

Relationship between speech acoustics and speech intelligibility in complex noise

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Background

- The acoustic qualities of speech vary greatly across speakers (Sataloff, 2006; Arslan & Hansen, 1996).
- Research also shows that some of these acoustic characteristics significantly contribute to the speech's intelligibility (Bradlow, Torretta, & Pisoni, 1996; McCloy, Wright, & Souza, 2015).
- Murphy and colleagues (2017, poster #173) showed that 20 female talkers' group, mean intelligibility was significantly hindered in the presence of 8-talker babble and an SNR = -7 dB (compared to restaurant noise and SNR = -5 dB). However, they did not explore the contributions made by each, individual talker to these results.
- Without measuring the broad and fine-grained acoustic characteristics of the talkers' speech, it is difficult to answer questions about what leads to differences talkers' intelligibility in noisy listening environments.

Aim

...to measure the acoustic properties of the talkers' speech from Murphy, et al. (2017) and explore the relationship between acoustic characteristics and intelligibility in the presence of noise.

Methods

Design: descriptive

Stimuli: 20 typically developing, monolingual, native American English speaking females aged 18-49 years ($M = 24.5$ years) recorded 8 randomly chosen Harvard Sentences ($N = 160$; IEEE, 1969).

Procedure: We used *PRAAT* (Boersma & Weenink, 2015) and analyzed the acoustic characteristics of each talker's 8 sentences.

Acoustic measurements: We measured fundamental frequency (F0) max, min, M, and SD. We also measured M speaking rate (phonemes/s). We targeted these characteristics because research showed them to be important indicators of speech intelligibility in the presence of both quiet (Bradlow, et al., 1996) and synthetic noise (McCloy, et al., 2015).

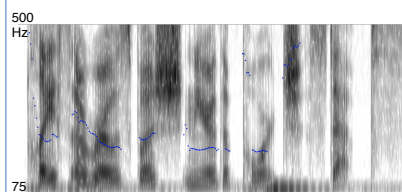


Figure 1. PRAAT spectrogram with F0 markers for the sentence, Place a rose bush near the porch step. spoken by talker 002.

Results

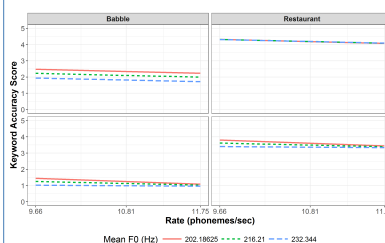
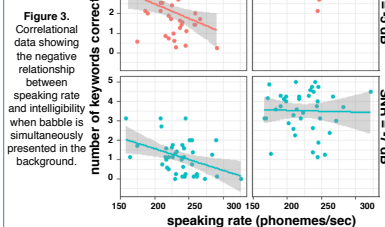
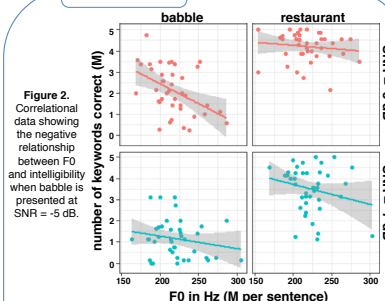


Figure 4. Analyses of the repeated measures data were conducted using generalized estimating equations (GEE; Liang & Zeger, 1986). GEE analysis indicated that both a talker's F0 and speaking rate affected intelligibility differentially depending on background noise.

Discussion

- Our data serve as a reminder of the classic invariance problem (Klatt, 1979) and the subsequent problems that can arise when we treat talkers as a fixed-effect in speech perception research (Barker, 2006).
- Our results corroborate the robust benefits of clear speech (Pichery, Durlach, & Braida, 1986) and its facilitatory effect on intelligibility.

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