

Title: EEG Frequency Measures During Effortful Listening

Abstract: Adults with hearing loss who report difficulty understanding speech with and without hearing aids often report increased mental effort or listening effort (Pichora-Fuller et al. 2016). Measures such as pure-tone thresholds, word recognition in background noise performance, and self-report have not reliably predicted listening effort in real world environments, perhaps because they do not typically account for cognitive workload, attention, or underlying neurological mechanisms (Zekveld et al., 2010; Pichora-Fuller et al. 2016; Smith et al. 2016; McMahon et al 2016). The purpose of this study was to evaluate an electroencephalogram (EEG)-based method to assess cognitive states associated with effortful listening. Three different EEG frequency ranges and changes in EEG power were examined based on evidence of: (1) increases in low-frequency alpha (8-10 Hz; LFA) power that have been associated with increased working memory task demands (Klimesch, 1999); (2) decreases in high-frequency alpha (10-13 Hz; HFA) power that have been associated with increases in semantic memory and cognitive demands (Klimesch, 1999); and, (3) increases in theta (4-8 Hz) power that have been associated with encoding information (Klimesch, 1999) and increased listening effort (Wisniewski et al., 2015). The Words-In-Noise test (WIN; Wilson et al., 2003) was used to examine variations in EEG and subjective ratings of listening effort with changes in the background babble signal-to-noise ratio (SNR). Stimuli were presented suprathreshold, background babble 70 dB SPL, the words to be recognized ranged from 24 to 0 dB SPL (4 dB SPL steps over 7 conditions) above background babble. Participants were 18-35 years old with pure-tone thresholds > 25 dB HL. Participants exhibited an inverted-U shape for the low-frequency alpha power measure across SNR conditions. There was no effect of correct or incorrect word recognition on EEG frequency bands measured. Correlations among EEG power in the three frequency ranges, WIN performance, and self-report measures of listening effort will be presented. The results of the project will further the understanding of the role cognitive systems have during effortful listening.

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