

2aSC18: Perceived emotion in clear speech: Effect of simulated hearing loss

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Background

Previous research suggests that both young normal-hearing (YNH) and older hearing-impaired (OHI) listeners judge clear speech as sounding angry more often than conversational speech. Interestingly, OHI listeners judged sentences to be angry less often than YNH listeners for both speaking styles, suggesting that age and/or hearing loss may play a role in judging talkers' emotions.

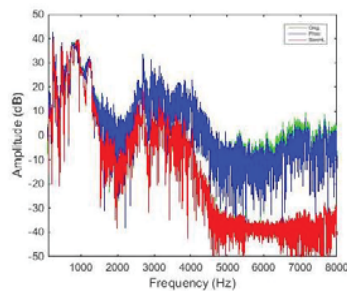
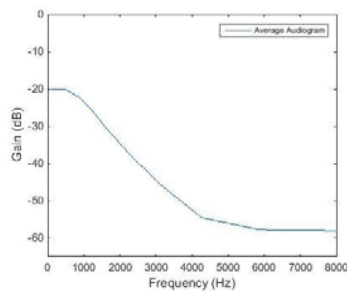
Aging effects have been found for visual and auditory emotion perception, which suggests that older adults attend to anger (and other emotions) **less often** than younger individuals (Ruffman, Halberstadt, & Murray, 2009). Alternatively, an **acoustic cue** that helps distinguish angry speech from emotionally neutral speech is **increased high-frequency energy**, which may be attenuated or rendered inaudible by age-related hearing loss.

Hypotheses

- 1) Sentences with a simulated hearing loss (SimHL) will be judged as sounding angry less often than sentences without SimHL.
- 2) Processed sentences without any hearing loss simulation (Proc) will not differ from original sentences (Orig).
- 3) Speaking style and talker group effects will be consistent with previous findings.

Signal Processing

Stimuli were processed and filtered using MATLAB to simulate both **reduced high-frequency sensitivity** and **loudness recruitment** (Glasberg & Moore, 1993). A **control group** of stimuli were processed, but not filtered to simulated hearing loss in order to identify any effect of signal processing on judgments of emotion.



Stimuli

8 talkers (4 male) were selected from the Ferguson Clear Speech Database (Ferguson, 2004).

- **Group A** (4 talkers, 2 male) had large differences in perceived clarity between CL and CO speech (i.e., **"good" clear speech**)
- **Group B** (4 talkers, 2 male) had small differences in perceived clarity between CL and CO speech (i.e., **"poor" clear speech**)

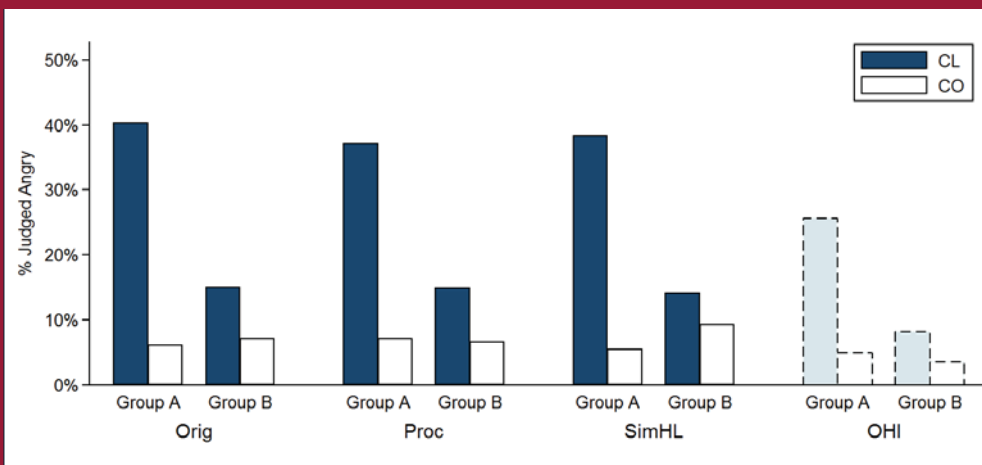
For each talker, **14 sentences** (identical in each speaking style) were selected with **emotionally neutral content**.

Procedures

Listeners were presented monaurally with either Proc or SimHL CO and CL sentences and asked to **select the emotion** (from the options below) they heard in each sentence.

- Anger
- Disgust
- Happiness
- Fear
- Sadness
- Neutral

Judgments were **combined** across all listeners to calculate the percentage of time each sentence was judged as belonging to each emotion category.



Listeners

Listeners (Proc stimuli):

- 22 listeners
- 18-30 years old (mean: 20.5; SD: 3.0).

Listeners (SimHL stimuli):

- 22 listeners
- 18-32 years old (mean: 21.6; SD: 3.4).

* All listeners had no history of speech or language disorders, were native speakers of American English, and passed a hearing screening at 20 dB HL for octave intervals from 250 – 8000 Hz .

References

1. Ferguson, S. H. (2004). "Talker differences in clear and conversational speech: Vowel intelligibility for normal-hearing listeners," *J. Acoust. Soc. Am.* **116**, 2365-2373.
2. Moore, B. C. J., & Glasberg, B. R. (1993). "Simulation of the effects of loudness recruitment and threshold elevation on the intelligibility of speech in quiet and in a background of speech," *J. Acoust. Soc. Am.* **94**, 2050-2062.
3. Ruffman, T., Halberstadt, J., and Murray, J. (2009). "Recognition of facial, auditory, and bodily emotions in older adults," *J. Gerontol. Psychol. Sci.* **64B**(6), 696-703.

Analyses

Linear mixed-effects models were used to analyze the data.

Main effects of **speaking style, talker group, and listener group**, as well as interactions among them were analyzed. **Talker** was included in each model as a random factor

Results

- 1) There was no effect of simulated hearing loss on judgments of anger ($z = .31, p = .757$).
- 2) There was no effect of signal processing without simulating hearing loss ($z = -0.59, p = .555$).
- 3) Results for main effects of speaking style and talker group were consistent with previous findings.

Discussion and Conclusion

The effect of simulating a moderately-severe sensorineural hearing loss had **no effect** on perceived anger. The absence of any listener group effects suggests that attenuation of high-frequency energy does not account for the reduced judgments of anger by OHI listeners when compared to YNH listeners. Therefore, the aforementioned difference is likely due to **aging effects** or other **auditory processing deficits** that accompany aging and/or hearing loss.

The effect of processing alone had no effect on emotion perception in YNH listeners. This suggests that processing stimuli by this filtering method can be an **acceptable research method** for future studies on indexical perception.

Clear speech was still to be judged as angry more often than conversational speech, especially when the talker had "good" clear speech, **validating prior findings**.

Future research should examine results of **older adults with normal hearing** to confirm the effects of aging on emotional judgments. Acoustic features of **emotionally neutral clear speech** should be identified. Other directions could investigate effects of simulating **more severe hearing losses** and other **auditory processes** on indexical perception.

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