

ROAD TRAFFIC CONTROLLERS AND THE USE OF LEVEL DEPENDENT HEARING PROTECTORS

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Constant, clear radio and voice communication is of crucial importance in safe working conditions for traffic controllers. The provision of electronic, level dependent, sound-restoration ear muffs would seem to offer an ideal solution to a working environment where the daily noise exposure is below the regulated level but frequently experiences periods of high continuous and impulsive noise. This report shows that careful thought and good consultation with the intended users must occur before these devices are introduced and accepted into the workplace

INTRODUCTION

Electronic, level-dependent hearing protectors designed for use in areas with occasional high level impulsive noise, have been recommended and readily available on the market for many years (Berger: 2000). With the inclusion of 'environmental' microphones that allow the immediate work environment of the wearer to be clearly monitored ('*sound-restoration ear-muffs*' (ISO/TR 4869-4)) and the inclusion of radio communication connectivity in many devices through the development of improved technology, there should be an increasing use of these devices seen at workplaces. However from anecdotal evidence this does not seem to be the case.

Having previously seen the successful use of this type of hearing protectors in a difficult work environment, such as firing ranges (Williams 2011), the authors decided to see if uses could be extended to similar workplaces. That is workplaces where intermittent loud noise, continuous and/or impulsive, is interspersed with periods of lower noise and where for safety purposes good communication must be maintained. One area where these characteristics are common is with traffic control personnel who are responsible for maintaining smooth and safe traffic flow in and around large civil construction sites.

METHOD

Participants were recruited from amongst individuals who work for a company which contracts to supply trained, experienced operators responsible for traffic flow and control on or around various active, large construction or work sites. In total there were 12 full participants, ten males, one female and one undeclared, the average age of the ten who supplied their age was 48 years with an age range of 21 to 63 years. Ethical approval was provided by the Australian Hearing Human Research Ethics Committee.

Participants were asked to wear a *350 dBadge Personal Sound Exposure Meter* (a dosimeter) manufactured by Casella, UK, for at least one typical work shift during participation in order to ascertain what could be considered a typical day's

noise exposure level ($L_{Aeq,8h}$) for the traffic control tasks carried out. All measurements were carried out in accordance with the relevant sections of AS/NZS 1269.1 (2005).

The work group from which the participants were drawn undergo regular workplace health and safety training and toolbox talks including the use and application of hearing protectors. Participants were supplied with a well-known brand of electronic, level dependent, sound-restoration, communication earmuffs. The sound level from the internal earphones in these ear muffs was variable, according to the desires of the user, but capped to an upper limit of 82 dB, A-weighted, sound pressure level, for both audio input from a radio or environmental sound from external microphones mounted on the ear-cups. The passive attenuation of the devices was appropriate for the situation meeting the requirements of international standards (ISO 4869) with an SNR of 31 dB.

Participants were rostered for working in and around large civil construction sites where there was an intermingling of construction activity such as: road construction machinery; excavation equipment; and pavement breaking and cutting operations; together with traffic movement from heavy vehicles, cars, trucks and buses.

Individuals were encouraged to use the hearing protectors as often as possible during the trial between March and July 2011 particularly while wearing the dosimeter. At the conclusion participants were requested to fill out a questionnaire (see the Appendix) that had been developed during previous such trials (Williams 2011).

Data and statistical analyses were carried out using the commercial statistical package Statistica[®] by StatSoft Pacific.

RESULTS AND DISCUSSION

Dosimetry results

Satisfactory noise exposure readings were only available from three dosimeters for the duration of the day's 'noisy' work. The mean $L_{Aeq,8h}$ was 81 dB with exposures ranging from 78 dB to 84 dB. These are below the $L_{Aeq,8h}$ exposure

standard for noise of 85 dB for any Australian jurisdiction. Within the working day noise levels for individual events (L_{Aeq}) varied between lows of around 65 dB to highs of around 95 dB – the dosimeters recorded one minute L_{Aeqs} for a minimum of seven hours. The maximum L_{Cpeak} s recorded were around the 135 dB, just below the peak exposure standard for noise of 140 dB. While these levels do not exceed the regulated levels they do not represent ‘safe’ levels under the recommendations of the WHO (1980) ($L_{Aeq,8h}$ less than 75 dB) but rather a level of acceptable risk.

