

# spectrum

a publication of the national hearing conservation association

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Volume 36 (Issue 1)

## NHCA's 44th Annual Conference in 2020 – Destin, Florida!

by Amy Blank  
NHCA President



It's crystal clear, we're here to hear for the 44th NHCA annual conference in Destin, Florida. Save the date for February 20-22, 2020. NHCA is busy planning another high quality scientific conference. This time we are destined for Destin with its' clear blue waters, white sandy beaches, sunshine, and of course, the camaraderie

that NHCA members and attendees have come to know. Keep an eye on your email and social media to learn more about the conference, including the call for papers/posters, registration, the Friday Night Event, hotel reservations and more.



**It's Crystal Clear  
We're Here to Hear!**

2020 NHCA Annual Conference  
The Sandestin Hotel • Destin, Florida

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*Spectrum* is available without charge to NHCA members in all categories. Anyone interested in publishing in *Spectrum* should contact Kim Gill at the NHCA office.

***The mission of the National Hearing Conservation Association is to prevent hearing loss due to noise and other environmental factors in all sectors of society.***



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# presidential pEARspective

**by Amy Blank**  
NHCA President

I hope ya'll had fun in Grapevine, Texas during the 2019 NHCA Conference! I also hope you learned a little something, networked with old colleagues and met some new ones, and enjoyed our wonderful exhibitors!

A true highlight of the conference was listening to Col. Don Gasaway give his perspective of hearing conservation with his family in the audience. For our newer members, Don was the 6th president of the NHCA (1988-1989). Because of his distinguished career in hearing loss prevention and long-term service to the NHCA, Don was the first recipient of NHCA's Lifetime Achievement Award. Name sound familiar...Gasaway Lecture? Yes, that's the one and only Col. Gasaway! NHCA is proud to recognize the long-lasting positive impact from members like Don.

I also want to send out a huge "thank you" to the conference planning team, who devoted hundreds of hours to make our annual conference memorable once again. A special thank you to Ed Lobarinas and Tanisha Hammill for their leadership and expertise.

So how did we do? Here's a look at the 2019 NHCA Conference "Deep in the hEART of Texas" by the numbers:

**236**

total attendees

**7**

workshops offered

**31**

presentations

**77**

first time attendees

**170**

workshop attendees

**18**

exhibitors

**31**

student attendees

**1.35**

CEUs offered

**16**

international attendees



Such a great way to start the year! Speaking of CEUs, are you looking for a few extra this year? Our Director of Education is coordinating two webinar presentations. If you attended the 2019 Conference, you will be able to access these webinars for FREE! Members who did not attend the conference and non-members will be able to participate for a nominal fee. Please keep an eye out on social media and email for further information.

We are excited to share some international news – the UKHCA (United Kingdom Hearing Conservation Association) debuted on World Hearing Day (March 3, 2019)! Much like NHCA, this new organization is focused on the prevention of hearing loss while impacting hearing health through common sense, cost effective, evidenced-based solutions. According to their website, the UKHCA "represents respected, informed and influential leaders in the field of noise, acoustics, health and hearing who can be trusted to provide independent, evidence-based advice and leadership in the area of hearing conservation". We look forward to working with the UKHCA in the future. To learn more about this organization, please visit their website at <http://hearingconservation.org.uk/>.

A big "thank you" to Dr. Dick Danielson and Dr. Jennifer Tufts for representing NHCA and developing materials for a learning module for the American Academy of Audiology in Columbus, Ohio. The module on the "Audiologists Roles and Assessment Options in the Evaluation of Auditory Fitness for Hearing-Critical Jobs" was jointly presented by Dr. Tufts and myself with significant coordination and input from Dr. Danielson. The expertise of Dr. Lynn Cook and others was appreciated as we highlighted case studies and fitness for duty models.



Left to right: Jennifer Tufts and Amy Blank

Last but not least, I would like to say thank you to YOU, the members of NHCA, for allowing me to represent you for the next year. I am proud to be a member of NHCA and share my passion for hearing conservation with others. If you have any questions, suggestions, or concerns please feel free to email me at [amy\\_blank@yahoo.com](mailto:amy_blank@yahoo.com). The Executive Council is excited to grow our organization and continue to share our expertise and resources and prevent hearing loss on and off the job.

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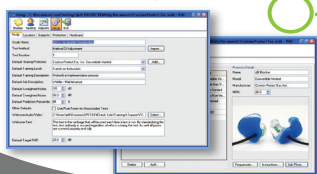
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# 2019 NHCA Conference Awards

## Neitzel and Nakashima are recognized for Outstanding Lecture and Poster Awards

by **Theresa Schulz**  
NHCA President Elect

At each annual NHCA conference, attendees vote for the Outstanding Lecture Award and the Outstanding Poster Award. NHCA celebrates and recognizes the contributions made by its' members.

