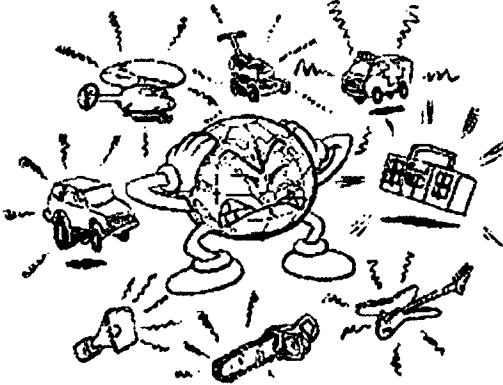


NOISE LETTER

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Spring 2018



Noise Hurts!

Noise Discrimination Against People with Hearing Loss, Tinnitus and Hyperacusis

By Jan L. Mayes

Chains of restaurants and retail stores are now offering Quiet Hour. The media says Quiet Hour is for people with autism spectrum disorder. An hour a week with canned or piped-in music turned off. Popping up from country to country. My first thought on hearing about it was why only an hour a week? It doesn't seem like enough time.

Also what about everybody else with quiet communication needs? All the people stressed by noise. All the people who can't hear or make out what people are saying in places with background noise or music, or who can't comfortably tolerate noise from muzak. This large group of people, from babies to seniors, has quiet communication needs. It includes people with conditions and disabilities like autism, hearing loss, tinnitus, hyperacusis, history of brain injury (concussion or head injury) and cognitive delays or declines.

Wheelchair ramps don't get rolled in for an hour a day. They're there even when nobody in a wheelchair or scooter needs access. Otherwise, it's discrimination against people with disabilities. Pedestrian crosswalks have audible signals even when blind people aren't there. For access all the time, otherwise it's discrimination against people with disabilities. Autism, hearing loss and cognition problems are classified as functional disabilities. Outside of Quiet Hour, stores, shops, cafés, restaurants and other public spaces playing piped-in music are discriminating against people with these disabilities by blocking quiet access.

Access Provided:

- 13% of people have mobility disabilities.
- 5% of people have a vision disability.

Quiet Hour Access Provided:

- 1% of people have autism (Note Quiet Hour is low sensory: music turned off, lights are also dimmed 50%, register and scanner volumes are turned down, PA announcements and collecting shopping carts/trolleys are avoided, etc.)

Access Not Provided:

- 16% of people have hearing loss.
- 33% of adults over age 65 have hearing loss.
- 10% of people aged 20 and older have tinnitus.
- 7% of people aged 18 and older have hyperacusis.
- 2.5% of people over age 12 have had a brain injury.
- 12% of people have cognitive functional disability.

I was watching a Frank Sinatra movie from the 1950s. In one scene, he was in a restaurant talking to another character. Something felt wrong about it. Eventually I figured it out. I could understand what they were saying. It was quiet. There was no background music playing inside the restaurant. Just conversation.

Pipedown, an international campaign to stop piped-in music that started in the UK, reports that 34% of people don't like piped background music, 30% like it and the 36% remaining don't care. They state "there is no *genuine evidence* to show that such music increases sales by one penny." In the UK, several retail chains never wasted money on built-in canned music. For the rest, piped-in music is getting turned off. By national bookstores and big retail chains like Marks and Spencer since 2015, Gatwick airport, and financial institutions like building societies aka credit unions. Pipedown is now letter

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campaigning to get canned music turned off in hospitals and doctor's surgeries/offices where patient calm and accurate communication are essential.

Companies usually have excuses why noise can't be stopped. It's too expensive. It's too difficult. Those excuses don't work when it comes to providing quiet access for people with functional hearing and cognitive disabilities. Turn off the piped-in background music. Easy. Free.

People with quiet communication needs, from disabilities like hearing loss, tinnitus and hyperacusis, should always have access to public spaces the same as people with mobility or vision disabilities. Discrimination by stores, restaurants, and other public places playing constant background music should end. Not just for an hour at a time.

