The Effect of Occluding the Ear on Variations in Voice Level and Fundamental Frequency with Changing Background Noise Level and Talker-to-Listener Distance: A Pilot Study

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1. Introduction

Understanding and modeling vocal effort for talkers wearing HPDs could enable the development of new personal radio systems.

2. Objectives

Measure the changes in:
1. speech level
2. fundamental frequency

with changing communication distance and background noise level for subjects wearing HPDs.

3. Materials and methods

- 12 test subjects, 5 distances, 3 noise conditions and 2 different quiet conditions;
- Measurement of individual earplug transfer function;
- Assessment of well-fitted earplug;
- Adjustment of the level of background noise under the earplug.

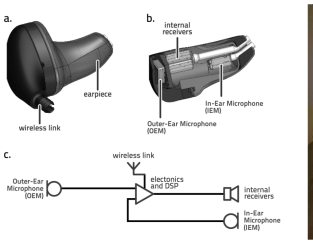

Figure 1- Intra-aural communication earpiece

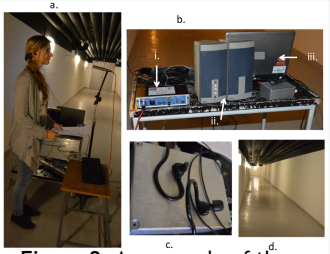

Figure 2- An example of the experimental setup with a participant

Ear Condition	Corresponding Ambient Noise (dB SPL)	Distance (m)
Un-occluded	Quiet (< 50)	1, 5, 10, 20, and 30
Occluded	Quiet (< 50)	1, 5, 10, 20, and 30
Occluded	70, 80, 90	1, 5, 10, 20, and 30

Table 1: Experimental Conditions

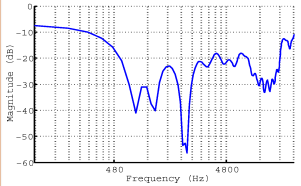

Figure 3- An example of a transfer function of a well fitted earplug

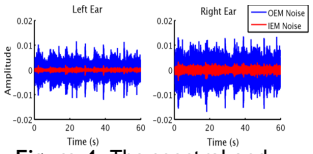

Figure 4 -The spectral and temporal differences between the simulated residual noise under the earplug and the outside noise

4. Results

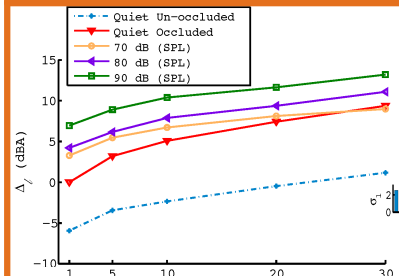

Figure 5 -Average increase in speech level, Δ_ℓ from the occluded quiet condition over increasing distance and noise levels.

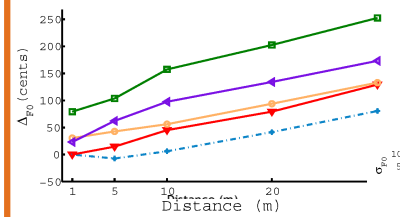

Figure 6 -Average increase in F0 level, from the occluded quiet condition over increasing distance and noise levels.

5. Conclusions

A simple model could be further developed to model speech effort as a function of the intended distance.

6. Funding Acknowledgement

Centre for Interdisciplinary Research in Music Media and Technology
Erasmus Mundus
Student Exchange Network in Auditory Cognitive Neuroscience

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