Viola

Debating Decibels: Considering Hearing Protection for Students

by Claire Davis

Hearing protection measures are infrequently discussed—and rarely in earnest—in the string and orchestra worlds, across education and professionally. As far as I know, it is also rarely discussed in band programs. I have personal anecdotes about poor hearing safety conditions, as do musicians I have worked with. One of the stories that first brought hearing protection to my notice as a student was a nightmare situation: Chris Goldscheider, violist, experienced acoustic shock from "an immediate and permanent traumatic threshold shift" caused by the noise (137 dB) in the pit at the Royal Opera House (ROH). Goldscheider sued the ROH in 2016 and won in 2018, at which point the judge determined that his "condition was caused by the ROH's breach of duty under [UK] statutory regulations of control of noise at work," which define "consistently loud sounds" as an "'exposure action value' of 85 decibels." In 2019, the decision regarding the ROH's breach of duty and compulsory hearing protection was overturned on the grounds of impracticability, but the damages paid to Goldscheider were not affected.[B11,B10,B8] The lack of discussion on hearing protection is reflected in popular literature. I did not find any articles from *Strings Magazine* that mention "hearing protection," "ear protection," "aural protection," or "ear plugs"/"earplugs"; and *The Strad* has two articles in addition to coverage of the Goldscheider lawsuit.[B9] Hearing protection has also not been discussed in past MNSOTA articles. From educational to professional environments, it is the norm that hearing protection is not often considered, and that practical safety measures are infrequently implemented or normalized.

Let's also define our terms. In physics, sound is described using:[B3]

- Frequency: Lol, we know this one. The pitch of a sound. Measured in Hertz (Hz).
- Intensity: "Average rate of energy transmission per unit area perpendicular to the direction of propagation of the wave"—that is, how fast the sound wave varies the atmospheric pressure. Measured in watts per square meter and decibels (dB).
- Loudness: A sound with a fixed intensity is perceived as variably loud at different frequencies. Determined statistically and measured in phons.

Unfortunately, I did not find studies that looked at intensity and loudness in student orchestras specifically. In an informal experiment, I recorded decibel levels throughout a student orchestra's rehearsal using the app Sound Meter from Coolexp, which I selected based on the 4.7-star rating and the fact that it is free. I recorded data from the back of the room for logistical reasons, about a yard behind the horns and basses. The volume ranged from 55 to 91 dB with an average of 80.67 dB and a median of 84.5 dB; the median being slightly greater than the mode indicates that much of the data sit closer to the upper end of the range. Let's contextualize these numbers. Sound Meter and *Encyclopedia Britannica* provide noise level reference tables (Figure 1).

Frequency and intensity combine to determine how loud we perceive a sound. For example, I noticed at several points during the rehearsal that some 90-dB intensities seemed louder than others (e.g., partial orchestra at *fortissimo* vs. *tutti* orchestra at *fortissimo* with accents). Further, my data were measured from the *back* of the room. In the viola section in front of the brass, for example, I am certain the intensity—and therefore the loudness and potential impact on hearing—would be higher. How we experience sound is important to keep in mind when implementing hearing protection solutions (e.g., which instruments produce the highest frequencies and intensities, how the loudness of a given intensity can be reduced).

What are hazardous sound levels? The National Institute for Occupational Safety and Health (NIOSH) recommends "exposure to 85 dB (A-weighted) levels for no more than 8 hours a day. Every 3 dB correlates to a doubling in power…, which means that for every 3-dB increase, the recommended 'safe' listening interval halves."

Figure 1. Noise level reference table (combined from Sound Meter and *Encyclopedia Britannica*) with highlighted range from informal experiment with a student orchestra.

Decibel (dB)	Examples
180	Space shuttle lift-off
130	Jet engine at 30 meters, amplified rock music
120	Threshold of pain, thunder
110	Rock music, car horns, loud orchestral music (in audience)[B3]
100	Blow dryer, electric saw
90	Diesel truck, power tools, bus or truck interior
80	Busy street, alarm clocks, car interior
70	Busy traffic, vacuum cleaner, average street noise, loud telephone bell
60	Normal conversation at 1 meter, business office
50	Quiet office, quiet street
40	Quiet residential area, park
30	Quiet room, whisper
20	Ticking watch; mosquito; rustling leaves; radio, TV, or recording studio
10	Breathing, almost quiet, soundproof room

Therefore, at *88 dB, the limit is 4 hours; at 91 dB, 2 hours*; at 110 dB, 30 seconds; and 120 dB, 7 seconds.[B6] As such, hearing protection needs to be seriously considered for students and recreational musicians, as well as professional musicians, who are regularly exposed over the long-term to the intensity of a symphony orchestra, other ensembles, and even individual instruments. A poster on Reddit observed, "Whenever I practice my clarinet I always get a notification on my watch saying the sound level has reached 90 decibels, so I figured I should probably protect my hearing since I'm practicing daily."[B5] Sound from a violin's f-hole can reach 100 dB, and a viola's sound intensity is likely similar.[B1] As such, NIOSH recommendations can apply to both individuals and student orchestras. We would all benefit from awareness beyond singular rehearsals or practice sessions to total daily exposure while listening to, practicing, and performing music.