Periodic exposures to such high noise at levels less than the exposure standard are capable of producing auditory fatigue and/or temporary threshold shift (TTS) (Sataloff and Sataloff 1987). For workers responsible for the safe movement of traffic in and around large work areas communication is very important whether by radio or face-to-face (Robinson and Casali 2000). For this reason the use of a level-dependent, sound-restoration, communication noise-excluding headset, such as those supplied during this project, would seem to offer an advantage over uncovered ears. The results from the applied questionnaire (see Appendix) indicate that this was not necessarily the case for both groups who self-reported a hearing loss and those who did not.

Questionnaire results

Twelve completed questionnaires were received from the participants. Analysis of the four hearing health and hearing protector use questions were:

QUESTION	YES	NO
Do you think you have a hearing loss?	6	6
Do family/close friends ever say they think you have a hearing loss?	3	9
Do you have trouble hearing conversation in background noise?	6	6
Do you ever experience tinnitus (ringing/buzzing in ears)?	6	6
Do you like wearing hearing Protectors?	5	7
What is your preferred style of hearing protector?	Plugs (4)	Muffs (8)

Except for the specific points discussed below there were no statistically significant differences with respect to questionnaire responses at the $p = 0.05$ level, between those who self-reported a hearing loss and those who did not.

Analysis showed that there were statistically significant positive correlations ($p < 0.05$) between increasing age and: self-reported hearing loss; self-reported tinnitus; family and close friends reporting that they thought that the individual may have a hearing loss; and the dislike of wearing hearing protectors. There was also a significant difference with feelings of stress. In general most people felt stressed when wearing hearing protectors however, those who self-reported a hearing loss felt more stressed when wearing hearing protectors than

those with no self-reported loss ($p = 0.016$). Those who self-reported no hearing loss felt less stressed when wearing the earmuffs under trial than those who self-reported a loss - indicated by a lower ordinate value in Figure 1. Self-reported hearing loss has been shown to be a reliable indicator of a measurable loss (Williams and Purdy 2008) with individuals who self-report showing an average measured loss of 26 dB.

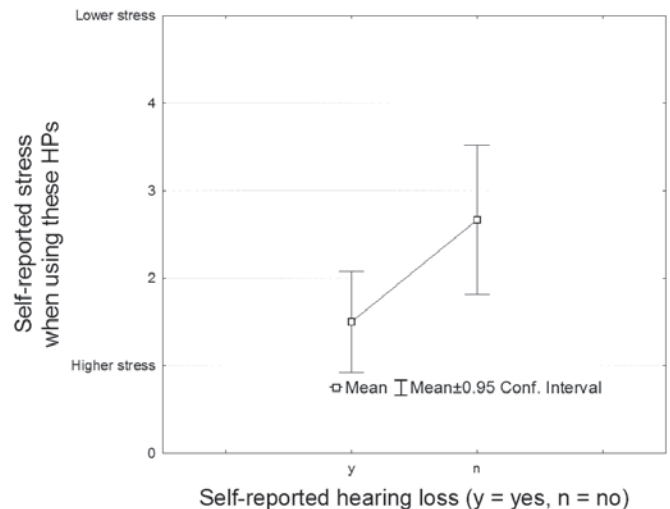


Figure 1. This graph shows a statistically significant difference ($p = 0.016$) between the self-reported stress of those individuals who self-reported a hearing loss (y) and no hearing loss (n). A lower score implies higher stress.

In general, on the negative side, the results from the questionnaire survey showed that the traffic controllers do not like wearing hearing protectors and find them uncomfortable to wear even for short periods. They also find that hearing protectors put excess pressure on their ears; increase feelings of isolation; interfere with some work tasks; and are a bit of a hassle to carry and wear. Those with a self-reported hearing loss felt more isolated while wearing the issued protectors than those without a self-reported loss and they also found it harder to converse with others. On the positive side the issued protectors: were easy to fit and use; facilitated talking to others while eliminating unwanted noise; made it a bit easier to hear wanted sounds; and facilitated talking to others.

