

FACE THE MUSIC: A BEFORE AND AFTER STUDY OF THE HEARING ACUITY OF CLASSICAL MUSIC STUDENTS

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Since the implementation and enforcement of the European Union Physical Agents Directive (Noise) the Acoustics Group has collaborated with the Royal Academy of Music creating the noise team formed from administrators, scientists, and senior management. Our challenge was to allow these highly talented artists to practice, rehearse, and perform safely during their time at the Royal Academy of Music. This ten year project involved more than 3000 musicians measuring sound exposure of each instrument group and the hearing acuity of every student, as well as hearing surveillance of a sample of graduates. At each occurrence the students were questioned as to their aural environment. The paper will focus upon the hearing acuity of 185 graduates after studying music for a period of four years.

Keywords: Hearing loss, classical music, audiometry

1. Introduction

Performing artists must be able to practice, rehearse, and perform safely. With respect to hearing and the “noise” of performance however, the nature of their work and the dedication of performers themselves may mean that they are placed in a difficult position when complying with EU Directive controlling noise at work regulations. Since 2008, with the enforcement of the Control of Noise at Work Regulations 2005 (HSE, 2005) [1] in the UK, hearing health surveillance is necessary for any employee at risk of high noise exposure in the entertainment industry. Being at the forefront of classical music education, the Royal Academy of Music decided to start the implementation of a health surveillance programme and to continuously collect data on the hearing acuity of their music students. This paper presents the results of retesting the students at the end of their course.

2. The Approach

The Royal Academy of Music took an inclusive view whereby every new student had to compulsorily take an automated audiometric screening test during the first week of his or her studies at the Academy (Fresher’s week). This has resulted in more than 3000 have being tested during this ten year study [2]. The retest takes place at the beginning of their last term, so as not to interfere with final examinations, a sample of 185 students were randomly selected. In addition, a one-to-one interview was held with each student, as well as an otoscopic examination and feedback on the health surveillance results.

The test was based on a pure-tone air conduction Bekesy test (frequencies 500 Hz to 8 kHz), using Amplivox automated screening audiometer with TDH49 audiocups. The test was conducted in the audiometric soundproof booths at the Acoustic Laboratory of London South Bank University (LSBU); see Figure 1. Both booths used met the criteria given in ISO 8253-1:2010 [3]. Once the test and questionnaire was completed, each audiogram was categorised according to the Health and Safety Executive (HSE) categorisation scheme [1]. Students receive a copy of their audiogram with the original being sent to the Academy for their records. Results were discussed individually with each student and advice has been given on protection from sound exposure, including advice on most suitable hearing protection option based on the instrument played.



Figure 1: Audiometric booth and audiometers response button and Audiocup headphones.

Table 1: Health and Safety Executive hearing categorisation scheme.

<i>Category</i>	<i>Calculation</i>	<i>Action</i>
1 ACCEPTABLE HEARING ABILITY Hearing within normal limits	Sum of hearing levels at 1, 2, 3, 4 and 6 kHz.	None
2 MILD HEARING IMPAIRMENT Hearing within 20 th percentile. May indicate developing NIHL.	Sum of hearing levels at 1, 2, 3, 4 and 6 kHz. Compare value with figures given for appropriate age band and gender.	Warning
3 POOR HEARING Hearing within 5 th percentile. Suggests significant NIHL.	Sum of hearing levels at 1, 2, 3, 4 and 6 kHz. Compare value with figures given for appropriate age band and gender.	Referral
4. UNILATERAL HEARING LOSS	Difference in the sum of hearing levels at 1,2,3,4 kHz of each ear > 40 dB	Referral
5 RAPID HEARING LOSS Reduction in hearing level of 30 dB or more, within 3 years or less. Such a change could be due to noise exposure or disease.	Sum of hearing levels at 1, 2, 3, 4 and 6 kHz.	Referral

3. Results

The results of the study can be divided into three parts. The first is the questionnaire responses, the second the audiometric screening categorisation and the third the hearing loss analysis.

3.1 Questionnaire Results

The students were selected to be retested based on a 10% random sampling size each year. As the students were only retested at the end of their course only six years of students were studied, a population of 1850 students, hence the sample consisted of 185 students.

