

## Sounds of Silence

*“Do not speak unless you can improve silence.”*

Anonymous

Lately, I have noticed my fellows and residents listen to music while studying images and dictating reports. I remember, when younger, I used to do the same, but now I crave silence. When writing, editing, or preparing conferences, I prefer to do it in my office, door closed, telephone ignored. When faced with a difficult situation, I wish for the muted silence that follows a snowfall. Some are fond of saying that silence is golden. The word “silence” comes from “silere” (unknown origin and meaning to be quiet or still), which then gave origin to the Latin “silentium” (being silent), and after that the French “silence” (absence of sound).<sup>1</sup>

Silence, or rather the noise that makes it nearly impossible to find, is the topic of *In Pursuit of Silence: Listening for Meaning in a World of Noise* by George Prochnik.<sup>2</sup> Prochnik says America is getting louder and younger generations are becoming addicted to sounds and noise. Noise can serve as a stimulant, but in large doses, it is counterproductive. Noise was abundant during the Industrial Revolution but not as ubiquitous and constant as it is now. These days, background noise is everywhere, from the elevator and the mall, to our cars, homes, and offices. Noise fragments your sleep and makes you feel tired the next day; your heart beats faster, you get vasoconstriction, and though the brain manipulates it to the point where noise becomes “invisible,” your body continues to feel stressed. Sometimes we are forced to choose between noises, one used to disguise another (like wearing your iPod). This is the case with “white noise,” which is generally used to mask other sounds. The term “white noise” is adapted from “white light,” in which the retinal cones for green, blue, and red (the primary colors) are equally stimulated, perceiving light as “white” or colorless. Thus, by extension, white noise is a sound you cannot perceive. White noise is evident in devices such as noise-cancelling headphones, which mask environmental and unwanted sounds (a case of creating noise to abate other noise). Curiously, noise comes in different “colors” such as pink (used as a reference sound), blue (low frequency without spikes), purple (a type of white noise), gray (equally loud at all frequencies), and the so-called unofficial noise colors (black, green, orange, and red).<sup>3</sup> Electricity has its own noise called the “Mains hum.”<sup>4</sup>

With so many different types of noise surrounding us, it is not surprising that some individuals have become “antinoise activists.” Antinoise militants wage battles against dogs barking, vehicle traffic, and airplanes, among other sounds. Dog barking is particularly annoying, and the authorities know this and use it to their advantage. Remember, the Branch Davidians in Waco, Texas, and Dictator Manuel Noriega in Panama were driven out of their sanctuaries with the aid of noise bombardment by way of dogs barking.<sup>5</sup> If wolves, which are the ancestors of dogs, do not bark, why do dogs do it? In his book, *Dogwatching*, the famous and popular zoologist, Desmond Morris proposes this is the result of thousands of years of

selective breeding by humans that have resulted in super barking animals.<sup>6</sup> Nomads use dogs as alarms. Noises of distress, coming from all kinds of animals and humans, are particularly stressful. A British social anthropologist, Sheila Kitzinger, says, “The sound of a crying baby... is just about the most disturbing, demanding, shattering noise we can hear.”<sup>7</sup> Taking advantage of this, the military used nonstop baby crying recordings as torture in the prison at Guantanamo Bay. The most frequent complaint Americans have about their neighborhoods is noise, not crime.<sup>8</sup>

Although as physicians, we may focus on health-related problems induced by noise, the government sees the issue as one related to civil liberties. In 1972, Congress passed the Noise Control Act by which the Environmental Protection Agency was put in charge of studying ways to reduce noise. In 1982, the Office of Noise Abatement and Control was closed. Today, there is an interest in re-establishing the Noise Control office of the Environmental Protection Agency, albeit with a very small budget.<sup>9</sup> The United States is one of the few developed countries in which government has no control over noise. The European Commission on the Environment has issued the European Noise Directive that charges all states to inform the public about the dangers of noise and related issues. Ways to reduce noise have been carefully studied in Europe where cities are smaller and living quarters closer to roads. Noise-induced stress is thought to be responsible for 3% of heart attacks in Germany.<sup>10</sup> Overall, about 45,000 fatal heart attacks occur worldwide as a consequence of noise-induced stress. As population density increases, so does noise. When population density reaches 10<sup>5</sup> per square mile, the average background noise level is about 75 dB (85 dB is considered harmful and may result in permanent hearing deficits).<sup>11</sup> Reductions in noise levels as small as 3 dB can make a difference (remember that the decibel scale is logarithmic).