*NHCA is proud to announce the Outstanding Lecture Award winner for the 2019 NHCA Annual Conference: Rick Neitzel.*



Dr. Neitzel presented data from the Centers for Disease Control and Prevention (CDC) systematic reviews of health outcomes associated with noise exposure in humans. The systematic reviews looked for potential associations between noise exposure and eleven health outcomes: 1) hearing loss; 2) ischemic heart disease; 3) hypertension; 4) mental health/psychological disorders; 5) injuries; 6) sleep disturbance; 7) low birth weight/premature birth; 8) endocrine disruption; 9) cognitive impairment; 10) obesity/overweight, and; 11) cancer or tumorigenesis. Published literature were reviewed for measured noise levels and noise duration and for objective measures of each health outcome. The strength of each study was evaluated and rated. Meta-analyses were conducted as the data allowed. The results can be used by the CDC to raise awareness and enhance prevention strategies regarding safe levels of exposure to noise. Dr. Rick Neitzel is an Associate Professor and Associate Chair of the Department of Environmental Health Sciences at the University of Michigan. His research focuses on the characterization of exposures to noise, heavy metals and other ototoxins and has published 80 papers on these topics. Dr. Neitzel's co-authors for this work are John Eichwald and Yulia Carroll of the CDC.

Dr. Neitzel will receive \$250 cash award and a certificate of recognition. Ms. Nakashima will receive \$150 and a certificate of recognition. NHCA congratulates you both and wholeheartedly thanks you for your motivational and educational presentations.

*NHCA is proud to announce the Outstanding Poster Award winner for the 2019 NHCA Annual Conference: Ann Nakashima.*

Ann Nakashima works for Defence Research and Development Canada. Ms. Nakashima presented findings from a study that investigated the potential impact of impulse noise on overall International Space Station (ISS), crew noise exposure, using ISS noise exposure criteria. During long-duration missions on the ISS, noise dosimetry data, including impulse noise, are closely monitored and applied against unique ISS acoustic requirements for crew health and performance. The data revealed very few high-level (>115 dB peak) impulses in the crew-worn dosimetry data obtained during sleep time and in static dosimetry data obtained at any time of day. The number of impulses (> 115 dB peak) that occurred during work time was strongly correlated with the  $L_{Aeq16h}$ , suggesting that impulses were caused by crew activity rather than ambient sources. However, for high-level impulses, the peak levels at 1-minute intervals did not correlate with the corresponding  $L_{Aeq1min}$  reading. Further analysis of the  $\frac{1}{3}$  octave band spectra of the impulses found that it was possible to associate some of them with non-acoustic causes (e.g., thumping or brushing against the microphone). The current analysis demonstrates that impulse noise data can provide additional insight in the investigation of exceedances or abnormalities in future ISS dosimetry data sets. Ms Nakashima's co-author is Dr. Dick Danielson. The NHCA is delighted to be able to award an Outstanding Poster Award for the first time in several years. Thanks to all of you who viewed and voted on the posters. Poster presenters add valuable content to our annual conference.



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# NHCA Scholarship Foundation Post-conference Report

by **James J. Jerome**

*NHCA Scholarship President*

We would like to congratulate the recipients of the 2019 National Hearing Conservation Association Scholarship Foundation, Student Conference Award (SCA). I'd like to share some of their comments with the membership.

## **Megan Bilodeau (SCA recipient)**



"To say I enjoyed my first NHCA conference would be an understatement. NHCA is truly made up of a very special, dedicated group of people, and I am so grateful that I was able to meet everyone and be welcomed into the fold. It was refreshing to meet professionals who had

similar interests as my own and to explore such a specific part of the field so in depth. I loved how the conference simultaneously felt small and cozy in the ways I was able to network and get to know everyone, while still feeling expansive in the amount of new knowledge I was able to take home. I feel more confident in my abilities to provide for patients with the knowledge I gained from the conference, as well as advocate for hearing health in my community. I'm already looking forward to next year!"

## **Candace Johnson (SCA Recipient)**



"My experience at the 2019 NHCA Conference was quite beneficial. I liked how the conference was scheduled. Each presentation was interesting and it was obvious that the presenters were passionate about their topics. I enjoyed learning more about the hearing conservation industry."

## **Jennifer Meyer (SCA recipient)**



"As a recipient of the Student Conference Award, I was able to attend the NHCA conference with very minimal expenses. Being a current graduate student, this award was critical in my ability to be in attendance. The conference was an amazing networking experience for an

aspiring occupational audiologist, like me. The sessions provided a wealth of information that I can apply to my current education and clinical experiences. The conference center was beautiful, with multiple attractions nearby to visit when the conference was not in session. Thank you to the NHCA Scholarship Foundation for supporting students and allowing us to have opportunities such as these so early in our careers!"