Of these 185 students the average age at entry to the Royal Academy of Music was 19.2 years, and hence on exit the average age was 22.7 years. This matches the entry tests taking place in Sep-

tember and the exit tests in April of each academic year and each course taking four years. The gender split was found to be 50:50 with 92 males and 93 females. The breakdown of instrument group is shown in Figure 2. The random nature of the sample allows a representative spread of instruments with strings, woodwind, piano and brass have significant number of students.

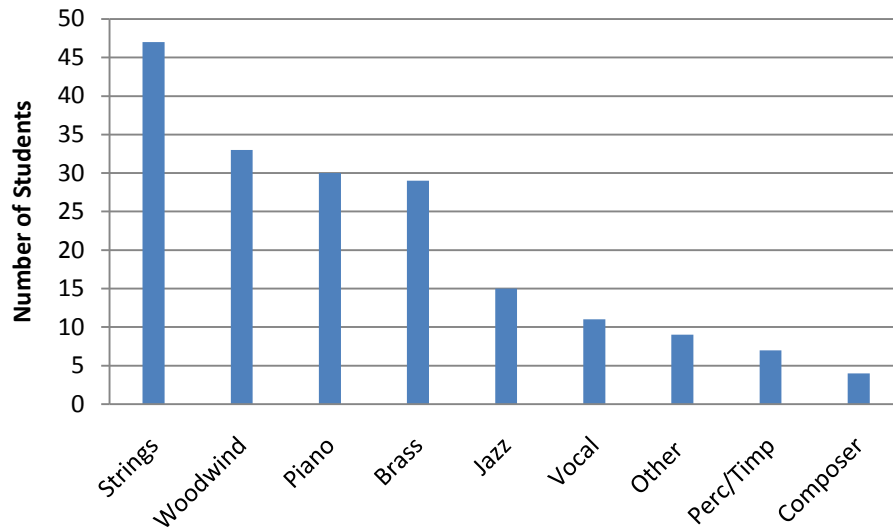


Figure 2. Number of students retested with regard to Instrument Group

The Royal Academy of Music expressed their concern for the students hearing outside their life at the conservatoire. Hence Figure 3 shows the perceived noise level of their commute, with the average commute time 40.7 minutes for the Entry students and 47 minutes for the Exit students. As is normal practice first year students stayed in nearby halls of residence hence reducing the commute time. However, 41% of the Exit students were exposed to noisy environments see Figure 3, such as London Underground [4], where 85 dBA is commonly found. These noise levels were in addition to that exposed to at the Academy.

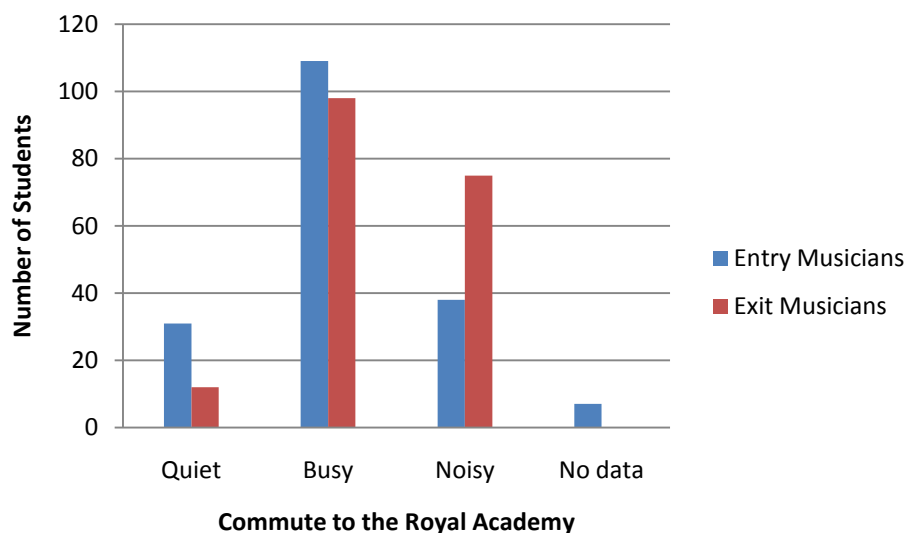


Figure 3. Self recorded noise experienced by the students on their commute.

