

The influence of background noise on vocal loading parameters in music theory teachers



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INTRODUCTION

Music theory teachers depend greatly on a well-functioning voice. Unlike other schoolteachers who primarily use their voice as a pedagogic tool, music theory teachers also use it as an instrument. In addition to high vocal demands associated with their profession, voice use of music theory teachers is likely to be affected by background noise in classrooms. To date, few studies have looked at the vocal situation among this population. This study investigates if voice use of music theory teachers might be influenced by background noise.

AIMS OF THE STUDY

Our study aims (1) to measure the background noise levels affecting music theory teachers in both professional and extra-professional environment, and (2) to describe the influence of background noise on vocal loading parameters.

METHODS

Subjects:

- 13 music theory teachers working in a music school (9 females and 4 males)
- Age: between 26 and 58 (median=46)
- French native speakers

Task:

All subjects were asked to wear a voice dosimeter (VoxLog, Sonvox) for one entire workweek, every day from early morning until the end of the day, resulting in a data corpus of 66 hours (mean) per subject. In this way, it was possible to compare data collected in the professional environment with that collected in the extra-professional environment.

Data Analysis:

Out of all data collected with the VoxLog voice dosimeter, we analyzed the following parameters:

- Background noise sound pressure level (dB SPL) → measured by a microphone integrated in the neck collar
- Duration of phonation (%) → measured by an accelerometer integrated in the neck collar
- Voice sound pressure level (dB SPL) → measured by a microphone integrated in the neck collar (mouth-microphone distance ~ 10 cm)
- Fundamental frequency of voice F0 (Hz) → measured by an accelerometer integrated in the neck collar



Fig. 1: VoxLog, Sonvox (<http://www.sonvox.com>)

RESULTS

Background noise levels (see figure 2)

- Overall: 75.2 dB (SD=5.4)
- Professional environment: 78.2 dB (SD=5.8)
- Extra-professional environment: 72.2 dB (SD=5.2)
- At work, background noise levels are significantly increased ($Z = -5.384, p < .001$).

Correlations (see figures 3-5)

- Background noise and voice SPL in all subjects ($r = .61, p < .001$).
- Background noise and F0 in females ($r = .41, p < .005$), but not in males ($r = .39, p = .055$)
- Background noise and duration of phonation in all subjects ($r = .50, p < .001$)
- An increase in background noise is accompanied by increased voice SLP, F0 and duration of phonation.

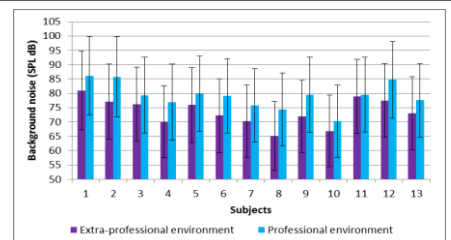


Fig. 2: Influence of background noise on our subjects in both professional and extra-professional environment

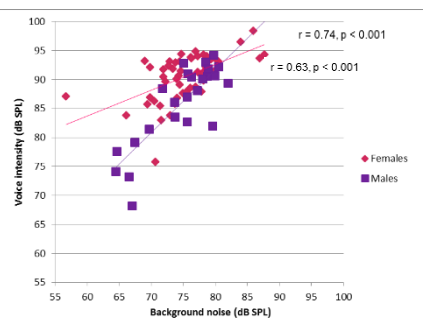


Fig. 3: Correlation between background noise and voice SLP

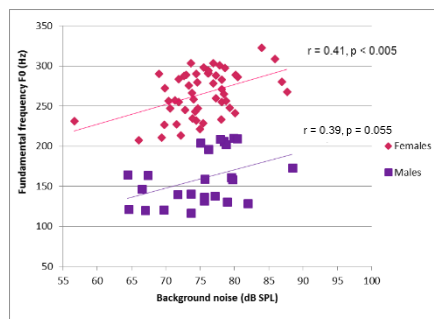


Fig. 4: Correlation between background noise and fundamental frequency

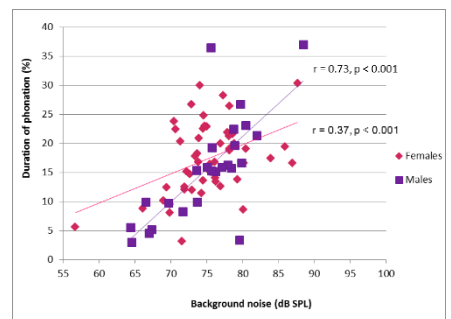


Fig. 5: Correlation between background noise and duration of phonation

DISCUSSION AND CONCLUSION

Our data suggest that at work, music theory teachers must cope with high background noise levels, dramatically exceeding the limit of 35 dB recommended by the WHO (Inserm, 2006). Increased background noise levels seem to lead to a rise in vocal loading parameters. We found positive correlations between background noise and voice SPL, a phenomenon known as the Lombard effect (Inserm, 2006), background noise and fundamental frequency (only in female subjects) as well as background noise and duration of phonation. The last finding is in compliance with a study of Ternström, Södersten, and Bohman (2002), who also observed a lengthening of voiced segments in noisy environments. We assume that music theory teachers prolong their voiced speech segments to make themselves understood in noisy classrooms. In the long run, an increase of vocal loading parameters could lead to the development of voice disorders (e.g. hyper-functional dysphonia) in music theory teachers.

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