

## Ear-Protection Project Military Music

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### Introduction

The recent introduction of customized hearing protection devices at Austrian military music did not yield satisfactory results. Musicians complained about subjectively negative aspects like 'fudged' sound as well as hard-to-estimate dynamics, loudness and intonation of their notes respectively sound (source: Tyrolean military music, 2002).

Positive summaries on hearing protection were obtained on following aspects:

1. Useful for technical practises with multiple musicians practising simultaneously.
2. Useful for playing forte passage while marching, especially in close proximity of drums.
3. Useful for drum practise, as far as dynamics are not permanently fudged.

International studies [2] show that most musicians are willing to accept or use suitable hearing protection only in case of increasing hearing impairment.

As a matter of principle, studies in other countries [4, 5, 6] so far did not document noise exposure during practises, although this can be seen as essential in the context of behavioural prevention [3].

### Methods

The observation study covered here was conducted with three representative Austrian military orchestras. Originally there were 146 participants, of which 129 filled out standardised questionnaires containing multiple items about handling, usage, application and acceptance of their personal hearing protection.

First, the participants were informed about aims and procedures of the study; afterwards each participant undertook an otoscopy and an audiometry.

Three months later a second set of questionnaires designed to ascertain the exposure time of each participant were handed out and explained in detail.

To detect the level of exposure, 103 musicians belonging to three different military orchestras were evaluated. They were given the task to record their personal sound exposure times over the period of eight weeks. The records were subdivided in three categories named 'hall', 'chamber' and 'outdoor'. In every category there are three ensemble levels called 'alone', 'group' and 'whole orchestra' as well as three loudness levels for 'loud', 'normal' and 'quiet' pieces. Every

musician was then asked to assign exposure times to the resulting 9 respectively 27 combinations; afterwards the sound pressure levels were measured for every possible combination and thus the weekly noise exposure level for every musician calculated. Musicians playing two or more instruments were omitted for this part of the study.

Every participant was equipped as a basic principle with customised hearing protection ELACIN containing standard filters ER-9. Additionally every band had access to a pool of ER-15 and ER-25 filters. ELACIN is a soft, individual otoplasty providing different acoustical damping depending on the type of filter applied. Unblurred hearing is achieved by a highly linear frequency dependence of the damping filters. The three different types of filters are easily replaceable and interchangeable.

At the end of the introductory phase (two months after providing hearing protections) another meeting was held and a questionnaire containing items about usage of ELACIN ER-9. A second survey about ELACIN ER-9, containing comparative data about ER-15 and ER-25 took place in September 2007; the analysis of this data was done with SPSS and is yet unfinished.

### Results

The project showed that raised noise exposure levels of the musicians are statistically significant regarding the risk of hearing impairments. Of the 146 musicians involved, 27 got their departments instructed to file for work-related hearing impairments after conducting audiometries and calculating noise exposure levels (One musician filed before the study took place).

Instrument	Musicians	Evaluated Weeks	Exposure level	Deviation
Trumpet	26	190	95,8	5,4
Horn	25	171	96,8	3,1
Trombone	11	88	94,9	4,0
Clarinet/Saxophone	20	137	95,0	3,5
Tuba	5	33	93,5	3,8
Piccolo Flute	1	7	92,3	2,1
Percussion	15	112	95,0	5,4

**Table 1:** Noise exposure levels

Analysing the data regarding the average age of impaired musicians and the respective instruments played is yet unfinished.

The Austrian Social Insurance for Occupational Risks AUVA has acknowledged four cases of work-related hearing impairment on musicians between 1997 and 2007.

While calculating the weekly noise exposure levels a total of 738 weeks was evaluated; the average levels are shown in table 1. Compared with the SUVA experienced data regarding orchestra musicians, the numbers for brass instruments are comparable.

The first questionnaire on contentedness of the participants while using ELACIN ER-9 yielded following results (in extracts):

At what places did you subjectively feel noise exposure to be high? (128 answers)

- outdoors: 1,6%
- hall: 14,8%
- chamber: 12,5%
- outdoors and hall 21,9%
- outdoors, hall and chamber 22,7%
- outdoors and chamber: 1,6%
- hall and chamber: 25,0% an.

