

HEARING LOSS IN CLASSICAL ORCHESTRA MUSICIANS

Alberto Behar¹, Frank Russo², Marshall Chasin³ and Stephen Mosher⁴

¹SMART Lab., 350 Victoria Street, Toronto, ON, Canada, M5B 2K3, behar@sympatico.ca

²SMART Lab., ³Musicians' Clinics of Canada, ⁴National Ballet of Canada

1. INTRODUCTION

Quian et al. performed a noise exposure survey on members of the National Ballet orchestra, using noise dosimeters. They concluded that the exposure normalized for the 360 hr./year of musicians' activities with the orchestra is below the hazard level of 85 dBA. As a follow-up to the survey it was decided to perform hearing tests to the members of the orchestra. A questionnaire was also conducted to gather information on particulars of the surveyed members.

2. QUESTIONNAIRE

Musicians were assured that the questionnaire will be anonymous: no names were gathered nor included, something essential to the participants, due to the nature of their occupation. In addition to basic questions concerning demographics, questions were asked about the musician's principal instrument (some participants play more than one), the duration of exposure through practice and performance and exposure to other sources of noise.

Because of the small number of participants involved, musicians were divided in five groups according to their respective locations on the orchestra floor (See Figure 1) and similarity of the spectral profile of the sound they generate. Groups were as follows: Group 1 (Violins); Group 2 (Violas/Cellos); Group 3 (Woodwinds); Group 4 (Brasses); Group 5 (Percussion & Double Bases).

3. AUDIOMETRIC ASSESSMENT

After completing an audiological history and otoscopic examination a full audiometric battery including middle ear assessment was performed on all participants. Air conducted and bone conducted audiograms were obtained using a clinical audiometer with 5 dB steps. All measurements were conducted in a sound treated audiometric booth Speech testing (word recognition scores and speech reception thresholds), and admittance measures (tympanometry and acoustic reflexes) were also part of the evaluation. The results of the test were explained to each musician and a range of hearing loss prevention strategies, including the use of uniform attenuation earplugs was discussed.

4. RESULTS

4.1 Noise Exposure

Normalized $L_{ex,8hs}$ noise exposures levels were calculated and shown in Table 1 below.

<u>Group</u>	<u>Average</u>	<u>St. Error</u>
1	86.5	0.8
2	86.8	0.3
3	89.8	0.8
4	92.7	0.5
5	89.0	0.5

Table 1: Normalized Average and Standard Error noise exposures.

4.2 Questionnaire

Forty-four of the 52 musicians completed the questionnaire (85%). Twenty-one of the 44 respondents were female (48%). Average age of males was 51.7 years (SD = 11.1), while average age of females was 48.7 (SD = 9.9). Average age of participants was reasonably matched across the five groups.

Table 2 shows the numbers of years participants were playing in general and professionally. An analysis-of-variance (ANOVA) determined that the groups did not differ with respect to the length of their exposure.

<u>Groups</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
Average playing	41.8	35.6	40.4	38.6	32.5
Average playing professionally	26.0	23.9	31.5	29.9	22.8

Table 2: Years of Playing

The majority of respondents reported listening to music through a speaker system (40). Many will also use earbuds with portable listening systems (21). Very few listen through circumaural headphones (5). Participants do not normally limit themselves to only one music listening device.

Finally, relatively few respondents reported involvement in noisy activities (9). However, it should be noted that a proper definition of "noisy activity" was not provided.

4.3 Audiometric Results

Figure 2 shows the average audiometric pure tone test results for the musicians. On average the data suggest only a slight to mild mid to high frequency sensory-neural hearing loss in the 4000-6000 Hz region. This is consistent with hearing losses observed in the earlier stages of other forms of noise exposure.

4.4 Measured and predicted hearing losses

The ISO 1999 Standard predicts hearing loss at different frequencies for males and females, according to age and the number of years of exposure at a given noise level. The algorithm presents the percentages of the population in 5% intervals.