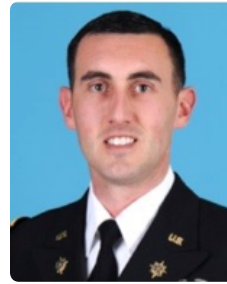
## **Two more students awarded!**

Unfortunately, the Foundation was subjected to a situation whereby two student applications were never received for award consideration even though each applied online. This was brought to my attention during the conference by each student's faculty advisor. In spite of this set back, they paid their own way to attend the conference and present their papers. The Foundation reassessed the award process. Ms. Ashley Stumpf applied for the Student Research Award. Her paper competed against all other submissions for the conference and was chosen by the Program Committee to present. Lieutenant Colonel Brandon Thompson applied for the Student Conference Award. Of the three conference awards already given, Colonel Thompson was the only one who presented. These facts were presented to the Directors of the Foundation, and it was voted that each student should receive their respective award. Following are their brief bios.

**Ashley Stumpf (SRA recipient)**

Ashley is a 4th year AuD candidate at the University of Northern Colorado, and recipient of the Student Research Award. She presented her paper, Noise Exposure of Sugar Cane Factory Workers in Guatemala at the 2019 annual conference. Currently, she is completing her final year externship

at a neuro-otology practice, Denver Ear Associates. Her academic interests include hearing loss prevention due to noise exposure as well as ototoxic pharmaceuticals, educational audiology, and hearing loss rehabilitation. Ashley is a certified Dangerous Decibels educator and a CAOHC certified Occupational Hearing Conservationist. Upon graduation, she will work at an audiology private practice in Colorado that will provide her the flexibility to pursue her passion of working in the area of hearing loss prevention and gain experience as an occupational audiologist. Ashley looks forward to learning more from fellow NHCA members in the future. During her off time she volunteers coaching youth in high school sports.

**Brandon Thompson (SCA recipient)**

Brandon is a Lieutenant Colonel (LTC) in the U.S. Army, a PhD candidate in Industrial and Systems Engineering with a concentration in Human Factors Engineering at Virginia Tech, and recipient of the Student Conference Award. He co-presented the paper, A Portable Auditory Localization

Training System For Military Applications: Training Stimuli Development & Protocol Optimization at the recent annual conference. Brandon has served seventeen years as a Military Intelligence and Operations Research Systems Analysis (ORSA) officer in the U.S. Army. He is a licensed Professional Engineer in Industrial Engineering. His doctoral research involves developing and validating a portable auditory localization training system to improve auditory situation awareness of military service members while wearing hearing protection devices. Following his PhD, Brandon will serve as an Assistant Professor in the Department of Systems Engineering at the United States Military Academy, West Point.

Ashley and Brandon have both received the benefits associated with each award as well as an award certificate. Again, we apologize to both for this oversight and congratulate them on their achievement!

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# Safe-in-Sound Award: And the Winner Is...

by Scott Schneider



The Safe-in-Sound Excellence in Hearing Loss Prevention Award™ is a partnership between the National Institute for Occupational Safety and Health (NIOSH) and the National Hearing Conservation Association (NHCA) and the Council for Accreditation in Occupational Hearing Conservation (CAOHC). The objective of this initiative is to obtain information about real-world successful hearing loss prevention programs and public health practices currently used in industry and disseminate it widely. By disseminating evidence-based strategies, Safe-in-Sound™ enables other groups to effectively advance hearing loss prevention practice.

The 2019 Safe-in-Sound Excellence in Hearing Loss Prevention Award for Innovation was awarded to Kurt Yankasas of the Office of Naval Research for the accomplishments of his Noise-Induced Hearing Loss Research Program.

Kurt's program funds a wide portfolio of research on noise control for ships, aircraft, and equipment; NIHL surveillance and risk evaluation; medical treatment of NIHL; and improved hearing protection for Navy personnel (approximately one in four sailors suffer from NIHL). Work funded by the research portfolio has led to the development of innovative solutions to difficult problems like ship noise control. In addition, Kurt's focus on the costs of both NIHL and tinnitus to the Navy led to a unique program focus on preventing "auditory injury." Other examples of the program's technological innovations include a smartphone app that provides information about hearing protection and a computer program for designing ships that have noise control features.

Presentation slides about the NIHL Research Program are available on the Safe-in-Sound website.

Safe-in-Sound Award™ winning stories are shared and showcased at special award ceremonies and in press releases disseminated to the occupational health and hearing research communities. Past winners of Safe-in-Sound Awards include individuals who developed community hearing

loss prevention programs, academics who have studied and developed products for hearing loss prevention, companies who have implemented exemplary hearing loss prevention programs. The common theme is their role in improving working conditions for those exposed to hazardous noise.

## Call for Nominations

Are you or someone you know passionate about preserving workers' hearing? If you are making extra efforts to prevent hearing loss, you might be eligible for the Safe-in-Sound Award. The two award categories are Excellence and Innovation.

