

Effect of hearing protection use on musician performance and experience

Preliminary results

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Use of the funds, challenges and outcomes

The funds were used to

- hire a research assistant to recruit participants and run the experiments,
- compensate participants for their time (15\$ per session)
- tuning the piano before the experiments.

The main goals of the project were achieved but we experienced delays as the ethics approval process took several months. We submitted our application in October 2018 but it was only approved in the Spring 2019. Given that the schoolyear was over, we had difficulties recruiting participants and had to wait until September to run the experiments. We decided to focus on pianists only for this first study. Future work will include other instrumentalists and increase the compensation to attract more participants.

This project did not result in publications yet. We had submitted an invited abstract to ICSV2019 but had to withdraw it given the delays in running participants. We anticipate writing at least one journal publication on this study and hope to apply for further funding to extend it to other instruments, particularly chamber music ensemble as we anticipate hearing protection to affect musicians' interaction.

Annelies Bocksteal moved back to Belgium in the spring, but I (CG) am exploring collaborations with her and her former collaborators at Université de Montréal and ETS (including CIRMMT members) to continue this line of research with experts from the field of Audiology.

Introduction

Professional musicians are often exposed to noise levels that exceed occupational exposure limits and thus face the risk of noise-induced hearing loss (Thom, et al., 2005). While there some disagreement in the literature as to whether incidence of noise-induced hearing loss is in fact higher among musicians than among the general population, there is no debate that the risk of hearing loss can be reduced by use of hearing protection. While standard foam earplugs tend to distort the spectral information perceived by the wearer, a variety of specialized musician earplugs have been designed with the aim of providing the wearer with undisturbed sound quality—an obvious concern for the professional musician. Despite advances in hearing protection technology, however, numerous studies have found use of hearing protection devices among professional musicians to be low and inconsistent (Laitinen, 2005; Laitinen & Poulsen, 2008; Zander, et al., 2008; Jansen, et al., 2009; O'Brien, et al., 2014).

The questionnaire studies cited here reveal that musicians' chief concern is the effect of hearing protection use on performance. Few studies, however, have looked at quantitative changes in performance with hearing protection. Those that have indicate that changes in performance are sensitive to additional factors like instrument type and performance setting (Cook-Cunningham,

2017; Kozlowski, et al., 2011; Rawool & Buang, 2017). This is not to say that quantitative measures are somehow more valid than subjective experience of performance. For example, if acoustic analysis reveals no difference but musicians report greater effort required to perform with hearing protection, this increased effort could present a barrier to consistent use. Thus, future studies should take both qualitative and quantitative aspects into account in order to better understand the effect of hearing protection on performance.

With the aim of better understanding the effect of hearing protection use on musician performance, the present study has three main objectives. First, to analyze changes in musician performance with and without hearing protection. Second, to explore how musicians subjectively perceive differences in performance and in effort required to perform with and without hearing protection. Third, to investigate if changes in performance as seen in the performance analysis and subjective perception of performance be linked to acceptance of hearing protection. For this first study, we focus on piano performance using a Disklavier so that we can collect MIDI data for analysis.

Methods

Seventeen pianists participated in the experiment. Five were professional musicians and 12 music students. Participants were first asked to fill out a questionnaire about their attitude toward hearing protection (Pre-questionnaire). They were then provided with 2 sets of new earplugs: a pair of generic foam earplugs, and a pair of musician earplugs designed to preserve sound quality with a flat frequency response (Etymotic ER-20).

In the first block of the experiment, participants performed a short excerpt (1 to 2 min) of a musical piece of their choice, repeated twice in 3 different conditions: 1) open condition with no earplugs, 2) while wearing foam earplugs and 3) while wearing musicians earplugs.

In the second block of the experiment, participants were be asked to sight-read two short excerpts, one from the standard repertoire (Chopin prelude) and a less familiar piece (Poulenc), in the same 3 conditions. The order of presentation of conditions was counterbalanced across participants in each block. After each condition, participants filled out a short questionnaire about the experience performing in this condition (Post-questionnaire).

MIDI-data was collected for each performance and we analyzed the velocity over time for each pianist and excerpt using Rstudio.