Did you use hearing protection before the start of this project? (128 answers)

- No: 81,3%
- Yes: 3,1%
- Otoplasty: 10,9%
- Plugs: 2,3%
- „Alpine“ hearing protection: 2,3%

Musicians' hearing protection is a good way to protect myself from hearing impairment: (128 answers)

- Strong agree: 49,2%
- Agree: 31,3%
- Neither: 12,5%
- Disagree: 4,7%
- Strong disagree: 2,3%

For how long did you use ELACIN ER-9? (126 answers)

- More than a month: 43,7%
- One to four weeks: 30,2%
- Less than a week: 26,2%

At which places did you predominantly use your hearing protection? (127 answers)

- outdoors: 14,2%
- hall: 18,9%
- chamber: 15,0%
- outdoors and hall: 21,3%

- outdoors and chamber: 4,7%
- hall and chamber: 14,2%
- outdoors, hall and chamber 11,8%

The hearing protection used in this study was evaluated as follows:

Body sounds amplified by hearing protection are disturbing while playing music (128 answers):

- Strong agree: 25,8%
- Agree: 31,3%
- Neither: 23,4%
- Disagree: 11,7%
- Strong disagree: 4,7%
- No answer: 3,1%

Secondary noises of the instruments (e.g. flaps) are disturbing (128 answers):

- Strong agree: 10,9%
- Agree: 25,8%
- Neither: 23,4%
- Disagree: 21,1%
- Strong disagree: 11,7%
- No answer: 7%

The occlusionary effect (own voice is perceived louder and seemingly 'in the head') is disturbing (128 answers):

- Strong agree: 32,8%
- Agree: 35,9%
- Neither: 18,8%
- Disagree: 8,6%
- Strong disagree: 0,8% (1 person)
- No answer: 3,1%

Did the hearing protection blur or fudge sound perception? (128 answers)

- Strong agree: 20,3%
- Agree: 28,1%
- Neither: 25,8%
- Disagree: 19,5%
- Strong disagree: 5,5%
- No answer: 0,8%

Is the air pressure adjustment / pressurisation of brass instruments hindered by hearing protection? (128 answers):

- Strong agree: 10,9%
- Agree: 18,0%
- Neither: 23,4%

- Disagree: 21,1%
- Strong disagree: 19,5%
- No answer: 7,0%

Does the reduced perception of dynamic range (while using hearing protection) affect my playing music? (128 answers)

- Strong agree: 33,6%
- Agree: 30,5%
- Neither: 20,3%
- Disagree: 7,0%
- Strong disagree: 6,3%
- No answer: 2,3%

Does wearing a hearing protection affect the correct intonation? (128 answers)

- Strong agree: 25,0%
- Agree: 22,7%
- Neither: 27,3%
- Disagree: 12,5%
- Strong disagree: 7,8 %
- No answer: 4,7%

Is tone colour affected in a negative way when using hearing protection? (128 answers)

- Strong agree: 26,6%
- Agree: 31,3%
- Neither: 20,3%
- Disagree: 14,8%
- Strong disagree: 6,3 %
- No answer: 0,8% (1 person)

I did not find playing together with other instruments difficult while wearing hearing protection? (128 answers)

- Strong agree: 9,4%
- Agree: 15,6%
- Neither: 33,6%
- Disagree: 25,0%
- Strong disagree: 16,4 %

The damping value of the filter employed was (122 answers):

- Too low: 4,9%
- Low: 7,4%
- Just right: 63,9%
- Strong: 19,7%
- Too strong: 4,1%

Hearing protection causes disturbing resonances inside my head (128 answers):

- Strong agree: 14,8%
- Agree: 18,0%
- Neither: 30,5%
- Disagree: 19,5%
- Strong disagree: 12,5 %
- No answer: 4,7%

I did not find comprehending verbal commands to be difficult? (128 answers):

- Strong agree: 29,7%
- Agree: 37,5%
- Neither: 15,6%
- Disagree: 16,4%
- Strong disagree: 0,8 % (1 person)

Using hearing protection proved to be a simple task (128 answers):

- Strong agree: 65,6%
- Agree: 28,1%
- Neither: 3,9%
- Disagree: 1,6%
- Strong disagree: 0,8 % (1 person)

Is the noise damping linear over the whole frequency range? (128 answers):

- Strong agree: 24,2%
- Agree: 42,2%
- Neither: 21,9%
- Disagree: 8,6%
- Strong disagree: 3,1 %

Wearing a hearing protection feels comfortable (128 answers):

- Strong agree: 43,0%
- Agree: 33,6%
- Neither: 18,0%
- Disagree: 3,1%
- Strong disagree: 2,3 %