**The Excellence Award** is meant for those employers that go out of their way to ensure the safety of employees' hearing by implementing exemplary hearing loss prevention programs. Nominees for the excellence award should employ a comprehensive approach to hearing loss prevention that goes above and beyond. Judges evaluate candidates for the excellence award based on what they have done to prevent hearing loss in the workplace. Safe-in-Sound judges, for example, consider whether award nominees are controlling exposures to the minimum requirements (e.g., OSHA standards) or to more protective levels, such as those recommended by NIOSH. Are they evaluating their program and improving it each year where deficiencies are found? Award winners are those who go above and beyond compliance and demonstrate a true commitment to protecting worker hearing.

**The Innovation Award** is meant to recognize individuals or organizations for their dedication to fostering, creating and implementing new and unique evidence-based advances in the prevention of hearing loss and creating innovative solutions to real workplace hearing loss prevention challenges. These advances can include policy development, program development and implementation, advocacy and outreach efforts as well as unique product applications and their effectiveness. The award is not intended to be an endorsement of a commercial product. For the innovation award, Safe-in-

Sound judges look for important contributions that will have a significant impact on hearing loss prevention. Such advances can include policy development, program development and implementation, advocacy and outreach efforts, and unique product applications and their effectiveness.

NIOSH, NHCA, and CAOHC are accepting nominations for the next round of Safe-in-Sound Awards. You can nominate others by June 7, 2019, or you can nominate yourself by July 15, 2019. Information on how to apply for the Safe-in-Sound Award is available online. An

additional document (PDF) provides useful tips on how to submit a strong application.

Join the small group of award winners who have achieved new heights in hearing loss prevention. More information about the awards is available on the Safe-in-Sound website.

*Scott Schneider, CIH, FAIHA, recently retired as director of Occupational Safety and Health for the Laborers' Health and Safety Fund of North America.*

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## Students' Corner

by **Christina (Tina) Campbell**

*NHCA Student Delegate*

### Caleb Kronen



Caleb Kronen is completing the 4th year of his audiology doctoral program at the Marion Downs Center in Denver, Colorado. Working closely with Dr. Jill Wayne, the Director of the Hearing Conservation Program and a clinical audiologist, Caleb is learning how to run a hearing conservation program that

has a mobile testing unit. Over 400 companies are tested per year and most of them include sound level surveys and dosimetry. However, audiogram review, work-relatedness, sound measurements and making referrals is not all that Caleb does. In the clinic, he specializes in hearing healthcare for musicians and audio engineers. He worked for six years in the Hearing Research Laboratory at the University of

Colorado conducting research on music-induced hearing loss, signal processing of music in hearing aids, and psychoacoustics. Last year he presented his capstone research project with Dr. Cory Portnuff. This research compared and measured volume limiting earphones that are marketed towards children.

As a past Student Delegate on the executive council of the National Hearing Conservation Association, Caleb has gained much knowledge on how the organization runs and its' philosophies. Having been a touring musician and professional audio engineer himself, Mr. Kronen is passionate about providing outstanding care for people in the music industry and industrial workers with noise-induced hearing loss.

Caleb's plans include becoming the Director of the Hearing Conservation Program at the Marion Downs Center following graduation in a few months. He also plans on being an active NHCA member for many years to come.



# Member Spotlight

## Christi Themann

by Elizabeth A. Masterson  
NHCA Member Delegate



NHCA has many dedicated members, each furthering the field of hearing conservation in their own way, with some in and out of the spotlight. One of these solid (yet perhaps not center-stage) pillars is Christa (Christi) Themann. Christi has been a research audiologist at the National

Institute for Occupational Safety and Health (NIOSH) for 29 years, and a member of NHCA for 28 of those years. Her accomplishments include co-authoring the NIOSH Criteria for a Recommended Standard for Occupational Noise Exposure, and the NIOSH National Research Agenda for the Prevention of Occupational Hearing Loss. She also contributed to the development of and has managed the National Health and Nutrition Examination Survey (NHANES) audiometric data collection for the last 22 years. The second picture is a typical day for Christi, surrounded by audiometers in her office. She was kind enough to let me ask her a few questions.

*What brought you into the field of Audiology and where you are now?*

It was not a direct path. I originally wanted to be a teacher but was told the field was overcrowded. I then became interested in speech pathology. As I was finishing up my undergraduate education, I was bit by the audiology bug. I ended up working at the Veterans Administration (VA) Hospital in Cincinnati for my clinical assignment and then for an ear, nose and throat practice. I was hoping to get a permanent job at the VA but as part of the application process, had to interview at other interested government agencies. NIOSH contacted me and from the first interview, I knew I was in the right place.

*Who was the most influential person(s) in your career?*

Ken Henry – who was a mentor at my VA clinical assignment, and Derek Dunn – my first manager and mentor at NIOSH.