What are some solutions? First, earplugs. Mixed reports have contributed to earplugs' ambivalent reputation in the past and a common resistance to wearing them. It is generally agreed among health professionals and researchers that earplugs are effective at reducing sound intensity, especially with training for how to secure a proper fit.[B7] This includes earplugs designed for musicians, called uniform attenuation earplugs (UAEs): "UAEs are filtered earplugs designed to provide linear attenuation (reduction of sound) with a set level of attenuation across a wide frequency range, typically from 125–4000 [Hz]… [UAEs] result in higher quality ratings and greater 'clarity' of music by listeners compared to traditional earplugs."[B7] There is now "a wide range of premolded earplugs… in different designs, styles, and price categories."[B4] In addition to correct fitting, "consistent use is equally important to achieve actual protection. In this regard, consistent use strongly benefits from a general positive attitude with respect to hearing protectors."[B4]

Earplugs require an adjustment period for the user to relearn how they perceive characteristics of musical sound and respond with the intended result (e.g., how loud is *piano* vs. *mezzopiano* both from the ensemble and the individual's instrument), and the physical sensation of earplugs may feel uncomfortable for some users.[B12] Aural disorientation and consequent stress are understandable: hearing with earplugs is a different experience from hearing without them. Interestingly, there is also evidence of the opposite experience: "some musicians report that HPDs [hearing protection devices] designed for music help to improve the sound quality of music by improving the clarity of sound. As high sound levels result in distortion in the inner ear, hearing protectors could improve sound quality for high music levels."[B7] Furthermore, a 2015 study demonstrates that the user's experience varies based on the earplug's design.[B4] It is worth a sustained attempt to adjust—on the individual *and* the social-ensemble levels—and explore which options work for a given individual. Additionally, if students are familiarized with their hearing experience with earplugs from an earlier point, the challenge of the adjustment may be reduced.

In addition to the use of and increased access to musician earplugs, a 2020 report from the World Health Organization makes 5 recommendations for hearing protection: sound level reductions, educational (public health) campaigns, regulations and standards, occupational sound limits for individuals working in music environments, and increased research to evaluate best practices. The report also states that "social norms are more important than personal attitudes in predicting HPD use. Therefore, any intervention to increase the use of hearing protection in social environments needs to work to address social normative behavior."[B7] Another researcher makes a similar observation about the impact of awareness and social behavior in regard to sound level reductions:

> "Ensemble sound energy is a direct reflection of what the teacher is doing. This suggests that there is a behavioral way to manage the amount of sound energy generated during playing activities… Ensemble directors and conductors must be prepared to educate students about this from a young age… to know how to manage ensemble behavior and to train future professional musicians who are going out to the world with this kind of knowledge and expertise."[B12]

Using existing UK regulations as a guide, the judge who decided the Goldscheider case noted similar opportunities for protective measures: risk assessment of performance spaces, ensemble configuration that reduces impact on musicians, monitoring of noise levels, and promptly making adjustments in response to complaints.[B10] These changes could also be implemented on an individual level as well, e.g., in practice spaces. Additionally, acoustic shields, combined with ensemble configuration (i.e., risers, more distance, especially where the intensity is highest), are an option to protect from sound from behind (though not from the sides, front, or one's own instrument).[B2] A 2015 article in *The Strad* provides a compact list of the above protective measures as well as several interesting additions, including humming: "humming immediately before and during a loud sound like a cymbal crash will offer significant protection… This is due to the stapedial muscle in the middle ear which, when contracted during the hum, partially blocks loud sounds from getting through to cause damage."[B1]

Implementing and normalizing hearing protection is an important consideration for student and recreational musicians, as well as professional musicians. In addition to the practicality of preserving the sense most often used in music performance, teaching hearing protection would teach students to value, pay attention to, and advocate for their health. In any environment, this is a critical skill.

Claire Davis is a recent graduate with a Master of Music in Viola Performance, during which she studied with Dr. Molly Gebrian. As a strings educator, she has taught String Project group classes, private lessons in viola and violin, and orchestra and chamber classes.

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Earplugs

These resources are not personal recommendations. I came across them while researching this article.

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iEatPothos. "Earplugs for musicians?" *Reddit* (r/ConcertBand). Accessed March 13, 2025. https://www.reddit.com/r/ConcertBand/comments/14wtnf9/earplugs_for_musicians/
Recommendations include Earasers, Decibullz Noise Cancelling Earplugs, Apple AirPod Pros Gen 2 in transparent mode. Original poster mentions Loop.

"Musician's Earplugs," Berklee College of Music. Accessed March 13, 2025. https://college.berklee.edu/mpe/etymotic-musicians-earplugs

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Recommendations include Minuendo, Etymotic ER20XS, and Loop.

Sudso110. "SINGERS!! Help with ear protection." *Reddit* (r/musicians). Accessed March 13, 2025. https://www.reddit.com/r/musicians/comments/zssnfj/singers_help_with_ear_protection/
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