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NCRAR Newsletter

National Center for Rehabilitative Auditory Research, Portland, OR

A VA RR&D Center of Excellence

Special points of interest:

- Auditory Impacts of Blast Exposure
- NCRAR Seminar Series
- Meet Sarah Theodoroff, Research Audiologist
- NCRAR Conference 2013 News
- Did you know...??

Note from the Director: Patrick Feeney



Welcome to our first newsletter of 2013. In this issue we are highlighting some of the research being conducted at the Center that focuses on central auditory processing disorders (CAPD) in Veterans with mild traumatic brain injury (mTBI). This research

has direct applicability to evaluating blast-related mTBI in military service members. We are interested in extending the NCRAR research focus to collaboratively studying issues of hearing and balance disorders with DoD researchers. One recent collaborative effort in our Center is a project by Dr. Jim Henry, who was recently awarded a grant by the Department of Defense (DoD) office of the Congressionally Directed Medical Research Programs (CDMRP) entitled, "The Effect of Military Noise Exposure on Tinnitus and its Outcomes in

Recently Discharged Veterans Seeking VA Health Care" (funding period-2013-2016, \$944,951). The primary objective of this research is to conduct an epidemiologic study and obtain initial data to address the etiology, prevalence, and effects of tinnitus and hearing loss among newly-discharged military Veterans who are seeking VA services. A secondary objective is to validate self-report of military noise exposure against the Defense Occupational and Environmental Health Readiness System—Hearing Conservation component (DOEHRS-HC) database. The results from the proposed investigation will ultimately inform future practice guidelines by providing the foundation with a longitudinal study that helps them better understand noise exposure levels of Veterans, and the tinnitus and hearing loss that results.

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Recent Findings: Auditory Impacts of Blast Exposure and Management Strategies

By: Gabrielle Saunders & Melissa Frederick

Traumatic brain injury (TBI) resulting from exposure to one or more blasts (explosions) has been the hallmark wound of the Operation Enduring Freedom (OEF)/Operation Iraqi Freedom (OIF) conflicts. About 225,000 OEF/OIF Veterans have some form of blast-related TBI, and of those individuals about two thirds report auditory difficulties. Some of these difficulties are associated with hearing loss that occurs following damage to the outer, middle and inner ears. However, about 20% of individuals reporting hearing difficulties have normal hearing. This presents clinicians with the formidable task of understanding the challenges faced by this young population, and of meeting their unique audiological needs.

So, what can happen to the auditory system in a blast? Injuries can occur at a number of levels. Going from the outermost part of the ear inwards, the pinna can be burned or damaged by flying debris. Although this does not result in hearing problems per se, it can make sound localization more difficult. The tympanic membrane (ear drum) can be ruptured and the ossicles (bones in the middle ear) can become disarticulated by the high pressure wave generated by the blast. These both can result in conductive hearing loss. More problematically, the hair cells along the basilar membrane can be torn from their support cells, leading to hair cell death, and consequently, a sensorineural hearing loss.

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Note from the Director (Continued)

Support for this type of collaboration across the VA and DoD is being supplied by the DoD Hearing Center of Excellence (HCE) with their new Research Coordinator team. They are supporting collaborative research initiatives by funding Research Coordinator, Kate Marshall at Madigan Army Medical Center in Tacoma, who is available to support collaborative studies at Madigan and the NCRAR. I will be traveling to the HCE in San Antonio at the end of January to attend

the kick-off meeting for this program at the HCE Research Directorate meeting. I am also an invitee for the January 30-31 HCE Strategic Planning Meeting as a new member on the HCE Executive Committee. I look forward to further developing the relationship between our two Centers of Excellence to expand research efforts for the benefit of both Veterans and military service members.

2013 NCRAR Seminar Series

Monthly seminars presented by renowned scientists from around the world.

All seminars take place 12-1 pm Pacific Time in PVAMC Building 101, Room 109. Most are also broadcast live via v-tel to other VA facilities and are available on DVD by request from Bonnie.Becker@va.gov

- February 8:** [Les Atlas, Ph.D.](#) Department of Electrical Engineering, University of Washington.
- March 22:** [Larry Roberts, Ph.D.](#) Department of Psychology, Neuroscience, and Behaviour, McMaster University.
- April 12:** [Larry Humes, Ph.D.](#) Department of Speech and Hearing Sciences, Indiana University.
- May 17:** [Adrian KC Lee, Sc.D.](#) Department of Speech and Hearing Sciences, University of Washington.
- June 21:** [Mark Parker, Ph.D.](#) Department of Audiology, Steward St. Elizabeth's Medical Center.
- July 19:** [Rick Neitzel, Ph.D.](#) Department of Environmental Health Sciences and Risk Science Center, University of Michigan.
- August 16:** [Marilyn Dille, Ph.D.](#) National Center for Rehabilitative Auditory Research.
- September 18-20:** [NCRAR Conference: Beyond the Audiology Clinic: Innovations and Possibilities of Connected Health](#), Portland, OR.
- October 18:** [A. Ravi Krishnan Ph.D.](#) Department of Speech, Language, and Hearing Sciences, Purdue University.
- November 15:** [Susan Griest, M.P.H.](#) Tinnitus Clinic, Oregon Health & Science University.