*What do you think is the most important challenge facing hearing conservation?*

The audiology profession as a whole doesn't recognize the need for hearing conservation/prevention – like a dentist knows you need to prevent cavities and actively counsels patients in how to do that and provides supplies. Among general clinical audiologists, prevention is not on the radar screen. It is not part of audiology training programs or clinical practice.

*What can be done to address this?*

I think we need to make an effort to ensure that the importance of prevention and the tools of prevention are incorporated into audiology training programs. That is likely where there would be the most impact. We as hearing loss prevention specialists, need to attend clinical audiology conferences and reach out to clinical audiologists already in practice.

*Of what accomplishment are you most proud, professionally?*

Maintaining the rigor and consistency of audiometric data collected in the National Health and Nutrition Examination Survey over the past two decades, so that the nation has reliable data on hearing ability from which to make policy and implement interventions to protect hearing.

*Of what accomplishment are you most proud, personally?*

Caring for my grandma for the last few years of her life. It was such a blessing for us both.

*When you aren't preventing worker hearing loss, what do you do for fun?*

Hang out with my family, globe-trot, walk with friends, and be a connoisseur of fine Italian food and spirits! [Note: Christi is VERY Italian]

### Lightning round:

Best place you have ever traveled: Nevers, France

Place you want to visit the most: Trecastelli, Italy

Favorite color: blue

Favorite animal: dogs [incidentally, she is currently seeking another furball]

Favorite food: eggplant parmesan

Favorite book: Ivanhoe

Favorite movie: I Confess (Alfred Hitchcock)

Favorite sound: church bells





*In Memoriam*  
**Larry Herbert Royster**  
 September 22, 1936 – March 18, 2019

**by Elliott H. Berger**  
*Student, friend, and collaborator*

Larry Herbert Royster died peacefully at his Raleigh, North Carolina home on March 18, 2019. Although Larry had experienced deteriorating health since 2003, his final days were a swift and pain free decline.

Larry was a native of North Carolina, where he spent virtually his entire adult life. It was during a brief sojourn outside the south that Larry obtained his first professional experience and a strong grounding in theoretical and experimental analysis. Working for North American Aviation, he investigated aerodynamic flutter models and advanced underwater acoustic transducers for sonar systems. During that stint Larry was dubbed *The Moose* for an unfortunate accident in which he damaged an aircraft model that was under test. At least one of Larry's students (the author of this piece) always enjoyed using that nickname, though he was not brave enough to exploit that moniker fully till after his graduation. The fact that he could do so attests to Larry's humility and sense of humor.

Larry's experience as an educator began early. After completing a BS in Mechanical and Aerospace Engineering at North Carolina State University (NCSU), he taught physics in public high school while working on an MS degree. After several years working in aviation engineering, he returned to earn a PhD at NCSU, where he taught in the Department of Mechanical and Aerospace Engineering until 2001, retiring as a full professor. Larry loved teaching as well as stimulating students to solve real-world problems. In fact, the "real world" was where so much of Larry's interest dwelt, since he was intensely practical in his approach to knowledge, research, and guidance. He sought meaningful applicable contributions that could be understood by all. Of Larry's many contributions to NHCA (discussed further below), one that was quintessentially Larry was the panel discussions he conceived of and helped to organize for the annual conference, in which he invited industrial hygienists, nurses, and shop workers to speaker before our "learned" audience to share their perspectives from the frontlines.

Larry's other important contributions to NHCA included accepting an after-the-fact appointment to be the Program Chair for 1997, wherein he had to step up to resolve an unexpected problem that had arisen well into the program planning cycle, and his guidance of the Task Force on Hearing Protector Effectiveness, whose assignment was to examine and issue a report on potential improvements that could be considered in place of the NRR.

Larry's interest in noise and vibration control led him to assist first the North Carolina Department of Labor, and later federal OSHA, in developing noise and hearing conservation regulations. Larry was present and testified at the hearings in Washington in 1970s when the Hearing Conservation Amendment was being hashed out; a measure of the importance of his contributions is the fact that he was cited 23 times in the original, and subsequent final version of the rule. As further evidence of the lengths he would pursue to uncover the unvarnished facts, was the four-year long, nationwide research project he undertook with Julia, his wife and esteemed collaborator, in which they visited and interviewed those who issued hearing protectors and directly interfaced with workers at 213 sites across the U.S. This unique study, not since replicated, provided a valuable insight into American hearing conservation circa 1980. Another of Larry's important contributions, also developed in collaboration with Julia, revolves around objective methods of establishing the adequacy of hearing conservation programs, including the creation of appropriate reference and control databases.

Prevention of noise-induced hearing loss remained Larry's passion and research interest throughout his professional career. He published numerous scientific papers and book chapters, especially in the highly regarded AIHA *Noise Manual* for which he was also an editor for the 4th and 5th editions. His contributions were recognized via prestigious awards from The Acoustical Society of America, the American Industrial Hygiene Association, and the NHCA, which bestowed upon him the Outstanding Hearing Conservationist award in 2000.

