve music enjoyment for hearing-impaired listeners. In a twenty-year-old German study (Feldmann and Kumpf, 1988), 79% of the listeners surveyed said hearing loss interfered with their enjoyment of music. The most common complaints were that music was either too loud or too soft overall and words were difficult to understand. Seeking to update these findings with an American population, Leek, Molis, Kubli, and Tufts (2008) undertook a new survey study. They conducted a telephone survey of sixty-eight hearing-aid wearers seen at Walter Reed Army Audiology & Speech Clinic. Only 28% of the respondents in that study said that hearing loss interfered with music enjoyment. Seventy-eight percent of the survey respondents reported wearing hearing aids while listening to music, and among those subjects, 84% said either that music was more enjoyable or there was no difference listening to music with hearing aids. Only 6% said listening to music was less enjoyable listening with hearing aids.

So, given that music remains important for many hearing impaired individuals and that a significant number of hearing aid wearers listen to music through their aids, how should hearing aids be programmed for listening to music?

Hearing Aids for Music

It is not surprising that hearing aids are optimized for speech input. However, multiple memory settings on modern aids allow for additional programs that may be specially tailored to enhance music listening. For example, manufacturers music programs, based on listening preference studies (Punch, 1978; Franks, 1982), often provide more low frequency energy. If there is no manufacturers program available, or if the one supplied is not adequate, one can be constructed using guidelines based on an understanding of the properties of music. Marshall Chasin, AuD, of Musicians' Clinics of Canada (www.musiciansclinics.com) provides specific recommendations for such modifications.

Music and speech share basic physical properties; however, there are differences in the range and importance of those properties that lead to differences in how they are affected by hearing loss and hearing aids. Listening to music remains an important activity for some hearing-impaired people. For casual music listeners, an aid properly fit for speech may be sufficient for music listening. However, if that is not enough, there are additional programming options available. Together, a hearing aid wearer and hearing aid dispenser can work to maximize music enjoyment.



Michelle Molis Ph.D. is an Investigator at the NCRAR and Assistant Professor in the Dept. Otolaryngology at OHSU

NCRAR Presentations & Publications (Cont. from Page 5)

Gallun, FJ, presented "The advantage of knowing where to listen", Invited talk at Univ. of Maryland Dept. of Psychology, October 22, 2008.

Henry, JA, & Zaugg, TL. "Managing Your Tinnitus: What to Do and How to Do it." (Part 1) NCRAR Tinnitus Education Group, VA Medical Center, Portland, OR, Oct. 7, 2008. (workshop for veterans and general public).

Leek, MR. "Update '08: Hearing Loss & the Perception of Speech, invited presentation, American Speech-Language-Hearing Association annual convention, Chicago, Nov 21, 2008.

McMillan, GP, "Lesion Sites in Diabetes-Associated Auditory Impairment" presented at the 2009 Triological Southern/Middle Sections Meeting.

Molis, M, NCRAR Seminar: "Music, Hearing Loss, and Hearing Aids" December 5, 2008.

Saunders, GH (2008) Clinical Applications of the Performance Perceptual Test (PPT). Invited Audiology Online e-Seminar. Oct 15th. Course accessible at http://www.audiologyonline.com/ceus/recordedcoursedetails.asp?class_id=12287.

Zaugg, TL, Henry JA,. "Managing Your Tinnitus: What to Do and How to Do it." (Part 2) NCRAR Tinnitus Education Group, VA Medical Center, Portland, OR, Oct 21, 2008. (workshop for veterans and general public).



Save the Date

The 4th biennial NCRAR Conference
**“The Ear-Brain System: Approaches
to the Study and Treatment
of Hearing Loss”**

will take place on October 7th to 9th
2009 in Portland, OR

Session Topic Areas:

*Hearing with the Brain: A
Neural Perspective*

*Binaural Processing: Using the
Brain to Use Both Ears*

*Attending to the Auditory Scene:
How We Put It All Together*

*Helping the Brain Help Itself:
Aiding the Ear-Brain System*

Invited speakers:

Arthur Boothroyd Ph.D.

Steve Colburn Ph.D.

Ervin Hafter Ph.D.

Sridhar Kalluri Ph.D.

Nina Kraus Ph.D.

William Noble Ph.D.

Robert Shannon Ph.D.

Robert Sweetow Ph.D.

Robert Zatorre Ph.D.

**Information about registration, accommodation and
applications for scholarships will be posted on the
NCRAR website by May 18th 2009**