NCRAR Lending Library

Clinicians and researchers can now borrow DVDs of previous presentations, including presentations from previous NCRAR conferences. For a list of DVDs available, check out the website:

http://www.ncrar.research.va.gov/Education/Clinician_Resources/Index.asp

and contact ncrar@va.gov with the title of the DVD you would like to borrow.

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Meet Sarah Theodoroff, Research Audiologist



While attending the University of Illinois, my family often wondered if I was getting my Ph.D. in audiology or in culinary sciences because I was always talking about what I learned from watching a particular program on Food Network. For example, I give Tyler Florence credit that my omelets are fluffy and delicious because he taught me once the omelet was almost set, to put my skillet in a 425-450 degree oven one and a half minutes prior to sliding the omelet onto my plate. I learned the science behind flat versus plump chocolate chip cookies from Alton Brown. I approached experiments in the kitchen not unlike the experiments I performed in the laboratory (minus the electrodes). Granted,

I was at school to become an expert in our sense of hearing, not taste, but they are somewhat related, being two of the five recognized human senses.

I have been interested in human sensory perception since I was a child. Being the only left-handed person in my family gave me a unique perspective growing up. The way I functioned in the world was different than those around me. Most southpaws can tell you stories about their experiences growing up in a right-handed world and I am no exception. My Mother spent many hours teaching me to hold my pencil correctly so as not to “write over myself”. I am always astounded to hear people tell me I have nice penmanship, for a lefty. My piano teacher thought it could be a disadvantage depending on the piece I was learning to play. I would have to be careful not to have the bass drown out the melody. My high school art teacher thought it was an advantage because I was already tapped into the “right side of my brain.”

It was in a human perception class I took at Michigan State University (I am proudly a Spartan, not a Wolverine), that I learned about audiology. I switched my major to Audiology and Speech Sciences and started on the path to where I am today. I have been fortunate to work in a variety of environments and my research is driven by my experiences as a clinician. Auditory perception is a particular interest of mine, specifically the assessment and treatment of tinnitus. My doctoral dissertation research examined peripheral and central auditory function in individuals with severe debilitating tinnitus in an attempt to discover a diagnostic measure of tinnitus. Because of the nature of my study, the eligibility criteria were very restrictive, to the point where it was exceptionally difficult to find participants in the greater Chicago area. After many months, I realized I would not be able to recruit enough participants to complete my project by staying in Illinois. I contacted William Martin, Ph.D., at the Oregon Health & Science University’s Tinnitus Clinic to see if it was possible for me to come to Oregon and recruit their patients to participate in my study. I will forever be thankful to Dr. Martin who was willing to let me complete my dissertation research at his facility as well as use their equipment to do so.



That is what brought me to Oregon- the hope to find enough participants to complete my doctoral dissertation research. I packed up my car, arranged for my cats to be cared for by a friend, and started off with my now husband on our first of many drives cross-country. In making arrangements to live in Oregon for a few months, a member of my dissertation committee, Jont Allen, Ph. D., suggested I get in touch with his friend and colleague, Gabrielle Saunders, Ph.D. Dr. Saunders invited me to present my research at a NCRAR seminar and that is how I met Marjorie Leek, Ph.D. Upon graduating with my Ph.D., I joined the NCRAR working with Dr. Leek as a post-doctoral research associate on her NIH grant-funded research. Currently, I work with Robert Folmer, Ph.D. on his VA RR&D funded placebo-controlled clinical trial evaluating the effects of repetitive transcranial magnetic stimulation (rTMS) on tinnitus. The goal is to discover if rTMS will reduce the perception or severity of tinnitus. It is a fascinating project and I am hopeful it will reveal rTMS as a viable treatment for tinnitus.