At the Royal Academy the students explained that they practiced solo on averaged 3.1 hours per day upon entry to the conservatoire. This increased to 3.2 hours per day for the Exit students. The breakdown of the total hours played is shown in Figure 4. It should be noted that difference instru-

ment groups practiced for different lengths of time, but averaged out as 4.8 hours on entry and 5.3 hours on exit.

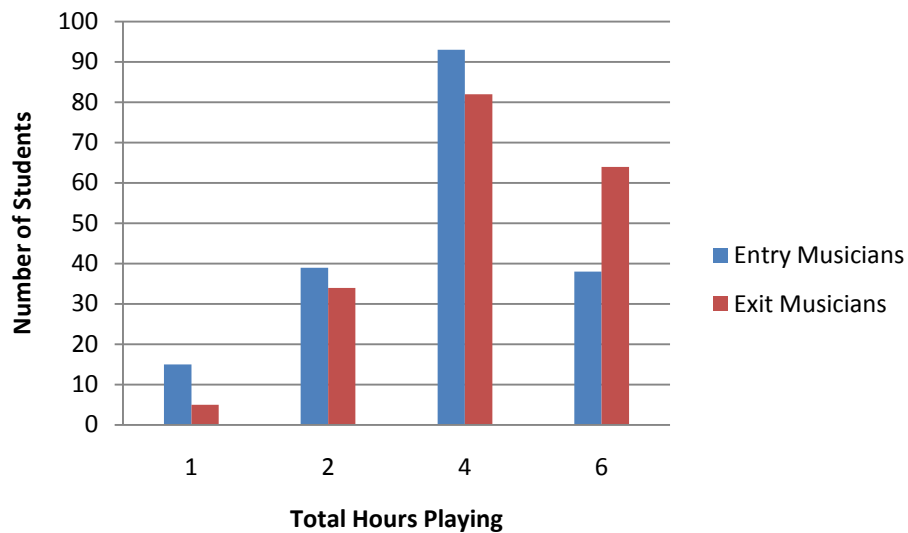


Figure 4. Total hours played by the students

As to the life outside the Academy the students were asked about their attendance at concerts, in bars and in nightclubs. As would be expected concert attendance went up for the Exit students, where as frequency of visits to bar and nightclubs were significantly reduced, see Figure 5.

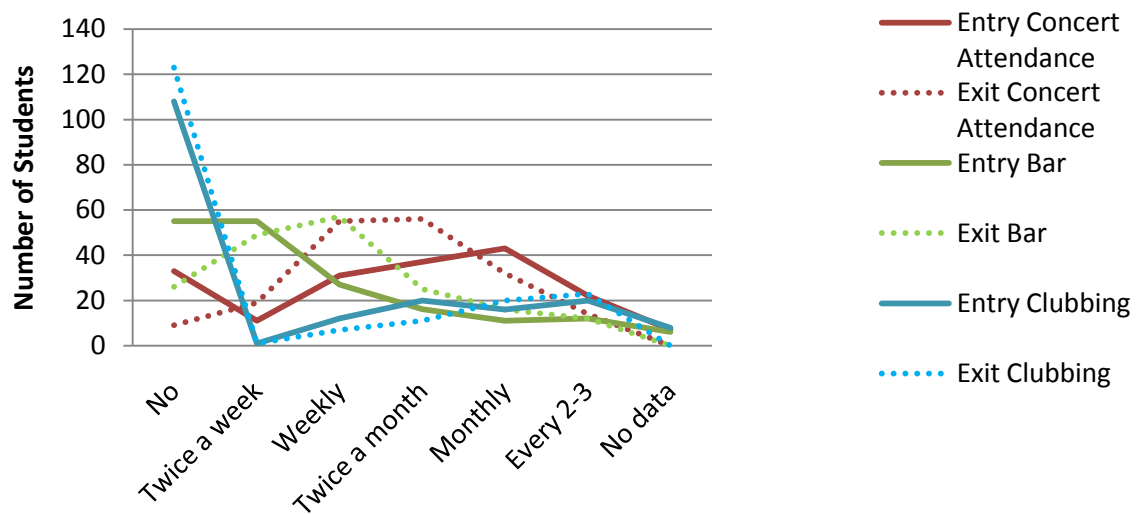


Figure 5. Attendance at Concerts, Bars and Nightclubs by Entry and Exit Students

The prevalence of hearing protection was reported as increasing over the course of their time at the Academy. At the beginning of their course 50 students had earplugs; this increased to 78 for the Exit students, 42% of the total. It should be noted that since 2015 all Royal Academy of Music students receive musicians' earplugs free of charge.

