Speech

The neural basis of human speech is unclear.

Grover et al., examined how speech intelligibility, perceptual speech characteristics, phonemic and semantic Verbal fluency and processes underlying it (clustering and switching) respond to LFS of 60 and 80 Hz in comparison to high frequency stimulation (HFS) (110, 130 and 200 Hz).

In this double-blind study, 15 STN-DBS PD patients (mean age 65, SD = 5.8, 14 right handed, three females), were assessed at five stimulation frequencies: 60 Hz, 80 Hz, 110 Hz, 130 Hz and 200 Hz. In addition to the clinical neurological assessment of speech, VF and SI were assessed.

Speech intelligibility and in particular articulation, respiration, phonation and prosody improved with LFS (all $p < 0.05$). Phonemic VF switching improved with LFS ($p = 0.005$) but this did not translate to an improved phonemic VF score. A trend for improved semantic VF was found. A negative correlation was found between perceptual characteristics of speech and duration of chronic stimulation (all $p < 0.05$).

These findings highlight the need for meticulous programming of frequency to maximise speech intelligibility in chronic STN-DBS. The findings further implicate stimulation frequency in changes to specific processes underlying VF, namely phonemic switching and demonstrate the potential to address such deficits through advanced adjustment of stimulation parameters [1].

Intracranial electrophysiological recordings revealed that high-gamma wave band oscillations (70-150 Hz) are observed in frontal lobe during speech production and in the temporal lobe during speech perception.

In human beings, it is the left hemisphere that usually contains the specialized language areas. While this holds true for 97% of right-handed people, about 19% of left-handed people have their language areas in the right hemisphere and as many as 68% of them have some language abilities in both the left and the right hemispheres.

Lateralization was first discovered in the 1800's by physicians (such as Broca and Wernicke, who we will discuss in a bit) who did autopsies on patients who had had several language difficulties before their deaths. These physicians found damage to particular areas of the brain now named after them, and these areas were consistently on the left hemisphere.

Whether the speech disorder can be termed cortical dysarthria or apraxia of speech is left open to discussion [2].

1)
Grover T, Georgiev D, Kaliola R, Mahlknecht P, Zacharia A, Candelario J, Hyam J, Zrinzo L, Hariz M, Foltynie T, Limousin P, Jahanshahi M, Tripoliti E. Effect of Low versus High Frequency Subthalamic Deep Brain Stimulation on Speech Intelligibility and Verbal Fluency in Parkinson's Disease: A Double-Blind Study. J Parkinsons Dis. 2018 Dec 28. doi: 10.3233/JPD-181368. [Epub ahead of print] PubMed PMID: 30594934.
2)

Saltuari L, Holzer A, Formisano R, Rauchegger H, Birbamer G. [Motor speech disorder after removal of a glioblastoma in the left hemisphere: Cortical disorder or apraxia?]. Folia Phoniatr (Basel). 1989;41(6):292-6. German. PubMed PMID: 2599492.