Energetic/Informational Masking and Listening Effort, as Measured by Electroencephalography and Pupillometry

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INTRODUCTION

- Attending to target speech in the presence of auditory maskers may result in decreased understanding of target information (lower speech intelligibility scores).
- However, intelligibility scores do not provide information about how much listening effort the task elicits.
- Even if a listener can understand 100% of the target speech, the task of doing so may be extremely effortful (Rennies & Kidd, 2018), which may have negative effects for the listener (Peelle, 2018).

STUDY AIMS

- To compare the amount of listening effort elicited in young, normal-hearing subjects to carefully-controlled high-informational masking (IM) versus high-energetic masking (EM) conditions, at equivalent reference points (TMRs).
- Hypothesis: A high-IM condition will require more effort.
- To compare listening effort data obtained by two different widely-used physiological indices: 1) pupil size, and 2) alpha power as measured by electroencephalography (EEG).
- Hypothesis: Results from the two indices will not be correlated but may reveal different insights about components of listening effort.

PARTICIPANTS

- 15 young, normal-hearing listeners (5 M, 10 F)
- mean age = 20.8, range = 18-24
- normal hearing in both ears (20 dB HL or better at 250, 500, 1K, 2K, 4K, and 8K Hz)
- native English speakers
- no diagnosis of ADHD/ADHD or TBI

EXPERIMENTAL STIMULI

Target speech consisted of 5-word matrix-style sentences, always beginning with the word Sue:

1. I bought a big bag.
2. Lynn had a blue hat.
3. Mike met a girl.
4. Pat saw an old man.
5. Sam sold an old tool.

Stimuli were presented in a sound-attenuated booth from three loudspeakers, each located approximately 1.5 meters from the listener’s head.

Part 1: Behavioral Testing

- Participants completed three adaptive tracks in each condition using a procedure adapted from Brand & Kollmeier (2002).
- These adaptive procedures were designed to estimate the TMR at which the participant could achieve 75% correct performance.

Part 2: Pupillometry/EEG recording

- Participants completed 2 blocks (24 trials) in each condition, with stimuli presented at their individually-estimated 75% correct TMRs.
- An SR Research Eyelink 1000 was used to collect pupil diameter measurements.
- A 32-channel BioSemi ActiveTwo system was simultaneously used to collect EEG data.

For pupil size analysis, a subtractive baseline correction was performed for each trial, with the median of the last 1000 ms of the masker-only, pre-target listening portion of each trial serving as the baseline.
- For EEG analysis, a divisive baseline correction was performed for each trial, with the last 1000 ms of the masker-only, pre-target listening portion of each trial serving as the baseline.

- A 1 x 3 RM-ANOVA examining the effect of condition on mean change in alpha (8-13 Hz) during the 0-6000 ms period after target onset was found to be non-significant, possibly due to high variability in the data or insufficient power.
- Additional analyses, possibly with a different baseline and/or time-frequency region of interest, may be performed in order to better understand these data.

REFERENCES


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