The response to the question on the percentage of wear time while what the user thought was ‘loud noise’ varied widely with a mean of 33% and a standard deviation of 18%. The wear time on a typical work day was estimated to average around 55 minutes with a standard deviation of 74 minutes.

GENERAL

The main outcome of the project was that the traffic controllers did not like using the communication, level-dependent sound-restoration ear muffs supplied. It was expected, as has been observed in other workplaces (Williams et al. 2002; Rabinowitz et al. 2007), that individuals may not necessarily be favourably disposed to wearing hearing protectors in workplaces where the noise levels are considered by workers to be relatively ‘low’, 80 dB for example, when

compared to areas where noise levels would be considered high, such as 95 to 100 dB. However it was anticipated that the issued hearing protectors would be more acceptable given that they had external microphones to enhance situational awareness. They also had inbuilt radio communication and some included Bluetooth® connectivity. These apparent advantages were not of sufficient advantage to encourage users to substantially increase their wear time.

Hearing protector use has also been observed to be underutilised in ‘low noise’ work environments, as in the case of the current trial, where exposure levels are at or below the regulated level of 85 dB (Rabinowitz et al. 2007). Rabinowitz reported that in areas of low or intermittent loud noise where the use of hearing protectors can interfere with communication users are more likely to remove or be reluctant to use hearing protectors in preference for what they perceive as better communication. Users in high noise areas where noise exposure is perceived as a greater hazard tend to be more conscientious with the use of hearing protectors.

Previous experience with workplaces involving high level impulse noise exposure from firearm training, showed that similar electronic, level dependent, sound restoration hearing protectors were well accepted (Williams 2011). The advantages of level dependent, environmental microphones and radio and Bluetooth® communication apparently did not outweigh the perceived disadvantages of wearing the headset in the ‘noise’ environment of the traffic controllers. The implication here, being that from the perspective of the wearer the advantages offered through the use of the hearing protector need to be greater than the disadvantages for the devices to be willingly worn.

The limitations of the outcomes of this study arise mainly from the difficulty of recruiting and maintaining active participants. Thus the relatively small number of participants does restrict the wider interpretation of the results.

CONCLUSION

This trial revealed that electronic, level-dependent sound-restoration hearing protectors that have application and acceptance in particular workplaces may not necessarily be useful in all workplaces even if conditions may appear similar. It would seem that the advantages from using such devices must outweigh the disadvantages and that careful thought and consultation with the users must occur before their introduction to the workplace.

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APPENDIX

Electronic hearing protector questionnaire

Date: _____ Age: _____

Gender: _____ Job: _____

Typical duties: _____

- 1) Do you think you have a hearing loss? Y/N
- 2) Do family/close friends ever say they think you have a hearing loss? Y/N
- 3) Do you have trouble hearing conversation in background noise? Y/N
- 4) Do you ever experience tinnitus (*ringing/buzzing in ears*)? Y/N
- 5) Do you like using Hearing Protectors? Y/N
- 6) If NO why?
- 7) What is your preferred style of hearing protectors? *Plugs or Muffs*?






8) What percentage of the time you are exposed to loud noise would you wear hearing protectors? 0 _____ 100%

9) About how long you generally wear hearing protectors each day when you work? 0- ½ hour ½-1hr
1-2hrs 2-3hrs 3-4 hours 4+ hours

10) Do you have any comments or suggestions about hearing protectors? (e.g if you could design the "perfect" HP, what would it be like?)

11) What is your opinion of the 'electronic' hearing protectors you used?

Tick the box representing your thoughts about your protectors

	No 		Don't know 		Yes 
a) They are comfortable to wear for up to 1 hour	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) They cut out unwanted noise	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c) They are easy to put on/fit properly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d) It is a hassle to carry/wear them	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e) I am less stressed at work when I wear them	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f) I need to make lots of adjustments while I am wearing them	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g) They allow me to concentrate better at work	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h) They are time consuming to fit/adjust	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i) They put a lot of pressure on my ears	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
j) They interfere with face-to-face communication	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
k) They help me to hear the sounds I want to hear	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
l) I feel isolated from co-workers when I wear them	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
m) They interfere with my work tasks	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
n) It is easier to talk with others when I wear them	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
p) They are easy to use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
q) They are comfortable to wear all day	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>