3.2 Hearing Loss Categories

The audiograms of each student were averaged across all frequency ranges, 500 Hz to 8 kHz, for each ear, as well as categorised according to the Health and Safety Executive scheme, see Table 1. Figure 6 shows the categories of the entry and exit students for the left and right ears.

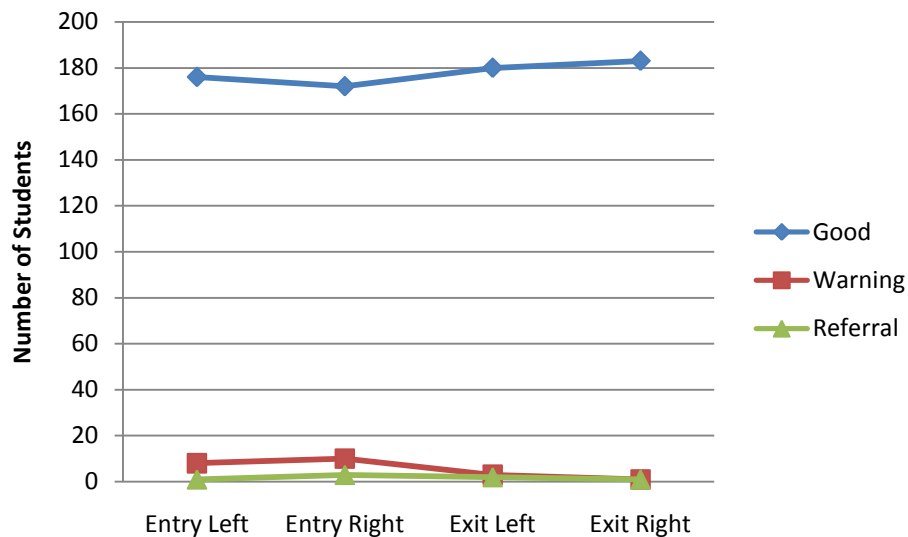


Figure 6. Health and Safety Executive Hearing Category for the Entry and Exit Students

It can be seen from Figure 6 that there was a slight increase in the number of students with a ‘Good’ hearing category for both the left and right ears, although more so for the right ear. It should be noted that three Exit students had unilateral hearing loss rather than the two on entry. The reason for the unilateral loss was found to be ‘Angelic’ hearing in one ear compared to only a ‘Good’ hearing in the other, giving rise to a significant difference in hearing acuity between the ears. ‘Angelic’ hearing was a new unofficial category introduced by the author of the study due to the number of music students with negative hearing losses.

Overall 98.9% of the Exit students had ‘Good’ hearing compared to 92.9% of the Entry students. It should be remembered that it is expected that 80% of people should have ‘Good’ hearing based on ISO 1999:2013 [5].

3.3 Hearing Loss Results

The audiograms of all 185 students were compared by averaging each frequency, 500 – 8000 Hz for the Entry and Exit students for the left and right ears.

