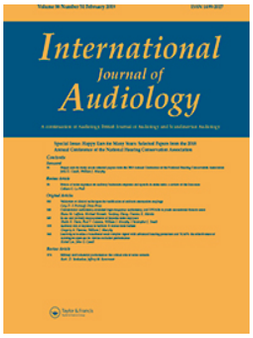

International Journal of Audiology

ISSN: 1499-2027 (Print) 1708-8186 (Online) Journal homepage: https://www.tandfonline.com/loi/iija20

Happy ears for many years: selected papers from the 2018 Annual Conference of the National Hearing Conservation Association

John G. Casali & William J. Murphy

To cite this article: John G. Casali & William J. Murphy (2019) Happy ears for many years: selected papers from the 2018 Annual Conference of the National Hearing Conservation Association, International Journal of Audiology, 58:sup1, S1-S2, DOI: 10.1080/14992027.2018.1546476

To link to this article: https://doi.org/10.1080/14992027.2018.1546476

Published online: 15 Jan 2019.

INTERNATIONAL JOURNAL OF AUDIOLOGY
2019, VOL. 58, NO. S1, S1–S2
https://doi.org/10.1080/14992027.2018.1546476

FOREWORD

Happy ears for many years: selected papers from the 2018 Annual Conference of the National Hearing Conservation Association

John G. Casali[a] and William J. Murphy[b]

[a]Auditory Systems Laboratory, Virginia Tech, Blacksburg, VA, USA and Hearing, Ergonomics & Acoustics Resources (HEAR) LLC, Blacksburg, VA, USA; [b]Hearing Loss Prevention Team, U.S. Public Health Service, National Institute for Occupational Safety and Health, Cincinnati, OH, USA

ARTICLE HISTORY
Received 5 November 2018
Accepted 5 November 2018

As co-editors for this *International Journal of Audiology* (*IJA*) special supplement, we are pleased to introduce seven papers covering innovative, impactful research that represent a selected subset of those presented at the 42nd annual meeting of the National Hearing Conservation Association (NHCA) held in Orlando, Florida in February 2018. This conference adopted the theme 'Happy Ears for Many Years,' and we think you will find that the research covered in this supplement aims directly, via diverse strategic avenues, toward the objective of conserving our hearing. This supplement is enabled by the financial support of the NHCA and its partners, including the National Institute for Occupational Safety and Health (NIOSH), the Council for Accreditation in Occupational Hearing Conservation (CAOHC), and the Department of Defense Hearing Center of Excellence (DoD HCE).

This supplement continues a longstanding partnership of nine years between the NHCA (http://www.hearingconservation.org/) and *IJA* to produce a supplemental issue that archives outstanding papers from the conference. Program Chair Rachel Bouserhal and her committee provided an outstanding program comprised of lecture and poster presentations, workshops, and exhibitors. After reviewing all abstracts and slides associated with the conference presentations, we identified 11 potential contributions for this supplement, and invited the authors to prepare and submit journal-style manuscripts. However, several authors had already submitted their work to other journals. Nonetheless, seven outstanding papers remained and were submitted to us for peer review, and all seven were ultimately successful. Based on this experience, we wish to emphasise that the NHCA and *IJA* have, for nine years, worked successfully to provide rigorous peer-reviews and to publish the important research that we have the privilege to see presented each year. This is the function of the *IJA* special supplement, so please keep it in mind when you next present a paper at NHCA.

The question we found ourselves asking from the conference theme is, 'What makes happy ears?' and 'How do we keep our ears happy for many years?' Perhaps a happy ear is one that can hear the sounds that we desire to hear without the need to wear amplification and other forms of artificial compensation. For Bill Murphy, happy ears do not strain to enjoy the melody of lyrical piano music or the signature movements of a jazz trio. For John Casali, happy ears help to tune a classic car engine to give just the right 'purr', or enjoy the sound of his Hammond B3 organ. Ask yourself, what is the sound that most pleases your ears? Whatever it may be, preservation of your ability to hear it with unimpaired aural perception is key.

This issue focuses on a wide range of topics: cochlear synaptopathy, changes in otoacoustic emissions (OAEs) from firearm noise exposure, auditory risks of gunshot-produced sound waves, personal dosimetry, hearing protector design and testing, auditory situation awareness measurement and training, and noise control engineering. These topics are clear evidence of the broad spectrum of research capabilities and practitioner skills of the membership of the NHCA. We find that this membership benefit is most valuable to our own research programs.

Relating back to the theme of 'Happy Ears for Many Years', having in-depth knowledge of noise exposure risks in various environments and ensuring performance of hearing protection devices (HPDs) or noise controls when confronted with noise hazards, are essential to maintaining those 'Happy Ears'. Each of this supplement's papers targets one or both of those important objectives. A brief introduction to each paper, in order of their appearance in this issue, follows.

First, in order, are three papers that address various aspects of small caliber firearm noise exposures, which are a particular threat to the hearing of our public safety and military personnel, as well as to civilian target shooters and hunters. Laffoon et al. measured extended frequency range pure-tone audiometric thresholds and distortion-product OAEs (DPOAE) from a study sample of 25 youth firearm users (YFU), aged 7–17 years. They found that DPOAE amplitudes were significantly reduced at 8 and 10 kHz but did not distinguish between 'younger' YFUs (7–12) in the study sample and the 'older' youth (13–17). Across all YFUs, the conventional audiometric thresholds were significantly reduced. The extended high frequency thresholds at 14 and 16 kHz were worse and a statistically significant difference was observed for older versus younger firearm users. This study clearly evidences the need for more than just conventional audiometry to evaluate YFUs.

