Influence of Different Noises on the Performance of Normal Hearing Listeners in an Open Logatome Test

Martina Bellanova[1], Marc Aubreville[1], Matthias Latzel[1], Ulrich Hoppe[2]
[1)] Siemens Audiology Solutions, Erlangen, Germany
[2)] ENT Department, University of Erlangen, Germany

Introduction

Speech intelligibility tests showed that logatomes are suitable to evaluate differences between various hearing aid settings. They provide high test-retest stability in both an open and a closed test design (Bellanova et al. 2010).

The purpose of the current study is to evaluate logatome speech material in four different types of masking noise.

Material

Speech material

- 59 CVC (consonant-vowel-consonant) and VCV (vowel-consonant-vowel) nonsense syllables, recorded from an untrained female speaker.
- To accomplish further homogenization of the speech material, a subjective adjustment of loudness was conducted by ten normal hearing subjects.

Noise material

- Four types of noise of which two were specifically designed from the logatome corpus and two were general purpose noises, i.e. pink noise and Olnoise (Wagener et al. 1999).
- For the two corpus-specific noises the signal was transformed to the Fourier space, where its phase was set to zero in one signal and to a uniformly distributed random value for the other signal. This resulted in one instationary and one stationary signal after back-transformation, respectively. The test material was equalized to have the same RMS value as the speech material.

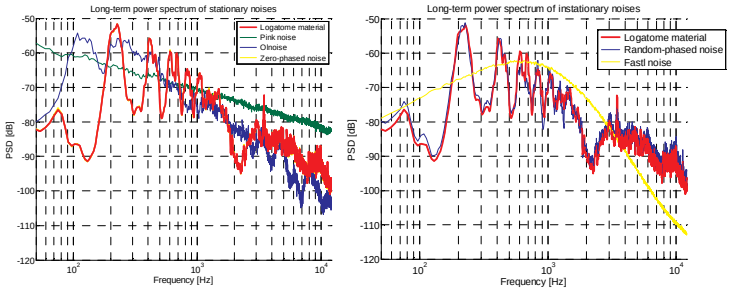

Figure 1: Power spectral density estimated with Welch's (1967) method (hamming window, window length 8192, 50% overlap) of the stationary (left) and instationary (right) noise types.

Methods

- Ten normal hearing subjects
- To avoid sequence effects, the order of the test stimuli and the order of the noises were randomized for each subject and each test.
- The noises were presented via loudspeaker at 60 dB SPL (0° azimuth), the level of the speech material adapted to 50% speech intelligibility starting at 0 dB SNR.
- Logatome test and Oldenburg Sentence Test
- Five different noises:
  - Olnoise
  - Pink noise
  - Fastl noise (Fastl 1987)
  - Random-phased noise
  - Zero-phased noise

Results

Logatome Test

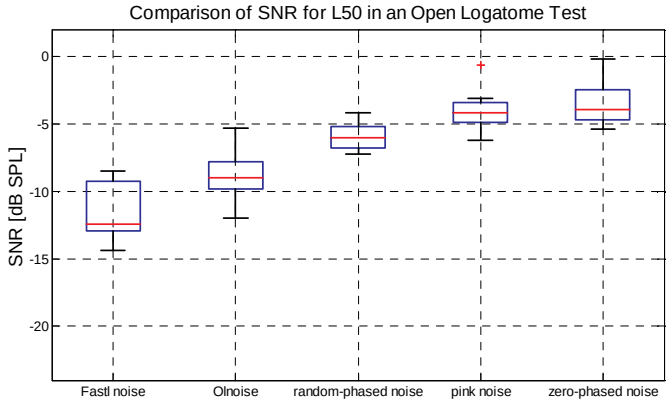

Figure 2: Comparison of SNR in an open logatome test for normal hearing listeners in five different noises.

Oldenburg Sentence Test

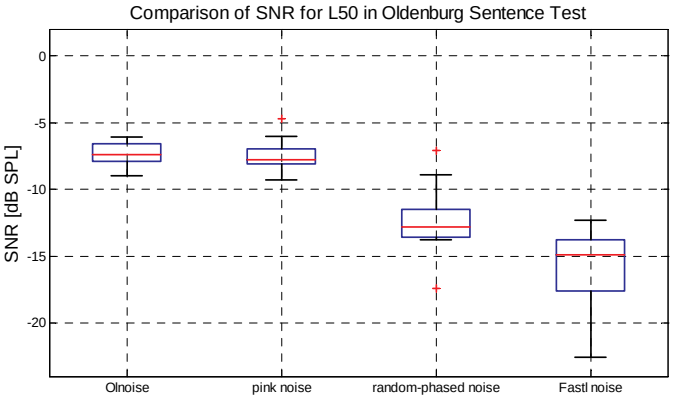

Figure 3: Comparison of SNR in Oldenburg Sentence Test for normal hearing listeners in four different noises.

Test-Retest Stability of the Logatome Test

Preliminary results show that test-retest stability is good for stationary noises whereas retests show a high variance in fluctuating noises.

Moreover, preliminary results indicate that test retest-stability varies according to the different phoneme groups.

Conclusions

- Pink noise proves to be a suitable masker for logatomes as well as for Oldenburg sentence material.
- Noises which are spectrally fitting the speech material lead to higher SNRs, i.e. lower L50 performance in both tests.
- There is a higher variance for instationary noises compared to stationary noises in both the logatome test and the Oldenburg Sentence Test.

References

Bellanova M, Serman M, Latzel M, Hoppe U (2010): Entwicklung eines Logatomtests zur mikroskopischen Differenzierung unterschiedlicher Hörgeräteralgorithmen. 13. DGA Jahrestagung 2010.

Fastl H (1987): A background noise for speech audiometry, Audiol. Acoustics 26: 2-13.

Wagener K, Kühnel V, Kollmeier B (1999): Entwicklung und Evaluation eines Satztests für die deutsche Sprache I: Design des Oldenburger Satztests. Z. Audiol. 38 (1): 4-15.

Welch, PD (1967): The Use of Fast Fourier Transform for the Estimation of Power Spectra: A Method Based on Time Averaging Over Short, Modified Periodograms, IEEE Trans. Audio Electroacoustics, Vol. AU-15: 70-73.

contact: martina.bellanova.ext@siemens.com