Larry's devotion to education and students extended well beyond the classroom. He and Julia would graciously invite students into their home. They also established student endowment funds at both the NHCA in 2000 and the Acoustical Society of America.

After retirement, Larry studied widely divergent scientific topics, reaching his goal in 2013 of reading more than 500 books post retirement, and pursued new hobbies in amateur radio, golf, and gardening. In all pursuits doggedly thorough, Larry was a man of integrity, fairness, and intense practicality who wanted to make the world a better place.

Larry is survived by his wife of 41 years, Julia Doswell Royster of Raleigh, North Carolina, his sons Larry Herbert Royster Jr. and William Kirk Royster, and many grandchildren, and by his students and friends who will miss him dearly and recall his smile and friendship.

Those who wish to honor Larry may contribute to the NHCA Scholarship fund by making a check payable to the NHCA Scholarship Foundation and mailing it to NHCA Scholarship Foundation, P.O. Box 3406, Englewood, Colorado 80155.



# Dismounted Military Operations and Auditory Situational Awareness: *Risks of Hyper-Focusing on Sound Localization*

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Military service can be extremely noisy. All service members will experience exposure to both hazardous impulse and steady-state noise at some point during their time in the military (Humes et al., 2006). Fortunately, conventional, passive hearing protection devices (HPDs) are an acceptable solution with most military occupational specialties to help protect against auditory damage from hazardous noise. Military personnel assigned to the infantry and other dismounted, combat, and combat support specialties, however, have a unique and far more challenging set of exposures and auditory needs than can be easily addressed with traditional passive HPDs. These individuals experience significant steady-state noise exposures while being transported in mobility platforms such as aircraft, ground vehicles and watercraft. For example, in the case of a CH47 helicopter, noise levels can exceed 115 dB SPL. At the end of transport, military personnel will disembark the mobility platform to conduct dismounted operations, and quickly transition to a quiet, potentially hostile environment, where their ability to hear is often critical to survivability and lethality. Those not wearing HPDs during transport may find themselves with a temporary threshold shift at the onset of the dismounted operations and are unable to hear soft, tactically relevant environmental sounds. The dismounted operation may last for hours or days, and the acoustical environment may be very quiet or consist of low-level urban noise. I refer to this period as a “quiet exposure.” During this quiet exposure, traditional passive HPDs are not ideal and are rarely used due to their effect on hearing ability.

Due to the nature of dismounted combat patrols, there is an ever-present possibility that immediately, and without warning, the environment will transition from quiet or low noise, into a kinetically dangerous, extremely hearing hazardous situation caused by high-level impulse noise from assigned weapon systems. Any hearing injury stemming from this exposure would likely be attributed

to the hazardous impulse noise exposure. What may be less obvious is that the dynamic auditory demands during the “quiet exposure” and concerns regarding a negative impact of wearing traditional passive HPDs on auditory situation awareness may have induced the service member to forgo their hearing protection. In other words, the quiet exposure was as much of a culprit as the hazardous noise in any resulting auditory injury.

The challenge in helping protect the hearing of these dismounted warriors is multifaceted and can only be achieved with a protective solution that addresses a multitude of auditory needs. First, the solution must offer protection against hazardous levels of steady noise. Second, it must enable a quick transition from noise to quiet where continued use will not significantly degrade hearing sensitivity. Third, it must allow for face-to-face and/or radio communications. Fourth, it must provide on-demand and virtually instantaneous protection against sudden, intense impulse noises. With 25 years of military service, including multiple deployments, it has been my experience that those conducting dismounted operations in combat as well as training will risk auditory injury to satisfy their immediate hearing needs if their protective solution degrades hearing ability.

Traditional passive HPDs are not ideal for providing a high degree of hearing and communication ability in these complex acoustical environments. What is the best case, therefore, is a more sophisticated materiel solution that addresses environmental hearing needs, radio and face-to-face communication requirements, and offers on-demand, and non-interfering hearing protection. A hearing solution that has been widely used in the special operations community and is increasing in use within conventional fighting forces is Tactical Communication and Protective Systems (TCAPS). These products typically offer electronic level dependent hearing protection (sometimes

referred to as “talk-through”), for environmental listening, some degree of hearing protection, and may interface with tactical communication radios.

The use of one’s hearing during tactical operations is commonly referred to as auditory situational (or situation) awareness (ASA). The most commonly listed components of ASA are sound detection, sound identification, sound localization and distance to sound estimation (Abel & Powlesland, 2010; Casali & Lee, 2018). Along with face-to-face communications and radio communications, these are the primary auditory tasks relied upon by those conducting dismounted operations. As one can imagine, a healthy normal auditory system can be an effective sensor for those conducting dismounted operations. A prime example is the fact that one can hear what cannot be seen.