Davis et al. participated in a unique noise survey of firearm noise at Marine Corps Base Quantico, and simultaneously monitored the noise levels in the ear canal and just outside the ear canal using a customized mobile system. Four hours of live-fire exercises were recorded and carefully analysed to provide new insight into the exposure risk posed by personnel firing weapons. Each device had a global positioning unit that permitted tracking the location, thus providing a detailed map relative to the shooting exercises. The in-ear and on-body results were used to

estimate compliance with wearing the HPD properly and demonstrate a high correlation with traditional hearing protector fit-testing methods.

Flamme & Murphy evaluated a component of firearm noise that is not typically experienced by persons using firearms at a target range or when hunting; that is, the hazard of the ballistic crack or N-wave of a supersonic bullet. When a bullet moves at supersonic speeds, the N-wave radiates outwards from the trajectory of the bullet like the surface of a cone attached to the bullet's tip. Their research question was motivated by a case of hearing loss for a police officer. They describe a technique that allowed a precise estimate of the proximity of the bullet's trajectory relative to a microphone array at 6.4 m downrange from the weapon. With detailed knowledge of the distance from the microphone, as well as the bullet's dimensions and velocity, they tested acoustic theories that predict the characteristics of the ballistic crack. Via this method applied to the N-waves from an AR-15 style assault rifle firing a 0.5-calibre Beowulf® cartridge, the authors found that unprotected exposures presented a significant risk to hearing through trajectories within 1.2-m from the ear. This research can inform hearing conservation professionals about how to avoid this exposure in training exercises.

Moving to papers specific to hearing protection issues, Portnuff & Price report on the results of an experimental comparison of probe microphone-based measurements and Real-Ear-Attenuation-at-Threshold (REAT) measurements obtained using sound field loudspeakers and two earphones, to ascertain the most valid method of measuring the performance of custom-molded uniform attenuation earplugs (UAE). To date, manufacturers' evaluations of specific filters as evidence that an earplug provides uniform (flat) attenuation across the frequency range 125–8000 Hz have relied on the standardized Real-Ear-Attenuation-at-Threshold (REAT) binaural listening method. The authors conclude that sound field REAT with contralateral masking for signals offers the most accurate and clinically viable method to verify the performance of UAEs.

When the noise exposure application involves provision of advanced HPDs to personnel, such as passive and electronic sound pass-through devices, Lee & Casali stress the critical importance of knowing the effects of such protectors on the wearer's auditory situation awareness, which can be deleterious. This both inhibits HPD usage, and compromises the wearer's safety and ability to function properly when auditory signals and speech must be heard and processed. The authors conducted a longitudinal experiment over 12 sessions or 'Learning Units' to evaluate how azimuthal localization skills were acquired, both with the open ear and while using two different electronic HPDs in counterbalanced ordering. Initially, localization performance in the HPD conditions was markedly poorer than the open-ear condition. However, with training, one in-the-ear device yielded improvements of 20%, ultimately nearing the performance of the open-ear, which itself was improved by 25%, demonstrating the plasticity of the aural system. However, a new prototype electronic HPD failed to exhibit acceptable performance after training, with localization accuracy never asymptoting nor approaching the open ear level. This article demonstrates the importance of providing training to HPD users when situation awareness is critical to accomplishing a mission, and to assessing advanced HPDs prior to fielding them.

Next are two outstanding review papers. LePrell reports on a comprehensive literature review of the topic of cochlear synaptopathy and speech-in-noise testing. The potential for noise exposures that result in a temporary threshold shift (TTS) and that exhibit recovery has significant bearing upon the restrictions that affect occupational and recreational noise exposures. Tests that can distinguish cochlear synaptopathy are urgently needed. Several candidate methods exercise different portions of the auditory pathway. Otoacoustic emissions can test the peripheral function in the middle ear along with some lower reflexive pathways. Auditory brainstem responses can diagnose retro-cochlear pathologies, while speech-in-noise tests exercise the entire pathway and involve cognitive abilities. This review article provides an excellent stepping-stone for individuals who are commencing research in this area.

In the final review paper, Yankaskas & Komrower offer comprehensive insight into how noise control engineering plays a significant role in several important applications, including the initial development as well as retrofitting of Naval warships and the design of hydroelectric power plants. The authors provide compelling examples, accompanied by quantitative noise reduction data, on various engineering-based noise control strategies, and how hearing hazard risks have been reduced without the requirement of HPDs. A source-path-receiver noise control systems approach is adopted, with emphasis on reducing noise sources and noise propagation, i.e. at the source and in the path, respectively. Innovative noise analysis software and three-dimensional graphics are highlighted as important tools for noise control engineers. When applied to shipboard applications, sometimes the noise control process can be perceived as a trade-off between mission performance objectives and the auditory health and safety of Navy personnel.

In closing, as 'veterans' of NHCA and its conferences over many years, we both are acutely aware of the vast expertise of its members and its conference presenters. In our own research efforts, we often refer to NHCA literature for key knowledge about hearing conservation discoveries and practices, including those from the *IJA* supplements. We are pleased to be your co-editors for this supplement, and hope that you enjoy reading and applying the information herein.

The following organizations provided support for this supplement:

CAOHC
Council for Accreditation in Occupational Hearing Conservation

DEPARTMENT OF DEFENSE
HEARING CENTER OF EXCELLENCE