Ecological noise and its effect on speech perception

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INTRODUCTION

Since its inception, speech perception testing has been an important part of the audiological test battery. There are several speech-in-noise tests which are currently being used to measure speech perception ability.

While these tests provide a good estimate of speech-in-noise performance, results are far from realistic. Largely, this is because the noises used with these tests are generated in a laboratory setup and are highly controlled in terms of their physical characteristics, whereas the noise present in the natural environment varies with time. Noise presented in a sound-treated room at a comfortable level makes communication conducive which can be predicted by traditional laboratory tests, but in a real-life noisy setting, its effects are varied.

Communication in noisy situations is a common complaint by individuals with hearing loss as well as individuals with normal hearing. So far, no research has been done to assess speech perception abilities in a typical (natural) noisy situation, because there is currently no available noise in the field of audiology that can simulate a real-life listening situation.

PURPOSE

The purpose of this study was to develop an ecological noise that can simulate a realistic environment for speech perception testing. It is important to have an efficacious speech perception assessment that assesses the actual performance of the listener in the real world. Creating such an assessment tool is needed to accurately reflect performance.

METHODS

Phase I: Development of Noise

- Different environmental sounds either downloaded from the internet or recorded
- Distributed in 8 different tracks
- Normalized to -3 dB range
- 4 talker babble from QuickSIN was added (Killion et al., 2004)
- A noise sample of 41 seconds was generated and looped

Phase II: Speech Perception Measurements

Participants

- 27 individuals (18 to 40 years; M = 25.5)
- Native English-speaking Americans
- Normal hearing and cognition

Stimuli

Sentence Lists

- Quick Speech in Noise Test
- AzBio Sentence Test (Spahr et al., 2012)
- Hearing in Noise Test (Nilsson et al.,1994)

Noise

- Ecological noise (EN)
- Respective noises from QuickSIN, AzBio and HINT

Procedure

- Pure Tone Audiometry
- Immittance Audiometry
- Cognitive screening

Speech perception measurements

- 2 signal-to-noise ratios (SNRs): 0 dB and +5 dB
- 2 sentence lists presented per noise & SNR condition
- Speech signal presented at 50 dB HL
- Sound field with listeners sitting 6 feet from the speaker

RESULTS

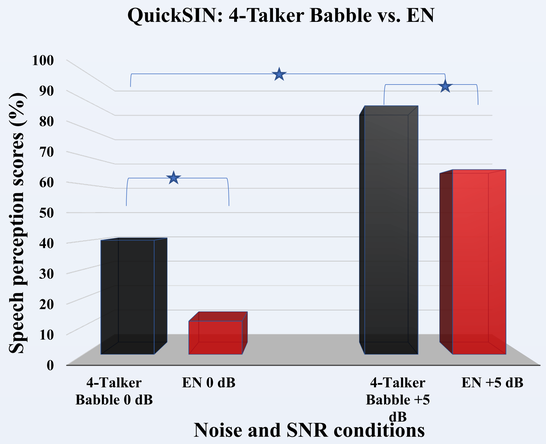

Figure 1. Mean percent correct scores for 4-talker babble and EN at 0 dB and +5 dB SNR (* = p<0.05).

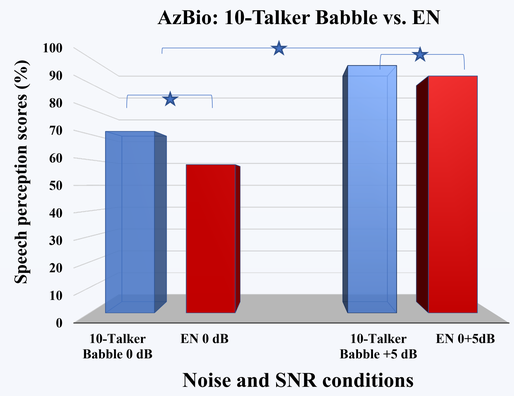

Figure 2. Mean percent correct scores for 10-talker babble and EN at 0 dB and +5 dB SNR (* = p<0.05).

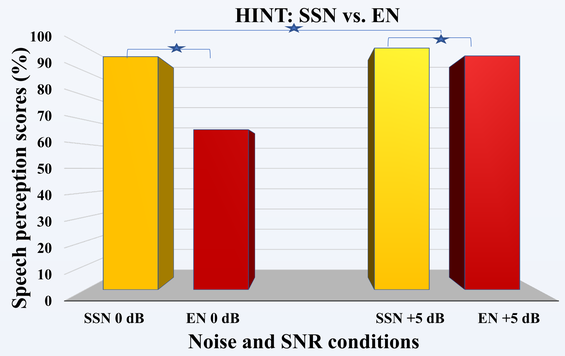

Figure 3. Mean percent correct scores for SSN and EN at 0 dB and +5 dB SNR (* = p<0.05).

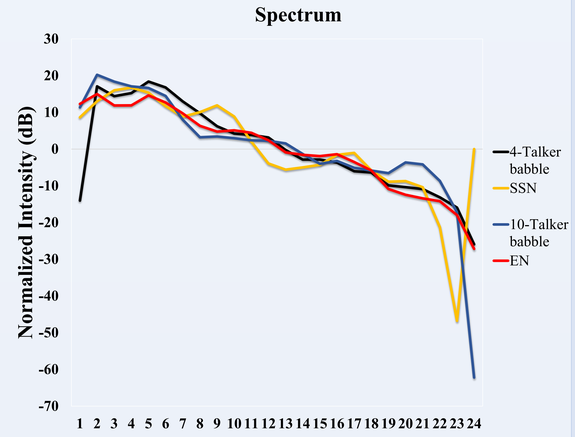

Figure 4. Spectrum of EN, 4-talker babble, 10-talker babble, and SSN.

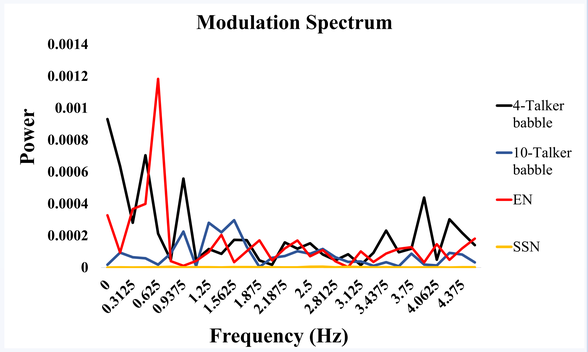

Figure 5. Envelope spectrum of EN, 4-talker babble, 10-talker babble, and SSN.

CONCLUSIONS

- Behaviorally, speech perception scores using EN were significantly poorer than multitalker babble (MTB) or SSN for all sentence tests.
- It is likely the EN was more difficult because it contains both informational masking effects (IM) from the MTB and energetic masking (EM) effects from the environmental sounds, whereas the MTB only has the IM effect and SSN only has the EM effect.
- Acoustically, the spectral characteristics of the EN were relatively similar to the other noises, whereas the temporal analysis of the EN showed a stronger low-frequency modulation.
- Ecological noise presents a more challenging listening situation than the use of MTB or SSN. The ecological noise developed in this study could be useful in the basic audiological battery for the speech perception testing.
- Speech perception scores measured using this ecological noise may provide a more realistic assessment of communication in the natural environment compared to MTB or SSN.

REFERENCES

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