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Automated individual-level parcellation of Broca's region based on functional connectivity

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Abstract

Broca's region can be subdivided into its constituent areas 44 and 45 based on established differences in connectivity to superior temporal and inferior parietal regions. The current study builds on our previous work manually parcellating Broca's area on the individual-level by applying these anatomical criteria to functional connectivity data. Here we present an automated observer-independent and anatomy-informed parcellation pipeline with comparable precision to the manual labels at the individual-level. The method first extracts individualized connectivity templates of areas 44 and 45 by assigning to each surface vertex within the ventrolateral frontal cortex the partial correlation value of its functional connectivity to group-level templates of areas 44 and 45, accounting for other template connectivity patterns. To account for cross-subject variability in connectivity, the partial correlation procedure is then repeated using individual-level network templates, including individual-level connectivity from areas 44 and 45. Each node is finally labeled as area 44, 45, or neither, using a winner-take-all approach. The method also incorporates prior knowledge of anatomical location by weighting the results using spatial probability maps. The resulting area labels show a high degree of spatial overlap with the gold-standard manual labels, and group-average area maps are consistent with cytoarchitectonic probability maps of areas 44 and 45. To facilitate reproducibility and to demonstrate that the method can be applied to