Introduction

• Difficulty understanding speech in noise is one of the most common complaints from hearing aid (HA) users.
• We can consider applying noise reduction (NR) algorithms, such as spectral subtraction. However, since the speech signal and noise are mostly overlapped in the spectral domain, NR attenuates noise at the cost of distorting speech cues [1, 2].
• Individual differences in NR preference exist; people have different susceptibility to background noise or speech distortion [3].

Questions:
1. Group-level efficacy: NR effect on both 1) neural processing and 2) outcomes?
2. Clinical suggestions for individuals: Who gets benefits from NR?

Study goals:
1. Find neural markers of good vs. poor speech-in-noise perception (without NR).
2. Test the effect of NR and explore the neural correlates of individual differences in NR benefits.

Study 1: Find neural markers of good vs. poor speech-in-noise perception [4]

Subjects: 26 normal-hearing adult listeners
Tasks: CVC monosyllabic words in multi-talker babble noise with 2 signal-to-noise ratios (SNRs) (±3 dB)
Aim: Within-subject design study to characterize SNR effect on cortical processes for speech-in-noise recognition
Hypotheses:
• In easy condition according to highest input SNR (+3 dB), listeners will show strong early activity in the earlier region (supramarginal gyrus: SMG).
• In hard condition, listeners will show strong late activity in the later region (inferior frontal gyrus: IFG).

Results:
ROI: Supramarginal gyrus (SMG) ROI: Inferior frontal gyrus (IFG)
HARD condition (low SNR) involves later region (IFG) at later timing.

Discussion and Conclusion

• The benefits of NR can be measured objectively using electroencephalography in such a way that the optimal NR configuration for a given listener would invoke the cortical processing that the reduced noise level can generate in normal-hearing listeners.
• In study 1, we found that the low-level noise (i.e., increased signal-to-noise ratio (SNR)) resulted in an “ideal” pattern of the cortical processing at SMG and IFG.
• In study 2.1, NR alters cortical speech-in-noise processing: More immediate processing through temporal route.
• In study 2.2, listeners’ speech-unmasking ability predict the benefits of NR, in a way that listeners with poorer speech-unmasking exhibit greater NR benefits.
• By understanding how NR affects cortical processing during speech-in-noise recognition, clinicians can provide better NR configuration in an objective manner for each listener.

References

Authors appreciate Hearing Health Foundation (Emerging Research Grant, PI Choi), as well as OARS/CIHR FHO Fellowship (given to Subong Kim).