Biologic effects of noise may be aural and nonaural. Non-aural effects include impairments in communication, sleep, recreation, and performance along with an increased sense of annoyance that leads to cardiovascular disease. Individuals exposed to transportation noise have an increased risk of hypertension and ischemic heart disease.<sup>12</sup> Prisons in which noise is abundant experience higher levels of inmate aggression than quieter ones. Perception of noise is somewhat cultural. For example, the Polish report increased annoyance due to traffic noise compared with Austrians, and people living in Munich are much more annoyed by noise than those residing in Genova.<sup>10</sup> Noise mapping for some major cities is available. A noise map for the city of San Francisco (second in terms population density after New York) indicates the Union Square and Embarcadero zones are the noisiest.<sup>13</sup> The municipality of the city of Paris offers an interactive, 2D and 3D, real-time noise map that presumably helps you to avoid the noisiest parts of La Ville Lumière. Noise maps are not only used in cities but also in smaller environments such as factories to determine their loudest parts. By definition, “noise” is a sound that is loud, unpleasant, unexpected, or undesired.<sup>14</sup> The origin of the word noise is probably from the Latin “nausea,” which means sickness.

The auditory cortex is involved in both processing noise and silence. Recently, it has been postulated that the impulses arrive at the auditory cortex via different pathways.<sup>15</sup> A spe-

cific pathway is turned on when a noise/sound occurs, but to turn it off, we need to stimulate a completely different set of neurons. If that does not happen, we cannot perceive the end of a sound, and our brain has no time to process and understand it. Thus, hearing problems can be due to the fact that we cannot activate the ON or OFF auditory circuits. The ability to hear someone speak to us at a loud party depends on this. A voice needs to be about 15 dB louder (at a distance of 3 feet) than the background noise for our brain to keep the ON circuit working while stimulating the OFF circuit. Once the latter is activated, background noise becomes less intrusive and we can concentrate on what an individual is saying. If we cannot activate the OFF circuit, we will be unable to separate an individual's voice from the background din. For hearing and speech therapists, this is of tremendous importance: instead of devices reinforcing the activity of the ON circuit, devices that activate the OFF circuit may help patients improve hearing.

Silence is critical to comprehension and learning. In 2002, a study of 326 children (mean age, 10 years) who were exposed to airport noise was published.<sup>16</sup> Reading, long- and short-term memory, and speech perception were all significantly affected by noise. Furthermore, with cumulative noise exposure, the children's ability to read worsened. Similar deleterious effects have been found in school children exposed to road traffic noise.<sup>17</sup> Those of us who have learned a new language as adults know silence is critical to understand it. Competing speech and background noise make it very difficult to understand the spoken word.<sup>18</sup> In those instances, we revert to lip reading.

Throughout history, silence has been associated with higher spiritual and intellectual states. Creativity needs silence, and when James Joyce faced writer's block, he wrote to his brother, "No pen, no ink, no table, no room, no time, *no quiet* [italics mine], no inclination."<sup>19</sup> Times of reflection call for silence. Cerebral blood flow increases and neural networks are more efficiently activated during times of silent meditation.<sup>20,21</sup> When compared with the East, we Westerners feel somewhat uncomfortable with silence. This is particularly true in the United States, where even the Apaches and other Native American tribes used silence as means of expressing anger and other negative feelings. In spirituality, silence does not refer to an outside state but rather one of inner peace. Silence is revered in the Christian, Buddhist, Hindu, and Islamic faiths. The gods speak to us by using silence rather than earthly words. Religious individuals are known to take a "vow of silence," and in some monasteries, the night hours are called "great silence" because speaking is forbidden. Not surprisingly, the concept of silence is closely associated with death. Do we better understand silence as we become older because death is closer? Death leads to the ultimate state of inescapable silence. To honor the dead, we generally have a moment of silence. A minute of silence is held during Remembrance Day (November 11 at 11:00 AM) to honor those killed in wars. Every mid-April, a Day of Silence is held to protest against injustices toward gays and lesbians. Silence may be used to mask unspeakable acts (eg, conspiracy of silence, code of silence).

In music, a period of silence is called a "rest" and is considered essential to distinguish between different parts of a composition. Silence in music is used to raise listeners' expecta-

tions about what comes next. Of course, for the sake of shocking audiences, this has been taken to extremes. In 1952, minimalist composer John Cage premiered his 3-act score called *4'33*.<sup>22</sup> This composition, written for any instrument, instructs musicians not to play, and thus the only sounds heard are those arising from the surrounding environment. Of silence, Cage said, "There is no such thing as an empty space, or an empty time, try as we may to make a silence, we cannot." Years later, John Lennon and Yoko Ono wrote a composition that sounds exactly like Cage's and is called "Two Minutes of Silence." The word silence has also been used in innumerable popular songs (eg, "Silent Night," "The Sounds of Silence" [Simon and Garfunkel], "The Silence" [Depeche Mode]).