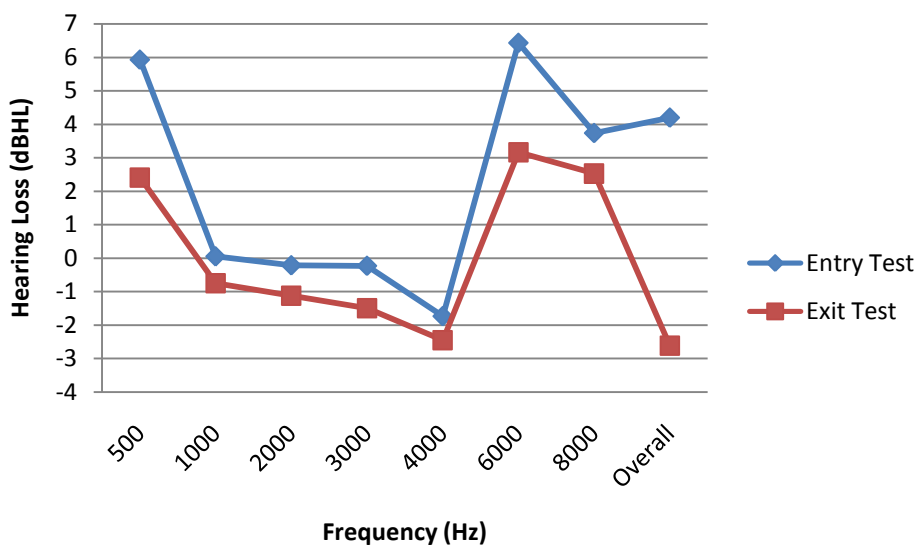


Figure 7. Averaged hearing loss per frequency for the Left Ear of the Entry and Exit students

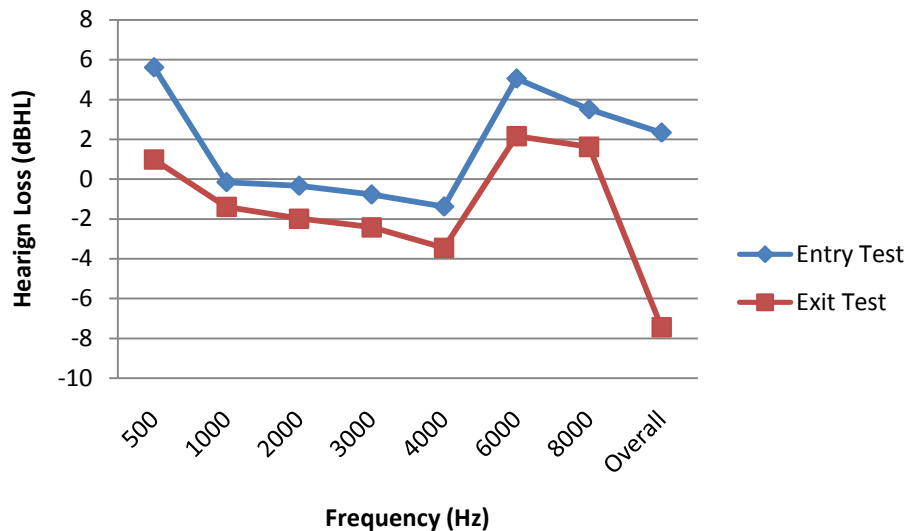


Figure 8. Averaged hearing loss per frequency for the Right Ear of the Entry and Exit students

It can be seen from Figures 7 and 8 that for both ears of the Exit students there was an improvement in hearing results across all frequencies. The left ear hearing loss was reduced from 4.2 dBHL on average to -2.6 dBHL, a 6.8 dB improvement. This was repeated for the right ear with an averaged hearing loss improvement of 9.3 dBHL, an averaged entry loss of 2.3 dBHL compared to a -7.1 dBHL at Exit over the 1000- 6000 Hz frequency range.

This result can be explained by the fact that a screening audiometric test, based on the Bekesy method, is essentially a listening test. The hypothesis is that listening is exactly what the students of the Royal Academy of Music have been perfecting over 3.5 years and hence have improved their results. This could be tested with a more objective measurement approach such as otoacoustic emission tests.

4. Conclusions

Since 2007, the Royal Academy of Music has been following a management policy to assess the hearing acuity of the musicians at the start of their career. Results of more than 3000 hearing tests revealed that music students have excellent hearing and less hearing problems than those of general population and same age despite their, already accumulated, hearing exposure. Of the 3000 hearing tests, 185 have been retested on completing their course.

The results of the questionnaire suggest the students work harder at the Academy at the end of their course increasing their music playing on average by 0.5 hours, to 5.3 hours per day. Their sound exposure is also increased by a 7 minute longer commute, 47 minutes on average. There attendance at concerts increased and their attendance at bars/clubs was reduced. Earplug use increased by 56%, although this was still only 42% of Exit students.

The hearing acuity of Exit students was extremely high, 98.9% of students with ‘Good’ hearing, compared to an excellent 92.9% at entry. When all 185 students audiograms were averaged for each ear the Exit students had an increased hearing acuity, approximately 9 dBHL over the five frequencies analysed. As an automated screening audiometer is essentially a listening test, there is a need to have an objective test, such as one base don otoacoustic emissions to identify any early signs of hearing loss amongst these most dedicated and talented professionals.

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