When I was asked to write about myself for this edition of the newsletter, I thought it would be interesting to conclude with two of the parting questions James Lipton, host of Inside the Actors Studio, asks his guest. He always gave credit to Bernard Pivot for the interview questions and here are the ones that I thought were particularly relevant:

WHAT SOUND OR NOISE DO YOU LOVE? The purring of any of my three cats

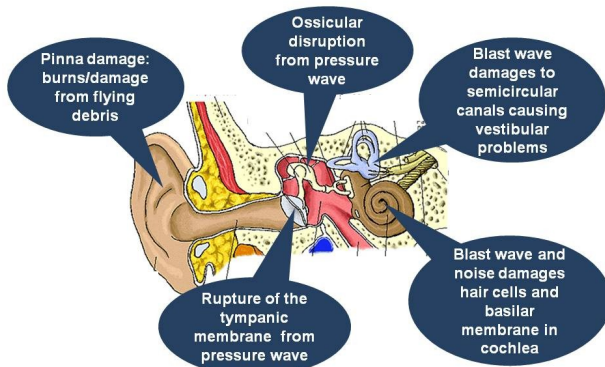
WHAT SOUND OR NOISE DO YOU HATE? Microphonic Feedback (if you do not know what this is, ask my husband)

I look forward to hearing the answer to these questions from the next person asked to write about him/herself in the NCRAR newsletter.

Recent Findings: Auditory Management Strategies Following Blast Exposure (Continued)

Also possible, but less common, is damage to the semicircular canals, which causes vestibular (balance) problems and dizziness.

Typical injuries from a blast



These types of injuries are fairly well understood and can be 'treated' with surgery (for conductive loss) or hearing aids (for sensorineural hearing loss). However, for those with normal hearing who report hearing difficulties the situation is more complex. The kinds of difficulties reported are to do with problems understanding speech in noisy places and when someone is speaking quickly, as well as problems following instructions and long conversations. Many also report tinnitus (ringing or buzzing in the ears) and hyperacusis (sensitivity to loud sounds). These symptoms strongly suggest a central auditory processing disorder and in fact recent studies show that that blasts cause damage to areas of the brain in which central auditory processing takes place (such as the temporal, parietal, and frontal/prefrontal cortices, the corpus callosum and thalamus) by causing it to move around within the skull resulting in damage to the neurons, bruising) and hemorrhaging.

The issue facing audiologists is how best to provide rehabilitation for blast-related damage. In a recent study conducted at the National Center for Rehabilitative Auditory Research (NCRAR) and the James A. Haley Veterans Hospital in Tampa, FL., two potential forms of rehabilitation were examined: use of FM (frequency modulation technology) and computerized auditory training with a program that trains temporal processing and auditory memory (the Brain Fitness Program from Posit Science). We chose to investigate these particular interventions because they assist with the specific reported difficulties. Specifically, when used properly, FM technology is highly effective at improving the signal-to-noise ratio, thus it should improve individuals ability to hear in background noise, while the AT program, trains temporal processing and memory—both of which individuals report as problematic.

Data were collected from 86 OEF/OIF Veterans, all of whom had pure tone averages (hearing thresholds) well-within normal limits. They were randomly assigned to one of four intervention groups: (1) Auditory training (AT-only), (2) FM system only (FM-only), (3) FM system plus AT (FM+AT), or (4) a control group. All also received a communication strategy training/informational counseling session during which they learned about ways to use communication strategies, such as building vocabulary, actively listening, and problem solving, to improve communication. Participants underwent baseline testing, used the intervention to which they were assigned for 8-12 weeks, and then conducted outcomes testing.

Preliminary analyses show that in general, the individuals in the FM+AT group had the best outcomes on behavioral and self-report measures, controls had the poorest outcomes, and those in the FM-alone and AT-alone groups fell in between. there were considerable individual variations in outcome between the study participants as well as large differences in whether or not participants used the intervention(s) to which they were assigned. While most used the FM system at least occasionally, very few completed all of the AT as recommended. Before we draw too many conclusions we still need to examine whether there is a strong relationship between use of the interventions and outcome, and whether outcome can be predicted from demographic differences or performance at baseline.

In summary, the combination of AT and FM appears to be an effective intervention strategy for blast-exposed Veterans with normal hearing who report hearing difficulties. However, it is important for audiologists to work with the patient to understand the type(s) of interventions they are open to using before providing them. In this manner, patients will receive evidence-based interventions in a patient-centered manner.



Above: Veteran wearing the FM System during a laboratory visit at the NCRAR.

NCRAR 2012 Publications

Publications

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- Folmer RL, Saunders GH. Preface to Special Issue of *Seminars in Hearing* - Proceedings of the 5th Biennial NCRAR Conference: Expanding our Horizons: Medical Conditions and Audiology. *Seminars in Hearing*. 2012; 33:213-216.
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- Hanson, T, McMillan, GP. Scheffe Style Simultaneous Credible Bands for Regression Surfaces with Application to Ache Honey Gathering. *Journal of Data Science*. 2012; 10(2): 195-224.

