The semantic variant of Primary Progressive Aphasia: a window into the spatiotemporal dynamics of language


Semantic variant primary progressive aphasia (svPPA) is a clinical syndrome associated with anterior temporal lobe (ATL) neurodegeneration and characterized by particular language impairments that denote loss of semantic knowledge. Notably, patients with svPPA manifest naming and single-word comprehension deficits, surface dyslexia (i.e., an impairment in reading words with atypical spelling-to-sound mapping), and impaired object knowledge. Investigating the spatiotemporal dynamics of language processing in svPPA thus can offer a privileged window into the neural correlates of language and semantic knowledge.

We compared svPPA patients and age-matched controls in a series of magnetoencephalography (MEG) tasks. All participants underwent comprehensive neuropsychological testing, were right-handed English native speakers, and had no history of developmental dyslexia. We recorded brain activity using a 306-channel whole-head MEG system (CTF), while participants performed reading tasks (i.e., reading words and pseudowords) and a semantic task (i.e., classifying pictures as living or non-living). We then reconstructed whole brain oscillatory activity with Nutmeg (nutmeg.berkeley.edu) and compared spatiotemporal dynamics of patients vs. controls.

When analyzing the reading task in controls, the key contrast between pseudowords (e.g., *pook*) vs. irregular words (e.g., *choir*) revealed differential activity in beta band (13-20 Hz) over the left IPS (L-IPS, ramping up after stimulus onset and peaking at ~700ms), supporting the involvement of this region in sub-lexical processes. This effect was absent in svPPA patients, and, crucially, direct comparison of svPPA patients and controls during irregular words reading isolated the same spatiotemporal cluster. In light of the dual route model of word reading, our results indicate that sustained activity over the L-IPS serves as the neural correlate of svPPA patients’ over-reliance on the sub-lexical route, arguably an active compensation for their impairment on the lexical one. The semantic classification tasks offered further insights into compensatory mechanisms within svPPA, who were able to perform the task but relied on a damaged conceptual system.

Taken together, these findings deepen our understanding of svPPA patients’ altered spatiotemporal dynamics of language processing, allowing us to refine the functional interplay between ventral and dorsal language paths.