Noise Exposure of Opera Orchestra Players

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1. INTRODUCTION

There is an abundant literature concerning the noise exposure of classical orchestra players. These studies assess risk of hearing loss of musicians playing in concert hall, using results from measurements of noise exposure levels and the hearing threshold of the musicians. Most of these studies deal with orchestra players playing in a concert hall. Most conclude that the musicians are not overexposed and do not experience significant hearing loss (E.g., see Eaton and Gillis, 2002; Kahari et. al., 2001).

However, for musicians playing in an orchestra pit, as in the case of opera and ballet, their noise exposure is expected to be higher due to the confined space of the pit. A study of the Finnish National Opera concluded that most musicians were over exposed, contrary to the studies performed in concert hall (Laitinen et. al., 2003).

The objective of this study is to examine the noise exposures of orchestra players from the Canadian Opera Company (COC) during rehearsals and performance of two operas, Madama Butterfly by Puccini and The Italian Girl in Algiers by Rossini.

2. METHOD

A survey was conducted on 73 musicians Measurements of L_{eq} were taken during either a rehearsal, .a dress rehearsal or a performance, which takes about three hours. L_{EX} was then calculated by normalizing the L_{eq} for a one-year exposure, assuming that the duration of their activity with the company is 300 hr,

We performed the measurements using five Quest Type Q-300 dosimeters. The "Slow" setting and A-weighting were used. The range was set to measure between 40 and 110 dBA. The microphone was attached on the shoulder of the musician as far as possible from the head to minimize sound reflections, according to the procedures in the CSA Standard Z107.56 – 94.

The noise exposure criterion adopted in this study was a daily 8 hours exposure limit of 85 dBA and a 3 dB exchange rate. This criterion is used by the Federal Government and several provincial agencies in Canada, as well as by the International Standard Organization (ISO).

3. RESULTS

3.1 Average L_{eq} of different musical instruments

Table 1 shows the averages of L_{eq} obtained from different instruments in the two operas. In general, highest noise exposure was found among the brass, followed by the woodwinds, and then the strings. The conductor has one of the lowest exposures among the musicians.

Comparing the two operas, higher noise exposure was measured in Madama Butterfly. A factor that appears to increase noise exposure is the proximity of the brass and woodwind section. For example, the second violins were the only instruments that have higher noise exposure in The Italian Girl in Algiers, as they are positioned in front of the woodwinds in this opera, and far from the brass and woodwinds in Madama Butterfly.

	Madama Butterfly	**The Italian Girl in Algiers**
Violin 1	84.8	82.8
Violin 2	85.7	86.5
Viola	88.3	85.8
Cello	88.7	81.4
Double Bass	88.2	83.7
Trumpet	93.7	91.4
Trombone	90.3	N/A
Horn	91.7	89.9
Piccolo / Flute	91.7	87.4
Clarinet / Base Clarinet	88.6	86.8
Oboe / Bassoon	88.3	84.6
Percussion	87.6	79.8
Cymbal	87.4	N/A
Conductor	83.3	81.3
Total	89.3	86.4

Table 1. Average L_{eq} of instruments

3.2 Average L_{EX}

According to the Personnel Manager of COC, the musicians play for 300 work hours per year for that company. The normalized yearly noise exposure level (L_{EX}) was calculated using the formula $L_{EX} = L_{eq} + 10 \log t/T$ (1), where t = 300 and T = 2000 (the yearly equivalent of a daily work period of 8 hours, used in the ISO document).

Table 2 shows the L_{EX} of different instrument after averaging the L_{eq} between the two operas. The L_{EX} of all instrument groups is below the safety limit 85 dBA. Therefore, we can conclude that the musicians are not at risk of noise-induced hearing loss from playing in the COC.

	Average L_{eq}	L_{EX}
Violin 1	83.9	75.7
Violin 2	90.0	81.8
Viola	87.3	79.1
Cello	86.4	78.2
Double Bass	86.3	78.1
Trumpet	92.7	84.5
Trombone	90.3	82.1
Horn	90.9	82.7
Piccolo / Flute	90.0	81.8
Clarinet / Base Clarinet	87.8	79.6
Oboe / Bassoon	86.9	78.7
Percussion	85.2	77.0
Cymbal	87.4	79.2
Conductor	82.4	74.2
Total	88.1	79.9

Table 2. Average L_{EX} of different instruments

4. DISCUSSION

The noise exposure obtained in this study considers only the activity of the musicians with the COC, i.e., rehearsals, dress rehearsals and performances. Individual rehearsals, and activities with other companies were not taken into account. Although the noise exposure was found to be below the safety limit, the combination of other activities could result in exposure higher than the limit, posing risk of hearing loss.

We recommended that a hearing protection program be instituted where musicians are made aware of the potentially hazardous noise levels, provided with hearing protection (musician earplugs), and educated about the care and use of earplugs. In addition, musicians should undergo bi-annual audiometric tests to ensure that the hearing protection measures are effective and that their hearing has not deteriorated.

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