Referenced websites:

<http://www.abc.net.au/news/2017-11-21/coles-rolls-out-quiet-hour-to-help-shoppers-with-autism/9176272>

<http://pipedown.org.uk/about-pipedown/>

<https://www.cdc.gov/ncbddd/disabilityandhealth/infographic-disability-impacts-all.html>

<http://www.cnib.ca/en/about/media/vision-loss/pages/default.aspx>

Jan L. Mayes, MSc Aud(C) RAud is an international Eric Hoffer Non-Fiction Health Award winning Canadian author, blogger and audiologist specializing in noise, tinnitus-hyperacusis, and hearing health education.

Did you hear that voice? It could be your brain looking for patterns

This study found that, by having people listen to noises while in an MRI, people who experience auditory hallucination are better able to identify intelligible phrases hidden in the noise.

As many as 15% of the population experience auditory hallucinations. This could mean hearing sirens, or a dog barking, or someone talking, when in fact nothing is there. Most people just call this "hearing voices". Most of these people never need to access mental health services. A recent study from Durham University in the United Kingdom looked at the ability of people who experience these hallucinations to detect voices hidden by noise. The researchers, including lead author Dr. Ben Alderson-Day, had voice hearers and non-voice hearers lay in an MRI and listen to recordings that contained people's voices converted into sine wave tones. While these sounds can be understood, it isn't immediately apparent that they are actually voices.

What they found was that people who experience audi-

tory hallucinations were more likely to detect the hidden speech, and noticed the voices faster. Dr. Alderson-Day says that one possible explanation for this is the theory that our prediction of reality affects how we experience and perceive reality. He says that "a lot of the time, what our brain is doing when it's taking in information from the environment around us is making its best guess or prediction, trying to fit a meaningful pattern to those signals that make sense of the world for us. The idea is that maybe for the people who hear voices, actually their brains are doing this more than others. They're looking for meaningful patterns, they're trying to find the signal amidst the noise."

Paper in the journal Brain, "Distinct processing of ambiguous speech in people with non-clinical auditory verbal hallucinations"

<http://www.cbc.ca/radio/quirks/august-26th-2017-1.4260928/did-you-hear-that-voice-it-could-be-your-brain-looking-for-patterns-1.4262383>

Advertising "quiet" makes good business sense

SEATTLE, Jan. 30, 2018 /PRNewswire/ (excerpts) - Boeing (NYSE: BA) and TUI Group, the world's largest tourism business, today celebrated the delivery of the operator's first 737 MAX 8. The cleaner, quieter and more efficient airplane will play a key role in TUI Group's ambition to operate Europe's most carbon efficient airlines.

"The 737 MAX is a great fit for TUI Group, with 14 percent lower carbon emissions and a 40 percent smaller noise footprint," said Monty Oliver, vice president of European Sales, Boeing commercial Airplanes.

LED streetlight conversion

Smart infrastructure like LED streetlights with smart sensors will lay the groundwork for improvements to the way citizens live, work and experience life in Kitchener. The City of Kitchener, Ontario, is converting over 16,000 street lights to LED fixtures that include adaptive controls (smart sensors) that make-up a city wide narrow-band network. These streetlights will transform everyday experiences - from simple things like the ability to brighten and dim the lights to more advanced uses like improved navigation for emergency services, making gas meter data available in real-time and **monitoring sound pressure levels** across the city.

<https://www.kitchener.ca/en/city-services/led-streetlight-conversion.aspx>

The eardrums move when the eyes move: A multisensory effect on the mechanics of hearing

Kurtis G. Gruters, David L. K. Murphy, Cole D. Jenson, David W. Smith, Christopher A. Shera and Jennifer M. Groh PNAS 2018; published ahead of print January 23, 2018, <https://doi.org/10.1073/pnas.1717948115>

Significance

The peripheral hearing system contains several motor mechanisms that allow the brain to modify the auditory transduction process. Movements or tensioning of either the middle ear muscles or the outer hair cells modifies eardrum motion, producing sounds that can be detected by a microphone placed in the ear canal (e.g., as otoacoustic emissions). Here, we report a form of eardrum motion produced by the brain via these systems: oscillations synchronized with and covarying with the direction and amplitude of saccades. These observations suggest that a vision-related process modulates the first stage of hearing. In particular, these eye movement-related eardrum oscillations may help the brain connect sights and sounds despite changes in the spatial relationship between the eyes and the ears.