Preliminary results

Different trends were observed among participants. The majority of participants exhibited some form of occlusion effect: they performed louder with the foam earplugs than with the musicians earplugs, which in turn was louder than the open condition (see Fig.1). But this effect was much stronger for the novel pieces (when sight-reading) than for the familiar excerpt. For the excerpt they knew well, only 3 participants exhibited this occlusion effect. This suggest hearing protection affects sight-reading but that when playing familiar pieces, pianists can adjust to keep the same velocity than without hearing protection. Other musicians used less dynamic range in the hearing protection conditions that in the open condition (see Fig. 2) or did not exhibit differences across playing conditions. Further analysis will look into:

- The experience of the pianists as measured with the post-questionnaire.

- The attitude and the previous experience of the participants with toward hearing protection, as measured with the pre-questionnaire.
- The relationship between these individual factors and their performance.

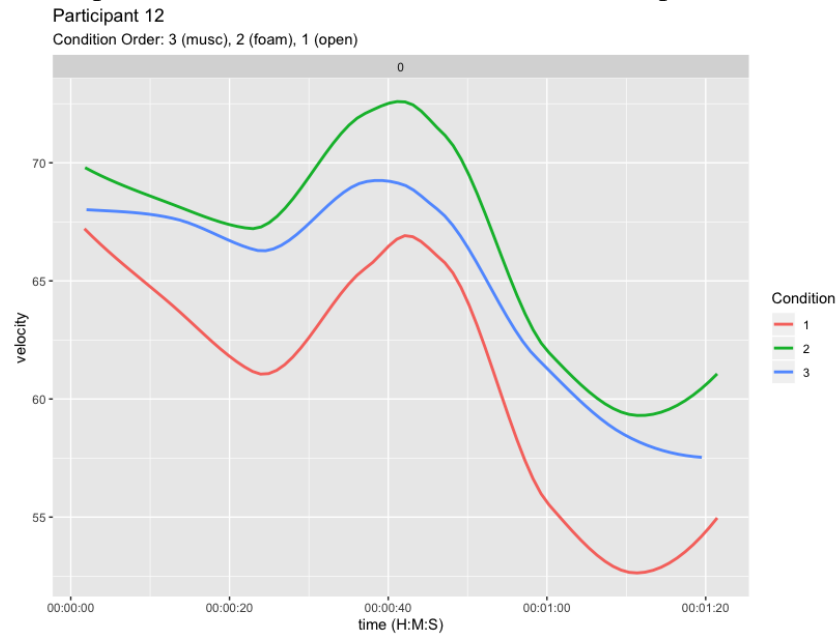


Figure 1. Occlusion effect. Velocity over time. Open condition in red, musicians' earplugs in blue and foam earplugs in green.

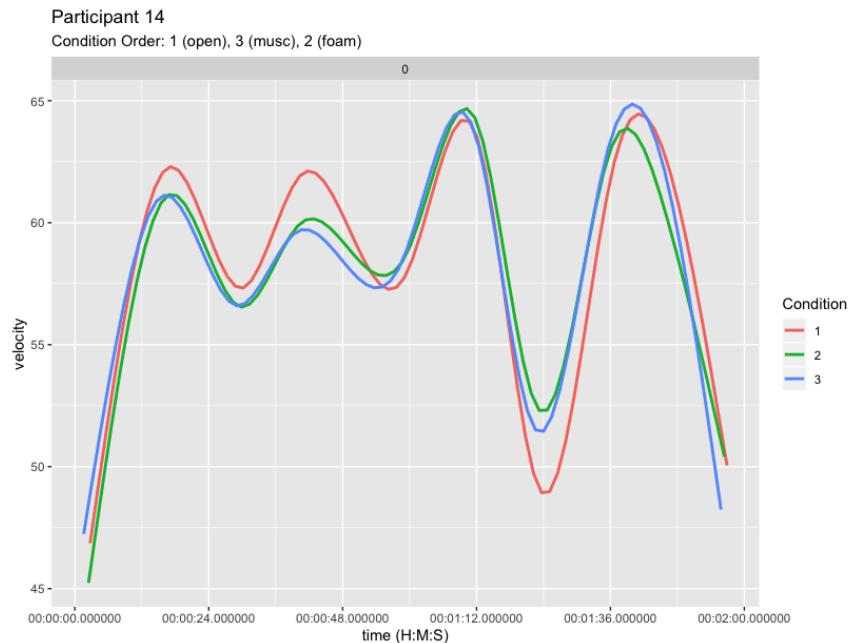


Figure 2. Reduced dynamic range under hearing protection. Velocity over time. Open condition in red, musicians' earplugs in blue and foam earplugs in green.

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