The importance of ASA for dismounted operations is widely accepted, yet no major study exists that analyzes the relative importance of each of the auditory tasks (detection, identification, localization, distance estimation, communications) in isolation and its individual impact on survivability and lethality. Due to the fluid nature of combat and rapidly changing demands placed on hearing, it does not make sense to assess a warfighter’s overall ASA by independently evaluating the auditory components in isolation. What is needed is an assessment of the effectiveness of the ensemble of the various components.

Many auditory researchers acknowledge that sound detection and sound identification are prerequisites of sound localization and are critical auditory skills relied upon during dismounted operations. Efforts by Lee, Casali, Sheffield and others, to highlight the importance of ASA and to measure the impact of poor ASA and the effectiveness of TCAPS products on dismounted operations in real world environments, are to be applauded (Sheffield, Brungart, Tufts, and Ness 2017; Lee and Casali, 2017). However, sound localization abilities appear to gather the lion’s share of focus when it comes to TCAPS product performance (Talcott, Casali, Keady, and Killion, 2012; Lee and Casali, 2018; Casali and Lee, 2018). Many publications and presentations begin with an overview of ASA but transition their focus to sound localization.

The lack of comprehensive ASA research quantifying the importance of the ensemble of tasks, combined with the current focus on a single ASA component (i.e. sound localization) may create confusion for those responsible for developing product requirements and, ultimately, the procurement of TCAPS products.

First, those responsible for procuring these items for military personnel are typically not acoustical experts. Information generated by acoustical labs via test reports, professional publications and presentations may leave the lay person with the impression that TCAPS test protocols and opinions regarding the importance of sound localization are rooted in a deep understanding of how military personnel use their hearing during dismounted operations. I suggest that, at best, a rudimentary understanding of ASA currently exists and that focusing too narrowly on the importance of sound localization, or any individual listening skill, is unwarranted. It would be unfortunate to negatively impact the procurement and delivery of TCAPS products to dismounted operators due to excessive focus on what is perhaps the most challenging technical component to TCAPS development: sound localization. The tendency to elevate and overstate the importance of single listening skills on survivability and lethality, given the incomplete understanding of ASA, can have severe consequences for the service member. If acquisition officers are left with the impression that the technology is still too immature to offer benefit, or that the most needed capability of a TCAPS product is sound localization, it may have the effect of cancelling procurement or may lead to procuring a device that localizes best but may not be strong in delivering other capabilities.

A simple example of an unintended consequence from advanced and exciting acoustical research, is the slow motion, high definition videos produced at the Institute of Saint-Louis (ISL) showing the physical effects on HPDs from exceedingly high-level explosives (195 dB SPL), well above the peak levels of most hand-held weapon systems. In these videos, over-the-ear HPDs can be seen separating from the head and in-the-ear HPDs move so violently that their protection is compromised. These videos were made of HPDs on acoustical test fixtures within close proximity to detonating explosive compounds and the effect of the pressure wave was visually impressive. Unfortunately, these videos made their way into the acquisition and tactical communities where they left some with the impression that there was no value in wearing hearing protection because loud sounds cause the products to lose their protective capability. The ramifications of this misinterpretation on the effectiveness of HPDs is unfortunate and continues to this day.

Second, much of the product sound localization testing is performed in an anechoic chamber using the normal functioning, open ear as the comparison standard. It



is even suggested that TCAPS products must perform as well as the open, normal functioning ear (Brungart, Hobbs, and Hamil, 2007). This is understandable if the goal is to compare these products to normal human hearing capability. However, there are two concerns with this approach.

1. The comparative condition should be the minimum accepted auditory condition for a tactical environment where the threat of extreme noise exposures places the dismounted operator at risk for auditory injury. In this case, some type of protected hearing condition (passive HPD or non-electronic level-dependent HPD) should be the comparative standard. (i.e., we would not compare eyewear optical distortion vs. the naked eye, or helmet blunt impact protection to an uncovered head). Comparison is based on need of protection in a hazardous environment. For eyewear – a level of visible light transmittance is deemed acceptable for a lens, based on the service member's ability to do their jobs. That level of acceptance is not equal to that of the naked eye. As with other studies regarding ASA, the data are limited, but suggest that localizing sound with passive hearing protection, the minimum acceptable condition to prevent noise induced auditory injury when hazardous noise exposures are expected, is significantly reduced compared to the open ear (Simpson, Bolia, McKinley, & Brungart, 2002).

2. Auditory performance in an anechoic environment may not translate well to auditory performance in an echoic environment, such as an urban environment where competing noise, and reverberant surfaces can degrade sound localization performance of normal hearing listeners. Sound localization in an urban environment is challenging, even for normal functioning open ears. For this reason, we must guard against suggesting that the degree of localization demonstrated during a lab test in an anechoic environment represents the same degree of ability likely in a more complex acoustical environment.