Abstract

Interactions between sensory pathways such as the visual and auditory systems are known to occur in the brain, but where they first occur is uncertain. Here, we show a multimodal interaction evident at the eardrum. Ear canal microphone measurements in humans ($n = 19$ ears in 16 subjects) and monkeys ($n = 5$ ears in three subjects) performing a saccadic eye movement task to visual targets indicated that the eardrum moves in conjunction with the eye movement. The eardrum motion was oscillatory and began as early as 10 ms before saccade onset in humans or with saccade onset in monkeys. These eardrum movements, which we dub eye movement-related eardrum oscillations (EMREOs), occurred in the absence of a sound stimulus. The amplitude and phase of the EMREOs depended on the direction and horizontal amplitude of the saccade. They lasted throughout the saccade and well into subsequent periods of steady fixation. We discuss the possibility that the mechanisms underlying EMREOs create eye movement-related binaural cues that may aid the brain in evaluating the relationship between visual and auditory stimulus locations as the eyes move.

Visual information can aid hearing, such as when lip reading cues facilitate speech comprehension. To derive such benefits, the brain must first link visual and auditory signals that arise from common locations in space. In species with mobile eyes (e.g., humans, monkeys), visual and auditory spatial cues bear no fixed relationship to one another but change dramatically and frequently as the eyes move, about three times per second over an 80° range of space. Accordingly, considerable effort has been devoted to determining where and how the brain incorporates information about eye movements into the visual and auditory processing streams. In the primate brain, all of the regions previously evaluated have shown some evidence that eye movements modulate auditory processing [inferior colliculus, auditory cortex, parietal cortex, and superior colliculus]. Such findings raise the question of where in the auditory pathway eye movements first impact auditory processing. In this study, we tested whether eye movements affect processing in the auditory periphery.

The auditory periphery possesses at least two means of tailoring its processing in response to descending neural control. First, the middle ear muscles (MEMs), the stapedius and tensor tympani, attach to the ossicles that connect the eardrum to the oval window of the cochlea. Contraction of these muscles tugs on the ossicular chain, modulating middle ear sound transmission and moving the eardrum. Second, within the cochlea, the outer hair cells (OHCs) are mechanically active and modify the motion of both the basilar membrane and, through mechanical coupling via the ossicles, the eardrum [i.e., otoacoustic emissions (OAEs)]. In short, the actions of the MEMs and OHCs affect not only the response to incoming sound but also transmit vibrations backward to the eardrum. Both the MEMs and OHCs are subject to descending control by signals from the central nervous system, allowing the brain to adjust the cochlear encoding of sound in response to previous or ongoing sounds in either ear and based on global factors, such as attention. The collective action of these systems can be measured in real time with a microphone placed in the ear canal. We used this technique to study whether the brain sends signals to the auditory periphery concerning eye movements, the critical information needed to reconcile the auditory spatial and visual spatial worlds.

Leaf and snow blower videos

<https://www.youtube.com/watch?v=wwTJAQGBABk> (showing man blowing leaves)

<https://www.youtube.com/watch?v=uYcwAj5OTnY> (leaf-blower info. from Consumer Reports)

https://www.youtube.com/watch?v=lyYs4Kyg3_E (snow-blower info. from Consumer Reports)

Courtesy of Utopia Pictures

<http://www.utopiapictures.com>, <http://www.youtube.com/user/utopiapictures2007>

Acoustical Society of America's magazine

We are pleased to announce that the spring 2018 issue of *Acoustics Today*, the Acoustical Society of America's magazine, is now on-line at <https://aip-info.org/1ZJV-5IJTC-GKY75H-31IPPZ-1/c.aspx>.

Synopsis: Trapping Large Objects With Sound

A new acoustic trap combines two vortex-shaped sound waves to trap objects up to 4 times larger than is possible with existing traps.

