Stream Segregation and Speech Recognition in Noise in Individuals With Cochlear Implants

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Statistical Analysis Plan

Data analysis will proceed in stages to confirm that our results replicate previous findings with at-home testing and to ensure the assumptions necessary to test for a mediating relationship are met.

Step 1: Determine the covariance structure of the memory battery

Performance across memory tasks should have a correlation of $r \approx 0.3$ (Engle et al. 1999; Shipstead et al. 2014), which reflects their common reliance on storage and processing constructs in memory. We will use principal components analysis to examine the loading of task outcomes onto common dimensions. It is possible they will all load onto a single working memory factor (similar to Rönnberg et al. 2016), or they could load onto two orthogonal factors that represent storage and processing (Unsworth and Engle 2007). Principal components with an eigenvalue greater than one will be included in subsequent steps and the remaining components will be discarded as measurement noise.

Step 2: Predict speech recognition accuracy in quiet

We expect both modulation detection thresholds to be significant predictors of sentence recognition accuracy, which will account for approximately half of the variance. We will compare the likelihood of generalized linear regression models which include only modulation detection thresholds against models which also include the memory components identified in step 1 to determine if these memory components are significant predictors of speech recognition in quiet. We will verify that modulation detection thresholds and working memory task performance are not correlated, as we found in participants with cochlear implants ($r = -0.36$, $r = -0.15$ for spectral and temporal threshold correlations with digit span, $p > 0.10$).

Step 3: Test for a mediating relationship of stream segregation for speech recognition in competing speech

We will extrapolate the predictor model for speech recognition in quiet developed in step 2 to the case of speech recognition in competing speech. If the model performs as well for speech in speech as it does for speech in quiet, we would infer that two-talker speech maskers do not introduce meaningful variability into speech recognition outcomes and stop here. If the speech in quiet model is a worse fit, we will add stream segregation to the predictor model and test whether it predicts unique variance in speech recognition accuracy in competing speech. This would demonstrate that stream segregation is a distinct aspect of speech recognition in the presence of competitors. Finally, to complete the mediator analysis we would test whether modulation detection thresholds and memory factors are significant predictors of stream segregation ability.