

Sound Resolutions for the New Year

By Nina Kraus, PhD, and Travis White-Schwoch

The New Year often prompts resolutions to live a healthier lifestyle, such as for diet, sleep, and exercise. But what about hearing health? This month, we're sharing three resolutions that could promote ear and brain health, and help us think preventively about aural wellness.

These resolutions are rooted in the concept that the auditory brain is plastic—that is, the auditory brain reorganizes following experience, and this reorganization affects our ability to make sense of sound (*Trends Cogn Sci.* 2015;19[11]:642). What is interesting about auditory brain plasticity is that it can be a boon or a bust to hearing health (*Nat Human Behav.* 2017;1:700). Positive and meaningful interactions with sound reorganize the brain to make it a more efficient sound processor. In contrast, negative and meaningless interactions with sound reorganize the brain to make it a less efficient sound processor.

CUT OUT THE NOISE

Noise insidiously creeps into our lives, be it a beeping truck out your office window, a relentless HVAC system, or a white noise machine in the bedroom. We think of these as harmful sources of noise because with rare exception they're not meaningful—they're just annoying. It's important to identify and avoid these sources of noise.

An obvious consequence of this noise exposure is hair cell damage. We like to remind people that we only get one set of ears, and once our hair cells are gone, they're gone for good. The outer hair cells at the base of the cochlea are extremely vulnerable to damage. These hair cells respond to high-frequency sounds. While the necessary acoustic information in speech occurs in a lower frequency range, there are still high-frequency cues in speech. These high frequencies provide reinforcing information to help understand speech (*J Acoust Soc Am.* 2012;131[2]:1003). Thus, even a subtle hair cell loss could impoverish speech understanding.

An often overlooked, and arguably more devastating, consequence of this noise exposure is in the brain. The auditory system reorganizes to adapt to its environment. If this environment is disordered, then auditory centers in the brain will also reorganize in a disordered fashion (*J Neurosci.* 2005;25[3]:699). Moreover, neurons in the auditory cortex will respond to sound less efficiently. Cutting out meaningless sources of noise can help avoid this maladaptive auditory brain plasticity.



Dr. Kraus, left, is a professor of auditory neuroscience at Northwestern University, investigating the neurobiology underlying speech and music perception and learning-associated brain plasticity. **Mr. White-Schwoch** is a data analyst in the Auditory Neuroscience Laboratory (www.brainvolts.northwestern.edu), where he focuses on translational questions in speech, language, and hearing.



WEAR EARPLUGS

Sometimes there are good reasons to engage in noisy circumstances, such as traveling on an airplane, attending a concert, or going to a football game, where deafening noise has become a dubious badge of honor for stadiums. The noise levels can have the same negative consequences for the ear and brain as meaningless noise, but that does not mean these environments need to be avoided.

It's always a good time to remember the importance of ear plugs, which can make these dangerous scenarios safe. It's also advisable to model good behavior for our friends; for example, when going to a concert with friends, bring a pair of earplugs for everybody.

Often overlooked is the potentially harmful impact of ostensibly safe noise levels, such as a hair dryer, on the brain. "Hidden hearing loss" is a new term to describe a phenomenon where either a single acute noise exposure, or a life of moderate noise exposure, causes the connections between the inner hair cells and the auditory nerve to degenerate (*J Neurosci.* 2009;29[45]:14077). This damage is hidden because audiograms and cochlear potentials are normal, but information from the ear is not effectively transmitted to the brain.

PICK UP AN INSTRUMENT

We can also engage in activities to boost the auditory system. Making music is a jackpot for brain plasticity because it combines sensorimotor, cognitive, and reward networks (*Neuroscientist.* 2016:9). When these brain systems are activated in tandem, the brain is primed to reorganize itself in a more meaningful way. Thus, actively making music is a viable strategy to make the auditory brain process sound more robustly. What's important to keep in mind from a health perspective is that one does not have to be a full-time musician to gain these brain benefits. Making music a couple of times a week can be enough to drive the auditory brain to more efficient sound processing, which leads to better hearing in noise, auditory memory, and attention. 