- By Katherine Wright, Contributing Editor for *Physics*

Acoustic traps use sound waves to capture and move an object remotely. But, to date, these traps have only worked for objects smaller than half the wavelength of the trap's sound waves—about 4 mm for the most common trapping wavelengths. Now researchers have gone beyond this size barrier with a new type of acoustic trap. Their approach could be used in applications that require the careful positioning and manipulation of both millimeter- and centimeter-sized objects, such as medical procedures like removing kidney stones.

An object in an acoustic beam experiences a “radiation force” as it scatters sound waves. If the beam is suitably shaped, this force can be used to manipulate an object. In theory, the sound wavelength can be varied to capture objects of different sizes. But the wavelength must be sufficiently short to avoid damaging the hearing of anyone nearby, which limits the sizes of objects in the trap.

In their approach, Asier Marzo and colleagues at the University of Bristol in the UK subject the object—in this case, a polystyrene sphere—to two acoustic beams that are both shaped like vortices but “wind” in opposite directions. The researchers alternately hit the bead with one beam and then the other. This process reverses the orbital motion of a particle as it spirals out of a vortex, “pushing” it back into the trap's center and capturing particles too big to be contained by a single vortex. By tailoring the pulse frequency, the team can trap particles with diameters up to twice the sound wave's wavelength. The same setup also allows them to controllably turn a bead in a circle with fixed rotational speeds.

A. Marzo et al., *Physical Review Letters*, January 22, 2018
<https://physics.aps.org/synopsis-for/10.1103/PhysRevLett.120.044301>

Focus: Aquatic Eavesdropping

- By Mark Buchanan

A structured membrane enhances sound transmission across a water-air boundary, allowing underwater sounds to be heard in the air above.

Communication breakthrough: Researchers have developed a structured material that permits sound waves to pass more easily from water to air or vice versa.

Sound waves mostly reflect back from any water-air boundary, making it nearly impossible to hear underwater sounds from above. But now physicists have devised a structure that, when placed in contact with the surface, can enhance sound transmission up to 160 times, allowing 30% of the sound energy through. The technology could be used to help communications with people underwater or in monitoring ocean environments. With further development, the sound-transmitting materials could lead to more sensitive underwater sound detection.

Sound is partially reflected whenever it encounters a boundary between two substances of different density and sound velocity. It's possible to reduce the reflection—and correspondingly increase transmission—by placing a material with intermediate sound-response properties at the boundary. One such acoustic coupling material is the gel used during a medical ultrasound scan to help sound waves pass from the body into the detector. However, water and air are so different that no common substance has the right intermediate properties.

Researchers led by Sam Lee of Yonsei University in Seoul, South Korea, have now demonstrated an alternative technique: enhance transmission by using a metamaterial—a structure designed to exhibit properties unlike any natural substance. In this case, the structure is a cylindrical shell, or cavity, with a thin, plastic membrane at one end. The membrane is divided into segments by a rigid frame, and a pill-shaped mass is attached to the central segment. When placed at the air-water boundary and hit by an incident sound wave, the structure responds by generating a secondary wave. The team could tailor this secondary wave by adjusting the length of the cavity, the tension of the membrane, and the size of the mass. Based on calculations, they chose a structure whose secondary wave interferes destructively with wave reflection and thereby enhances transmission.

To test this structure, Lee and colleagues experimented with sound propagating through a vertical tube of diameter 30 mm, separated into two compartments by a thin plastic separator. The upper compartment was filled with air, while the lower one contained water. Before adding the metamaterial structure, the team measured the transmission of sound waves from the water side to the air side using waves with frequencies from 600 to 800 Hz. They found that, at all frequencies, only about 0.2% of the wave energy came through.

