

PREFACE

Occupational Hearing Loss from Non-Gaussian Noise

For millennia, we have known that loud noise can harm hearing. However, defining the specific hearing risk posed by a specific noise for a specific individual is still elusive. Many factors influence whether or not a given noise is harmful. Attempts to quantify this potential harm began in earnest after World War II, when many veterans returned to their civilian lives with service-connected hearing loss. Database analyses, laboratory studies of permanent and temporary threshold shifts in animals, and laboratory studies of temporary threshold shifts in humans led to the first recommended hearing damage-risk criteria and corresponding hearing conservation programs in the 1950s. Not unexpectedly, as our ability to measure and monitor both noise exposures and their effects on humans and animals has evolved, recommended hearing damage-risk criteria and hearing loss prevention practices also have evolved.

Between the early 1970s and late 1990s, several regulations and national standards were promulgated, which have profoundly influenced policies and practices regarding noise exposure. These include the U.S. Environmental Protection Agency 1974 recommendations for community and environmental noise exposures (EPA/ONAC 550/9-74-004), the U.S. Occupational Safety and Health Administration 1983 occupational noise exposure standard (29 CFR 1910.95), the International Organization for Standardization standard for estimation of noise-induced hearing loss (ISO 1999), and the U.S. National Institute for Occupational Safety and Health (NIOSH) 1972 and 1998 criteria documents on occupational noise exposure (NIOSH 73-11001 and 98-126).

Because of the widespread use and acceptance of these guidelines, it has become “business as usual” for noise-exposed workers to be enrolled in occupational hearing conservation programs. Likewise, many community leaders and individuals engaged in noisy recreational activities have a heightened awareness of the harmful effects of loud noise, which has led to the establishment of community noise standards and use of personal hearing protection, respectively. However, it would be a very serious mistake to conclude that the hearing loss prevention profession now has all the technical tools and professional guidelines necessary to effectively prevent noise-induced hearing loss.

In particular, existing noise exposure guidelines have addressed mainly continuous and steady state (Gaussian) noise. Intermittent exposures, impulsive noise, and combinations of noise exposures (termed “complex” or “non-Gaussian” noise) have received much less attention. However, recent advances in noise measurement instrumentation and methods, as well as the introduction of new metrics to characterize complex, non-Gaussian noise, now enable study of the relationship between these noises and hearing damage risk. As a result, hearing conservationists can begin to work toward establishing guidelines for preventing hearing loss from time-varying, impulsive, or combined noise exposures.

At the same time, new research has found that the physiological effects of noise may extend beyond the outer hair cells of the cochlea to the synapse between the hair cells and auditory neurons. This damage—known as *synaptopathy*—can create a “hidden” hearing loss not evident on the pure tone audiogram.

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Occupational Hearing Loss from Non-Gaussian Noise; Guest Editor, Mark R. Stephenson, Ph.D.

Semin Hear 2017;38:223–224. Copyright © 2017 by Thieme Medical Publishers, Inc., 333 Seventh Avenue, New York, NY 10001, USA. Tel: +1(212) 584-4662. DOI: <https://doi.org/10.1055/s-0037-1603690>. ISSN 0734-0451.

With these advancements in mind, the National Institute for Occupational Safety and Health awarded a contract for evaluating the considerable body of recent research on the effects of intermittent and impulsive noise exposures. This effort re-examined the research used to support NIOSH's 1998 criteria document and examined recent research on the exchange rate, non-Gaussian noise exposure, and synaptopathy. As the lead scientist in this effort, Dr. Alice Suter conducted an exhaustive review of what is known about the effects of noise exposure on the hearing mechanism. In this issue of *Seminars in Hearing*, Dr. Suter has

eloquently presented the results of her review. Readers of this issue will develop a clear understanding of the scientific principles needed for establishing guidelines for exposure to non-Gaussian noise and the need for updated hearing damage-risk criteria that consider the relationship between noise exposure and synaptopathy. With these factors in mind, this issue of *Seminars in Hearing* should provide a valuable resource for those pursuing efforts to update and revise hearing damage-risk criteria.

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