Complete silence cannot be achieved unless you are deaf. Right now I am typing in a relative silence; the air conditioning hums, the keyboard clicks, I can hear my own breathing. Silence is an essential part of life that I fear is disappearing. As I was lying in bed last night, the idea of silence was so strong that I decided to write this short essay on it. To finish, I quote *The Sounds of Silence*:

"Hello darkness, my old friend  
I've come to talk with you again  
Because a vision softly creeping  
Left its seeds while I was sleeping  
And the vision that was planted in my brain  
Still remains  
Within the sound of silence"

## References

1. Dictionary.com. [www.dictionary.reference.com](http://www.dictionary.reference.com). Accessed July 4, 2010
2. Prochnik G. *In Pursuit of Silence: Listening for Meaning in a World of Noise*. New York: Doubleday; 2010
3. Wikipedia. **Colors of noise**. [http://en.wikipedia.org/wiki/Colors\\_of\\_noise](http://en.wikipedia.org/wiki/Colors_of_noise). Accessed July 7, 2010
4. Wikipedia. **Mains.hum**. [http://en.wikipedia.org/wiki/Mains\\_hum](http://en.wikipedia.org/wiki/Mains_hum). Accessed July 7, 2010
5. Science Dog Network. **BarkingDogs.net**. [www.barkingdogs.net](http://www.barkingdogs.net). Accessed June 3, 2010
6. Morris, D. *Dogwatching*. New York: Crown Publishers; 1987
7. Jerome Goopman. **The colic conundrum**. *The New Yorker*. [http://www.newyorker.com/reporting/2007/09/17/070917fa\\_fact\\_groopman#ixzz0pnMix8TM](http://www.newyorker.com/reporting/2007/09/17/070917fa_fact_groopman#ixzz0pnMix8TM). Accessed June 16, 2010
8. The Right to Quiet Society. **Welcome to peace and quiet**. <http://www.quiet.org>. Accessed June 3, 2010
9. The Free Library by Farlex. [www.thefreelibrary.com](http://www.thefreelibrary.com). Accessed July 7, 2010
10. [www.silence-ip.org/site](http://www.silence-ip.org/site). Accessed July 5, 2010
11. [http://www.hmmh.com/cmsdocuments/PopulationDistribution\\_US\\_FunctionOutdoorNoiseLevel.pdf](http://www.hmmh.com/cmsdocuments/PopulationDistribution_US_FunctionOutdoorNoiseLevel.pdf). Accessed July 7, 2010
12. Babisch W. **Transportation noise and cardiovascular risk: updated review and synthesis of epidemiological studies indicate the evidence has increased**. *Noise Health* 2006;8:1-29
13. San Francisco City-Wide Noise Map. <http://www.sfdph.org/dph/files/EHSdocs/ehsPublDocs/Noise/noisemap2.pdf>. Accessed June 3, 2010
14. The Free Library by Farlex. [www.thefreedictionary.com/noise](http://www.thefreedictionary.com/noise). Accessed June 25, 2010
15. Scholl B, Gao X, Wehr M. **Nonoverlapping sets of synapses drive on responses and off responses in auditory cortex**. *Neuron* 2010;65:412-21
16. Hygge S, Evans GW, Bullinger M. **A prospective study of some effects of aircraft noise on cognitive performance in schoolchildren**. *Psychol Sci* 2002;13:369-474
17. Hygge S, Boman E, Enmaker I. **The effects of road traffic noise and meaningful irrelevant speech on different memory systems**. *Scand J Psychol* 2003;44:13-21
18. Hygge S, Ronnberg J, Larsby B. **Normal-hearing and hearing-impaired subjects' ability to just follow conversation in competing speech, reversed speech, and noise background**. *J Speech Hear Res* 1992;35:208-15

19. Manguel A. *A Reader on Reading*. New Haven, Connecticut: Yale University Press; 2010:20
20. Lazar SW, Bush G, Gollub RL, et al. **Functional brain mapping of relaxation response and meditation.** *Neuroreport* 2000;11:1581–85
21. Short EB, Kose S, Mu Q, et al. **Regional brain activation during meditation shows time and practice effects: an exploratory fMRI study.** *Evid Based Complement Alternat Med* 2007;7:121–27
22. Wikipedia. **John Cage.** [http://en.wikipedia.org/wiki/John\\_Cage](http://en.wikipedia.org/wiki/John_Cage). Accessed July 7, 2010

M. Castillo  
*Editor-in-Chief*

DOI 10.3174/ajnr.A2283