But with their metamaterial structure in contact with the plastic separator, the boundary let as much as 30% of the

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wave energy through at frequencies around 700 Hz. For other frequencies in the range from 650 to 750 Hz, transmission was also enhanced, though not as strongly. The team stresses that the frequency of maximum transmission can be altered—or even extended to a wide range of frequencies—by changing the membrane tension or by making other adjustments to the metamaterial structure. The team performed detailed numerical simulations that reproduced the observed wave behaviour. They also simulated placing several of their ring structures next to each other, with no overlap, to create an array that could enhance transmission over an extended surface.

Lee and colleagues expect that such metamaterials should find many uses in helping sound travel either from water into air or vice versa. For example, the technology could improve underwater microphones (hydrophones), which are currently about 1000 times less sensitive than microphones that operate in air. One could imagine a hybrid device in which an air microphone is in an airtight cavity surrounded by a metamaterial interface. Placed underwater, the metamaterial would transmit sound waves into the cavity, where they could be picked up by the microphone. The interface, the researchers suggest, would allow underwater sound detection with 10 times the sensitivity of the current best hydrophones.

Metamaterials physicist Ping Sheng of the Hong Kong University of Science and Technology thinks the authors have found an extremely simple solution to the problem of sound transmission across a boundary. “The thing that is surprising is why this was not demonstrated a long time ago,” he says. Daniel Torrent, also a specialist in metamaterials, from the University of Bordeaux in France, thinks this technology could offer a noncontact way to do ultrasound imaging, as the metamaterial could enhance transmission of sound waves from a water-based object of study through the air to a detector.

Physical Review Letters, <https://physics.aps.org/articles/v11/9>

Industrial noise compels Savannah sparrows to change their tune

This article was originally published on *The Conversation*, an independent and nonprofit source of news, analysis and commentary from academic experts. Disclosure information is available on the original site. Author: **Miya Warrington, Adjunct professor in Natural Resources, University of Manitoba**. Canadian Press, January 25, 2018.

Whether in cities or in oil fields, we can often hear the chirps and trills of the birds that share our spaces. But birdsong is more than just a soothing backdrop for our activities, it is a code that birds use to tell other birds about themselves, including details about the singer’s species, identity — and sexiness. Humans, on the other hand, fill the air and land with their own noise, disrupting the communication between birds and other animals. This means that crucial information that an animal uses for hunting, keeping an eye on predators and maintaining contact with mates and group members may be lost. Scientists like me can figure out which aspects of a bird’s life are under threat by listening for changes to specific parts of a bird’s song. Birdsong, in a sense, is a message in a bottle.

Sending an S.O.S.

At first glance, the Canadian prairies may look empty, but the land has been heavily influenced by human activity. It has been developed into farms dotted with infrastructure used to extract oil and natural gas. In North America, grassland songbirds are declining faster than songbirds in any other ecosystem, and activities from energy extraction may further threaten vulnerable species. My colleagues and I recently studied the songs of Savannah sparrows in their grassland habitats in southern Alberta, near Brooks. The area is typical for a rural Canadian prairie farming town, with farms and cattle grazing mixed with native mixed-grass prairie landscapes. We found that the birds adjusted their songs in subtle and precise ways to cope with the noise pollution produced by the machinery set up to extract natural gas and oil.

DuoLingo for Savannah sparrow songs

Bird songs are made up of many notes or syllables, with each one encoding a piece of information about the bird and its personal traits or intentions. In a sample of a Savannah sparrow’s male song, the introductory note alerts the audience, either potential female mates or male rivals, that a performance is about to begin. The clicks, high clusters and trills that follow are an indication of this male bird’s sexiness. The dash syllables are used as a name or individual identifier, and the buzz syllables identify the bird as a Savannah sparrow. As such, a bird’s song contains many types of information, just like song lyrics. A bird may be singing “Hey, hey, sexy, hey, Bob, Savannah sparrow, sexy, sexy.”