Does the character of tones remain unchanged? (128 answers):

- Strong agree: 10,9%
- Agree: 18,8%
- Neither: 33,6%
- Disagree: 21,1%

- Strong disagree: 15,6 %

I think I could get better accustomed to using hearing protection in the future (128 answers):

- Strong agree: 21,9%
- Agree: 29,7%
- Neither: 25,8%
- Disagree: 11,7%
- Strong disagree: 10,9 %

I don't think I'll ever get accustomed to a hearing protection (127 answers):

- Strong agree: 11,0%
- Agree: 11,8%
- Neither: 29,9%
- Disagree: 20,5%
- Strong disagree: 26,8 %

In what kind of situation would voluntary use of hearing protection be feasible? (128 answers)

- Orchestra rehearsal: 4,7%
- Marching: 17,2%
- Solitary (technical) practise: 3,9%
- Register rehearsal: 1,6%
- Never: 5,5%
- Other: 5,5%
- Orchestra rehearsal and marching: 28,1%
- Orchestra rehearsal and solitary practise: 1,6%
- Orchestra and register rehearsal: 3,9%
- Orchestra rehearsal, marching and solitary practise: 3,1%
- Orchestra rehearsal, marching and register rehearsal: 9,4%
- Orchestra rehearsal, marching, solitary practise and register rehearsal: 4,7%
- Marching and solitary rehearsal: 4,7%
- Marching and register rehearsal: 2,3%
- Solitary practise and register rehearsal: 0,8% (1 person)
- Marching and solitary practise and register rehearsal: 2,3%
- Orchestra rehearsal, solitary practise and register rehearsal: 0,8% (1 Person)

In a summary: The level of noise exposure is on average significantly raised and thus stating a health risk that has in some way to be met according to Austrian regulations (VOLV: By-law on noise and vibrations). Apart from choosing the right hearing protection and coordinating

organisational measures technical labour protection is requested to minimise noise exposure to musicians.

To improve results of noise exposure calculations, we are currently planning to equip some musicians with personal noise dosimeters and to analyse their data over an extended period of time. Thus the correct relative part of the abovementioned 27 'noise situations' could be determined far more easily. Data should be especially accurate for instruments with only a few musicians (e.g. piccolo flute) and for conductors. The employment of further labour-psychological strategies seems to be necessary to improve acceptance, motivation and usage of hearing protection. As there are no technical improvements to be expected in the near future, the potential of personal voluntary use has to be put forth.

## Discussion

During the actual project the question about optimised usage of customised hearing protection was raised. The technology level is already very high and there are no imminent technical improvements to be expected, so it seems to be far sensible and promising to focus first on technical and organisational noise reduction measures, second on behavioural effects and behavioural prevention of musicians to reduce long-time hearing impairments. A complementary labour-psychological strategy with a focus on awareness of these issues as well as practical usage of hearing protection is recommended.

Specific internet pages, e.g. BGIA for testing the personal level of noise exposure (including information for musicians about which kind of noise reduction is most suitable for his instrument and playing profile, as well as comparisons between different kinds of hearing protection, e.g. bracket plugs for rehearsal and otoplasty for concert, and weekly noise exposure levels with or without hearing protection) are a viable approach, but cannot entirely replace the personal discussion with a labour medic or psychologist.

## References

- [1] Erfahrungsbericht der Militärmusik Tirol – Jahr 2003
- [2] Laitinen H.: Noise health 2005- Factors affecting the use of hearing protectors among classical music players (Finnish Institute of Occupational Health, Department of Physics – Helsinki Finland)
- [3] Mendes MH, Morata TC, Marques JM.: Rev Bras Otorrinolaringol (Engl Ed) 2007- Acceptance of hearing protection aids in members of an instrumental and voice music band. (University of Cincinnati, USA)
- [4] Axelsson A, Lindgren F.: Factors increasing the risk for hearing loss in 'pop' musicians (Scand Audiol.1977)
- [5] Laitinen HM, Toppila EM, Olkinuora PS, Kuisma K.: Appl Occup Environ Hyg. 2003 – Sound exposure among the Finnish National Opera personnel ( Department of Physics, Finnish Institute of Occupational Health, Helsinki, Finland)

- [6] Zober A. Zentralbl Bakteriologie Mikrobiologie Hygiene 1984 –  
Noise—a stress factor in occupational and other  
environments.