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- Jacobs PG, Konrad-Martin D, McMillan GP, McDermott D, Fausti S, Kagen D, Wan E. Influence of acute hyperglycemia on otoacoustic emissions and the medial olivocochlear reflex. *J Acoust Soc Am*. 2012 Feb; 131 (2);1296-1306.
- Jacobs PG, Silaski G, Wilmington D, Gordon S, Helt W, McMillan G, Fausti S, Dille M. Development and evaluation of a portable audiometer for high frequency screening of hearing loss from ototoxicity in homes/clinics. *IEEE Trans Biomed Eng*. 2012; 59(11):3097-3103.
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- McMillan G. Response to Barnett et al. Small N designs for rehabilitation research. *J Rehabil Res Dev*. 2012; 49 (1): 175-86.
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- Molis MR, Diedesch A, Gallun F, Leek MR. Vowel identification by amplitude and phase contrast. *Journal of the Association for Research in Otolaryngology*. 2012 (On-Line) DOI 10.1007/s10162-012-0352-1.
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- Pope DS, Gallun FJ, Kampel S. Effect of hospital noise on patients' ability to hear, understand and recall speech. *Research in Nursing & Health*. Submitted September, 2012.
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Save The Date!

NCRAR Conference September 18-20, 2013

Beyond the Audiology Clinic: Innovations and Possibilities of Connected Health



This year's conference will address an array of topics pertaining to teleaudiology:

- Principles and Methodologies,
- Technologies and Implementation,
- Rehabilitation and Interventions,
- Implications for Audiological Practice.

Invited presenters:

Harvey Abrams, Terry Chisolm, Deborah Ferarri, Chad Gladden, Louise Hickson, Jeffrey Kaye, John Kokesh, Elizabeth Krupinski, Robert Margolis, and Jerry Northern

Stay tuned to the NCRAR website for conference updates, registration information and scholarship opportunities (<http://www.ncrar.research.va.gov/>).

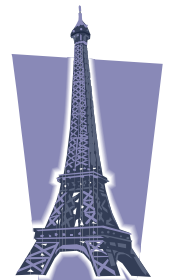
Did You Know...?



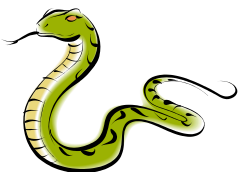
- Cicadas have their hearing organs in their stomachs.

- The whole area of the middle ear is no bigger than an M&M.

- Parrots have extremely good hearing. During World War One (WWI), they were kept on the Eiffel Tower in Paris to warn people of enemy aircraft long before any human ear would hear it.



- On October 14, 1947, General Chuck Yeager was the first person to travel faster than the speed of sound.



- Snakes do not have ears, but their tongues are sensitive to sound vibrations.

NCRAR 2012 Publications (continued)

- Saunders GH, Echt KV. Blast Exposure and Dual Sensory Impairment. Invited article for Special Issue: Sensory and Communicative Disorders in Blast-Related Injuries. *Journal Rehabilitation Research and Development*. 49:1043-1058.
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- Stecker GC, Gallun FJ. "Binaural hearing, sound localization, and spatial hearing" in *Translational Perspectives in Auditory Neuroscience: Normal Aspects of Hearing*, edited by K. Tremblay and R. Burkhardt. 2012. Plural Publishing, Inc., San Diego.
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- Theodoroff SM, Schuette A, Griest S, Henry JA. Individual patient factors associated with effective tinnitus treatment, *J Am Acad Audiol* (in review).
- Wan EA, Paul AS, Jacobs PG. Tag-free RSSI based indoor localization, Presented at Institute on Navigation 2012 International Technical Meeting, Newport Beach, CA, Jan 30-Feb 1 2012, In press.

Ongoing NCRAR Research Studies

- A Hearing Loss Prevention Program for Veterans
- Assessment of Auditory Function in Patients with Parkinson Disease
- Auditory Rehabilitation from the Perspective of the Significant Other
- Central Auditory Processing Deficits Associated with Blast Exposure
- Clinical Trial of Transcranial Magnetic Stimulation for Relief of Tinnitus
- Clinical Validation of a Novel Combination Hearing Aid and Tinnitus Therapy Device
- Determinants of Word Recognition Speed in Older Listeners
- Effects of Speech in Noise Training on Physiology and Perception
- Electrophysiology and Perception of Speech in Noise
- Hearing Loss and the Perception of Complex Sounds
- Individualized Objective Techniques for Early Detection of Ototoxicity
- Integrating Auditory and Visual Information to Improve Hearing Aids
- Longitudinal Changes in Auditory Function Among Veterans with Diabetes
- Mechanisms of Imbalance and Falls in Multiple Sclerosis
- Multi-site Evaluation of Progressive Tinnitus Management
- Multi-site Study of the Efficacy of Speech Perception Training for Hearing-Aid Users
- Predicting the Benefits of Spatial and Spectrotemporal Cues
- Telephone Tinnitus Education for Patients with TBI
- Wideband Clinical Diagnosis and Monitoring of Middle Ear and Cochlear Function.