Measuring sound

When faced with noise, birds can change their tune so that they’re heard. Measuring song pitch, or frequency, is popular among scientists when they are looking at the effects of noise pollution on birds. Birds may change the pitch of their song to move it outside the frequency range of the encroaching noise to avoid overlap, or they may lower their song pitch so that it can be heard over longer distances. We can also measure tone, which describes how clear or

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INAD 2018 campaign

- By RtoQ member Jeanine Botta

Members of the Right to Quiet Society are observing the 23rd Annual International Noise Awareness Day by writing letters to leaders locally and globally, asking if elected leaders and other prominent individuals plan to observe the day in any way. We offer ideas and suggestions to those who have not made plans, and provide a brief set of links to both academic and mainstream articles about noise and health. Society members began writing letters in March, and will continue throughout the month of April. **This year INAD falls on Wednesday, April 25th.**

The Acoustical Society of America will observe INAD 2018 throughout the month of April with a crowdsourcing data collection project and a YouTube live stream event that includes a panel discussion on noise on International Noise Awareness Day from 11:00 a.m. through 1:00 p.m. Eastern Time. People can join the event from anywhere in the world, and have their questions about noise answered by experts in a variety of related fields. Information can be found at <http://exploresound.org/international-noise-awareness-day-2018>.

Scientist's INAD comment

"There is so much to the soundscape that speaks to people and animals. The soundscape includes sounds made by living things (animals and plants), the Earth (such as wind, water and geology), as well as human-generated noise sources. The acoustic soundscape connects us all. As a scientist, I study animal communication, and the acoustic soundscape holds much information about the animals communicating within it and how they are relating to their habitat. Animals voices themselves hold information about their individual traits, such as sex, breeding status, group dialects and physical states, so listening to their voices allows humans to gauge what is going on in their lives and how we may be affecting them. In some sense, studying their communication may act as a "message in a bottle". Animals are talking, and we should be listening. They have much to say. Understanding and protecting our natural soundscapes will protect the animals living and communicating within them; when they go, our world will fall silent, not just because the voices of living things are gone, but because we ourselves are dependent on these living creatures."

- Miya Warrington, PhD

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whistle-like a syllable sounds to the ear. More tonal syllables sound like a clear whistle and look like a clear line on the sonogram because we (and the birds) are hearing only a small range of pitches at once. Less tonal syllables sound "buzzier" and less whistle-like (like the caw of a crow) and look like a thick band on the sonogram because we are hearing many frequencies at once. Less tonal, "buzzier" sounds make the singer easier to find, while more tonal sounds can be heard at farther distances.

Sounds matter

The infrastructure used to extract oil and natural gas make all kinds of different noises: Low hums, deep rhythmic pulses and high-pitch whirrs. The frequency sounds that overlap with birdsong are the ones that matter most to the birds. In our study, we found that Savannah sparrows sang differently depending on the type of infrastructure nearby. Birds altered their songs mostly at generator-powered screw pumps, but also made song changes at other infrastructure types. Most song changes at the screw pumps were changes to pitch or frequency. Most song changes at natural gas compressors, grid-powered screw pumps and generator-powered pumpjacks were to tonality, changing the way the whistle-like syllables sounded. When infrastructure noise masked the birds' sexy click syllables, the male Savannah sparrows sang them at a higher pitch. They also sang sexy high cluster and trill syllables in a buzzier, less tonal manner. Those changes should have made it easier for female listeners to locate the singing male. These Savannah sparrows also sang the introductory notes of their songs, which attracts listeners, and the buzz syllable, which identifies the bird species, at lower pitches and in a more whistle-like tonal manner. These changes increased the distance at which their song could be heard and likely attracted more listeners.

The message matters

When faced with noise, birds can benefit from changing their songs to restore important or lost information. What that information is, exactly, all depends on what they are trying to communicate. It's not unlike having a conversation at a loud cocktail party; you may repeat your name several times if that's what is important to you at the time. Grassland songbirds are in decline, and although we often think of the Prairies as a quiet place, noise may be contributing to the lower mating success seen in some grassland birds. Even though we know that the birds we heard changed their songs, we don't yet know if it was an effective strategy because that depends on whether the changed song is heard or understood by their audience. It's also possible that the audience will no longer respond to the changes. Our next step is to find out if the Savannah sparrow song changes are effective. We will be playing back modified bird calls to female and male audience members and see how they respond, which in essence, is like talking to the birds themselves.