Structural differences in the left insula correlate with word production latencies in normal subjects
Sonya Mehta¹, William W. Graves², David Rudrauf¹, Thomas J. Grabowski¹,³
¹Department of Neurology, Carver College of Medicine, University of Iowa
²Neuroscience Graduate Program, University of Iowa
³Department of Radiology, Carver College of Medicine, University of Iowa

Introduction: Response latency has been used as a behavioral index for the efficiency of overt language production. Normal subjects vary in the efficiency with which they retrieve and produce words. We analyzed behavioral and structural MRI data from an event-related fMRI experiment to identify structural correlates of word production latency.

Methods: High resolution T1-weighted MRIs were obtained in twenty-four right-handed subjects (ages 18-58, 17 Females) on a GE CV/i scanner (1.5 T). Images were registered to a Talairach-compatible atlas and smoothed with a 10mm FWHM kernel. Tissue segmentation was also performed.

Subjects participated in an event-related picture naming fMRI experiment. Subjects 1) named, aloud, pictures of concrete entities and 2) performed a simple categorization task requiring stereotyped speech (“light” or “dark”), hereafter referred to as the “stereotyped response”. Stimuli were presented in mixed order. Response latencies were determined using a spectral subtraction algorithm [1] that leveraged a time-aware acquisition system [2].

Using the smoothed MRI signal as the dependent measure, three regression analyses were performed with the following covariates of interest: 1) mean naming latency, 2) mean stereotyped response latency, and 3) the difference between these latencies, which was taken to reflect articulatory planning as opposed to more automated aspects of articulation. The regression analyses included global signal, age, and gender as confounding covariates. Results were thresholded using non-stationary RFT cluster-size inferences (p < 0.05, corrected) [3].

Results: Significant results were observed exclusively in the left insula (Fig 1). Naming latencies were correlated with greater T1 signal intensity in the mid-posterior insula (Fig 2). Although not significant, longer stereotyped response latencies were also correlated with more signal (p = 0.065) in the posterior insular region partially overlapping the structural correlates of naming latency. Longer differential latencies were correlated with T1 signal intensity in the anterior insula. Neither gender nor age correlated with signal intensity in these insular regions, nor were these factors correlated with latency measures.

Parallel analyses with gray matter and white matter VBM suggested that longer latency correlated with an increase in white matter and a decrease in gray matter in these insular regions.

Discussion: Prior studies have implicated involvement of the left insula in auditory-verbal language processing [4, 5]. Within the insula, anterior and posterior regions may have distinct roles. Activation of the left insula is seen during overt but not covert tasks [6] suggesting a role in articulatory/phonological processes as opposed to semantic retrieval. The anterior region has been linked to articulatory planning [7], while the posterior insula may facilitate more automated language responses [8]. Our results are consistent with these findings. They also suggest that structural differences in both insular regions may underly variability of word production efficiency among normal individuals.
References:

Category = Language
Sub-Category = Production
Patient vs Healthy = Healthy subjects