Lastly, as previously discussed, ASA is complex, the primary component can change rapidly and is situationally dependent. Initial self-reported ASA data gathered from experienced special operations forces, by the author in an ongoing effort, suggests that sound detection is the primary ASA component for survivability and radio-communications is the most important to lethality. For both survivability and lethality, sound localization ranks third. Other research involving self-reported ratings for these three areas reveals similar results (Bevis, Semeraro, van Besouw, Rowan, Lineton, & Allsopp, 2014). This

is important because sound detection in quiet, and communication capability in noise, are areas in which TCAPS products perform well. Worth noting is that TCAPS products offer a useful degree of hearing protection to the soldier while assisting with sound detection and radio communications. Given that the special operations force (SOF) community has a long history of TCAPS product use, it would be interesting to evaluate current hearing loss data from that group compared to hearing loss rates from the pre-TCAPS era.



Image 1. Patrolling in an Urban Environment (Photo courtesy of Drift Media)

To illustrate the complex nature of auditory demands, refer to the photos labeled as Images 1, 2 and 3. Image 1 shows a dismounted patrol in an urban environment. While there may be background noise, it is essentially a “quiet exposure” and an environment where passive hearing protection, if worn, would likely degrade the user's hearing to the point that it affects their sound detection abilities and is undesirable. Yet, the threat of a sudden hazardous noise exposure from their weapon system and resulting need for communication in high levels of impulse noise are ever present. Unless the hearing protection solution addresses ASA and communication needs, the service member may feel as if they must choose between hearing and hearing protection.



Image 2. U.S. Marines in Iraq (Photo courtesy of U.S. Marine Corps)

In Image 2, we see two U.S Marines engaged in a firefight. Please note that the Marine on the ground is carrying a M249 Squad Automatic Weapon (SAW). While most members of a Marine infantry squad are assigned assault rifles, a very small number of Marines in a squad carry SAWs. This belt fed machine gun is important for tactical reasons as it is used to deliver bullets at a high rate of fire to suppress the enemy. It appears that the Marine firing the SAW is covering his left ear canal, presumably because the noise exposure is extremely uncomfortable. His right hand is not visible. Regardless of what his right hand is doing, firing a SAW with only one hand substantially impairs the Marine's ability to fire accurately, and, if he is also covering the right ear due to auditory discomfort, this would be even worse, since he would not be firing his weapon at all. Consider the ramifications. An unprotected noise exposure may be responsible for reducing the squad's firepower. A hearing protective solution that does not work during the quiet exposure in Image 1, is not likely to be worn when a service member finds themselves in a situation like the one in the second photo.



Image 3. SFC Paul R. Smith (Photo courtesy of U.S. Army)

Image 3 portrays SFC Paul Smith, the first Medal of Honor recipient of the Iraq War on Terrorism. He is monitoring two radios, with two separate handsets. If the vehicle is in motion, and at some point, it would be, the environmental noise within the passenger compartment can be as high as 100 dBA. Bear in mind the critical nature of battlefield communications. To be effective, a military unit must be able to shoot, move and communicate, with efficiency. Delivering the incoming radio communications via a hands free TCAPS like hearing protection headset rather than the clumsy make shift two handed effort shown here is a far more desirable method for communication in noise.

Each of these three images demonstrates the complex auditory demands and dynamic acoustical environment faced by service members during military operations. While sound localization ability will at times be an important auditory capability for dismounted operations, there are no data to suggest that it should be elevated above other auditory tasks.

Much of my current work is with global SOF units. In this work, it is rare to find a SOF team that goes into a combat tactical operation or a training event without a TCAPS headset. These experienced operators understand and accept that their tactical headsets may offer decreased auditory performance in some areas (i.e. sound localization), compared to their open ear, but offer enhanced auditory capabilities in other areas (i.e. sound detection, tactical communications) compared to the open ear in noise or to the ear protected by a traditional passive HPD. At the end of the day, their broad acceptance and use of these products suggest that the advantages outweigh the disadvantages. Plus, the TCAPS headset offers a hearing protection solution that can be worn in tactical environments.

In conclusion, while sound localization is an important component of ASA, it is potentially harmful to emphasize it more highly than other ASA components. Those conducting dismounted operations must be offered a hearing protection solution that can meet minimal auditory demands in a dynamic acoustical environment, or they are likely to choose the open ear, which can result in significant auditory injury, thus compromising their overall ASA and communications capability. While excellent research on ASA factors and product performance, including sound localization, is unquestionably advancing our understanding of these factors and the performance of TCAPS and other electronic products, perhaps it is good to pause and ask: Even though we are advancing science, are there unintended consequences to our messaging that makes its way into the tactical and acquisition communities, that may diminish the use of currently available and valuable TCAPS?

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