Figure 3 shows the measured and calculated hearing losses for orchestra musicians. It may be observed that there are practically no differences between measured and calculated hearing losses at 3000, 4000, and 8000 Hz. Although the difference at 500 Hz is likely due to background noise in the audiometric booth, there is no obvious explanation for differences at 1000 and 2000 Hz. In any case, the differences between measured and predicted losses do not exceed the limits of measurement accuracy.

5. DISCUSSION

Pure tone audiometry showed that threshold varied as a function of instrument group and frequency region. Brasses and percussion/basses had the highest thresholds, bordering on clinically significant losses in the 4000-6000 Hz region. These differences across groups could not be explained by age, years of playing, or years of playing professionally, and are thus most likely due to differences in occupational noise exposure. Brass players had the highest noise exposure level (10 dB or greater than strings and woodwinds between 4000 and 8000 Hz). This finding is consistent with other noise-exposure surveys and audiometric investigations which raises some concern about long-term hearing health of brass players. Nonetheless, it is important to acknowledge that at the time of testing, none of the groups had hearing loss that would be considered outside the limits of normal hearing.

Noise exposure levels in the orchestra, normalized to 360 hr/year were below the hazard limit of 85 dBA with the exception of the brasses. Longer playing times will increase the risk. It seems reasonable to recommend that orchestras comparable to the National Ballet Orchestra adopt a Hearing Conservation Program (e.g., NIOSH, 1998), and that linear ear-plugs be considered for those orchestra members that are exposed to higher noise levels. On the basis of the current study, it appears that such interventions may be most necessary among brass players.

REFERENCES

- Quian, C., Behar, A., Wong, W.: Noise exposure of musicians of a ballet orchestra. *Noise & Health*, Jan-Feb 2011, 13:50, 59-63.
- ISO 1999 (International Organization for Standardization) (1990). Acoustics—Determination of occupational noise exposure and estimation of noise-induced hearing impairment. ISO TC/43 N1139. Revision of ISO 1999:1990. Second CD March 2010.
- NIOSH (National Institute for Occupational Safety and Health) (1998). NIOSH criteria for a recommended standard: occupational noise exposure, revised Criteria 1998. DHSS(NIOSH) Publication No. 98-126. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health.

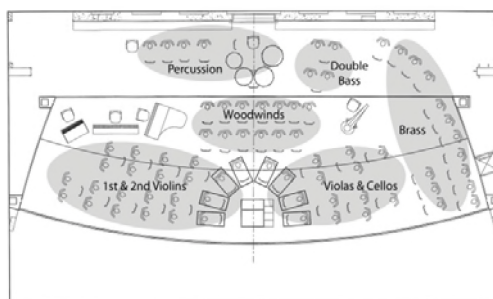


Figure 1: Location of the instruments groups on the orchestra floor

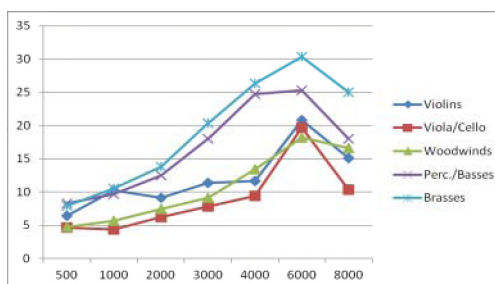


Figure 2: Average hearing loss of the different groups.

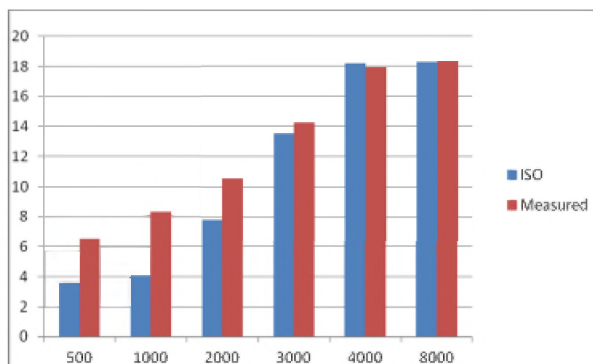


Figure 3. Measured and predicted hearing losses (as per ISO 1999) in dB.