Title: Perceptual Decision-Making during Speech Recognition in Noise by Middle-Aged and Older Adults

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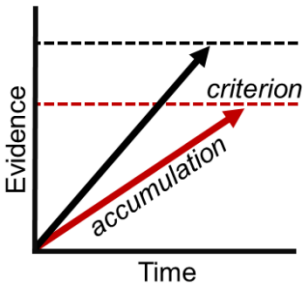
Abstract: During speech recognition, perceptual decision-making processes are thought to collect sensory information until there is sufficient evidence for lexical selection (Ben-David et al., 2014; Anders et al., 2015). Perceptual uncertainty and noise slow the collection of sensory information (*accumulation rate*), which has been associated with activity in fronto-parietal cortex (Ploran et al., 2007, 2011). Decision thresholds (*criteria*) can be raised to emphasize response accuracy by collecting more information over a longer time period, or lowered to improve response speed (Figure inset). Criteria adjustments have been associated with cingulo-opercular regions of frontal cortex (Van Maanen et al., 2011). To clarify the functional significance of cingulo-opercular activity that is consistently observed during challenging speech recognition tasks (Eckert et al., 2016; Peelle, 2017), the current study tested the hypothesis that pre-stimulus cingulo-opercular activity facilitates speech recognition in noise (Vaden et al., 2013, 2015) through criteria adjustments. During a sparse acquisition fMRI experiment, middle-aged and older adult participants [N = 30; age = 58.3 ± 8.8 years] listened to and repeated words presented at +3 or +10 dB signal-to-noise ratio (SNR) in 82 dB-SPL multi-talker babble. Participants had normal to mildly elevated pure-tone thresholds. No significant hearing loss effects were observed. Word recognition was significantly poorer for older than middle-aged adults and for the +3 than +10 dB SNR trials. Cingulo-opercular BOLD contrast prior to the presentation of each word was significantly related to correct recognition. A perceptual decision-making model for speech onset times (Anders et al., 2016) indicated that participants emphasized accuracy more so for the +10 than +3 dB SNR trials [criteria: $t(26) = 2.25$, $p = 0.02$] and that evidence collected more quickly on the +10 dB SNR trials [accumulation rate: $t(26) = 2.76$, $p = 0.005$]. Participants with relatively higher criteria (i.e. greater emphasis on accuracy) for the +3 dB SNR trials demonstrated significantly higher word recognition benefit from pre-stimulus activity in the dorsal cingulate [+3 dB SNR: $r = 0.54$, $p = 0.003$; +10 dB SNR: *ns*]. Criteria were significantly higher on trials with increased pre-stimulus activity in bilateral frontal opercula/insula regions [left hemisphere: $t(26) = 2.72$, $p = 0.006$; right hemisphere: $t(26) = 2.01$, $p = 0.03$], such that decisions emphasized accuracy and were formed with more evidence following high pre-stimulus activity. The current findings indicate that pre-stimulus cingulo-opercular activity can adjust perceptual decision-making processes to enhance speech recognition for middle-aged and older adults in difficult listening conditions.



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