The Effect of Noise on the Selective Attention

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Introduction

Background

Recent research investigating selective attention has demonstrated that neural responses can be decoded in order to identify the attended sound source in everyday listening environments [1].

Auditory attention decoding (AAD) methods [2] from EEG data enable the decoding of the attentional selection.

Motivation

This study investigates the **effect of different signal to noise ratios (SNRs)** [3] on selective attention, quantified by decoding accuracy.

Research question

*Can AAD methods be used to examine the **effect SNR in hearing-aid (HA) users**?*

Experiment

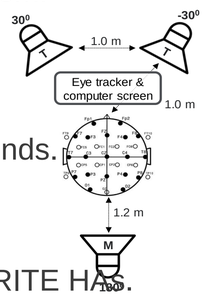
Participants

8 hearing impaired subjects with mild sensorineural, symmetrical hearing loss hearing loss (avg. age of 70 ± 12 years).

EEG data Acquisition

64 channels of scalp EEG data (10/20 system) were recorded using the Biosemi ActiveTwo system.

Stimuli



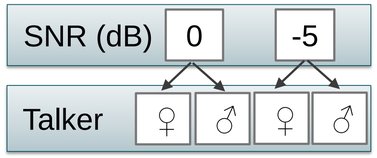
- **30s of Danish** non-dramatic news clips.
- 30° azimuth via loudspeakers.
- **Target (T)**: attended (A) & ignored (I) sounds.
- **Masker (M)**: 4-talker babble noise.

Hearing Aid settings

Subjects were fitted with 2 Oticon Opn1 mRITE HAs. Amplification was provided using the Voice Aligned Compression (VAC) rationale

Experiment design

Test design:

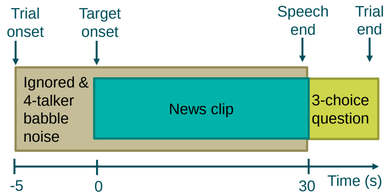


$$\mathrm{SNR} = \frac{\text{Signal power of A}}{\text{Signal power of I}}$$

Attended sound presented at either:

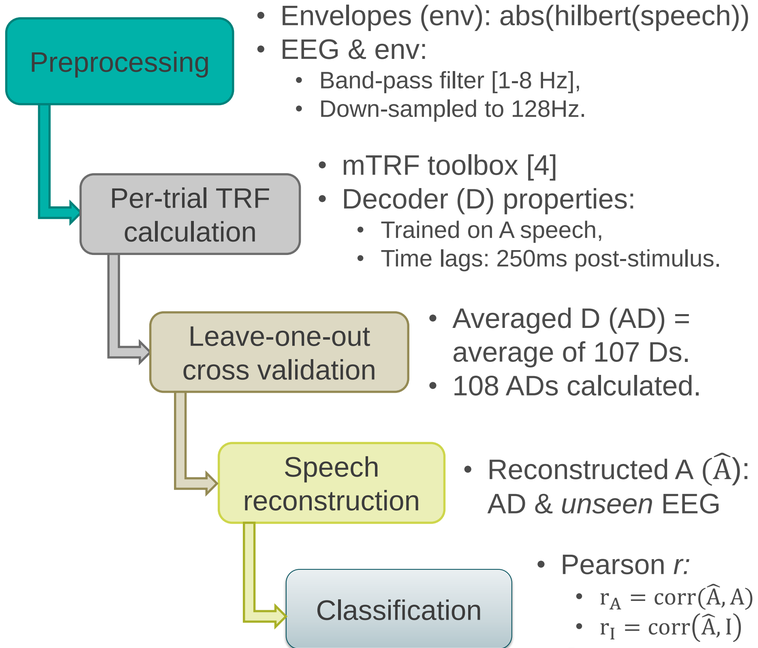
- 0 dB SNR (high SNR),
- -5 dB SNR (low SNR).

Task design:



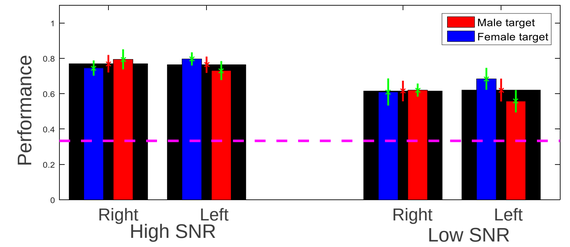
- 27 trials per conditions.
- 4 conditions: 2SNRs (0 &-5dB) vs 2 target positions (-/+ 30 degree)

Data analysis method



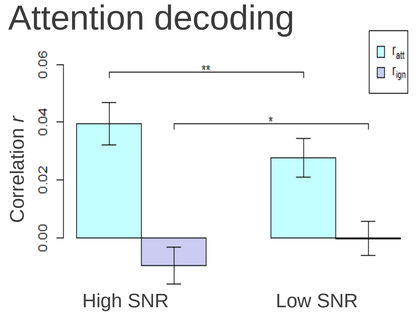
Results

Behavioral performance



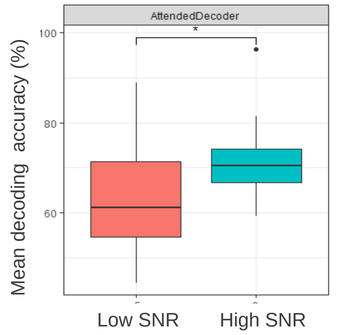
Averaged behavioral performance data. Sig effect of SNR (p=0.0028)

Attention decoding



Sig effect of SNR on:

- reconstructed A envelopes (p=0.0095).
- reconstructed I envelopes (p=0.0344).



Sig effect of SNR (p=0.0291).

Conclusion

Data analysis showed that SNR had a significant effect on AAD, demonstrating the potential of the AAD methods to reveal the impact of SNR on selective attention in individuals with hearing impairment.

Information
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Read more at:
www.eriksholm.com:

References [1] O'sullivan, James A., et al. "Attentional selection in a cocktail party environment can be decoded from single-trial EEG." Cerebral Cortex 25.7 (2014): 1697-1706. [2] Das, Neetha, Alexander Bertrand, and Tom Francart. "EEG-based auditory attention detection: boundary conditions for background noise and speaker positions." Journal of neural engineering 15.6 (2018): 066017. [3] Alickovic, Emina, et al. "A Tutorial on Auditory Attention Identification Methods." Frontiers in Neuroscience 13 (2019): 153. [4] Crosse, Michael J., et al. "The multivariate temporal response function (mTRF) toolbox: a MATLAB toolbox for relating neural signals to continuous stimuli." Frontiers in human neuroscience 10 (2016): 604.

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