Superior precentral gyrus of the insula

Broca (Broca P. Bull Soc Anat Paris 36: 330-357, 1861) influentially argued that posterior left inferior frontal gyrus supports speech articulation. According to an alternative proposal (e.g., Dronkers NF. Nature 384: 159-161, 1996; Wise RJ, Greene J, Buchel C, Scott SK. Lancet 353: 1057-1061, 1999; Baldo JV, Wilkins DP, Ogar J, Willock S, Dronkers NF. Cortex 47: 800-807, 2011), a region in the anterior insula [specifically, the superior precentral gyrus of the insula (SPGI)] is the seat of articulatory abilities. Moreover, Dronkers and colleagues have argued that the SPGI is functionally specialized for (complex) speech articulation. Here, we evaluate this claim using individual-subject functional MRI (fMRI) analyses (e.g., Fedorenko E, Hsieh PJ, Nieto-Castanon A, Whitfield-Gabrieli S, Kanwisher N. J Neurophysiol 104: 1177-1194, 2010). We find that the SPGI responds weakly, if at all, during articulation (parts of Broca's area respond 3-4 times more strongly) and does not show a stronger response to higher articulatory demands. This holds regardless of whether the SPGI is defined functionally (by selecting the most articulation-responsive voxels in the vicinity of the SPGI in each subject individually) or anatomically (by using masks drawn on each individual subject's anatomy). Critically, nonspeech oral movements activate the SPGI more strongly than articulation, especially under the anatomical definition of the SPGI. In line with Hillis et al. (Hillis AE, Work M, Barker PB, Jacobs MA, Breese EL, Maurer K. Brain 127: 1479-1487, 2004; also Trupe L, Varma DD, Gomez Y, Race D, Leigh R, Hillis AE, Gottesman RF. Stroke 44: 740-744, 2013), we argue that previous links between the SPGI, and perhaps anterior insula more generally, and articulation may be due to its high base rate of ischemic damage (and activation in fMRI; Yarkoni T, Poldrack RA, Nichols TE, Van Essen DC, Wager TD. Nat Methods 8: 665-670, 2011), combined with its proximity to regions that more directly support speech articulation, such as the precentral gyrus or the posterior aspects of the inferior frontal gyrus (Richardson JD, Fillmore P, Rorden C, Lapointe LL, Fridriksson J. Brain Lang 123: 125-130, 2012), and thus susceptibility to joint damage [1].

1)

Fedorenko E, Fillmore P, Smith K, Bonilha L, Fridriksson J. The superior precentral gyrus of the insula does not appear to be functionally specialized for articulation. J Neurophysiol. 2015 Apr;113(7):2376-82. doi: 10.1152/jn.00214.2014. Epub 2015 Jan 28. PubMed PMID: 25632073.