Combining structural connectivity-based parcellation and functional imaging to elucidate the role of SMA and preSMA in response selection

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Résumé

The supplementary motor area (SMA) and the pre-supplementary motor area (preSMA), regions of the dorso-medial frontal cortex, have been shown to play a crucial role in response selection. While no gross anatomical landmark exists to separate these regions, they have been dissociated based on their function: while the SMA seems to fulfill more clear-cut executive functions, the preSMA has been shown to process information on the task set, i.e. to fulfill more cognitive functions. Recently it has been shown that an anatomic separation based on the connectivity fingerprint of these regions is possible. However, in the current literature on cognitive control functions of the SMA/preSMA, the functional labeling of these regions is not always consistent, as it rarely refers back to anatomical criteria.

In our current dataset (30 participants) we use connectivity-based parcellation of diffusion tensor imaging (DTI) data to anatomically define SMA and preSMA. We use 'blind' probabilistic tractography: after defining a dorso-medial target region, the connectivity profiles of voxels in this mask to voxels in the whole brain is determined. Similar connectivity profiles are clustered together, and result in a posterior (SMA) and an anterior (preSMA) parcel in each individual. We present results from spectral reordering and k-means clustering.

With our such individually defined anatomical map at hand, we can now clearly attribute functional clusters to either SMA or preSMA. Application of this methodology is exemplified to better localise response-selection related activity in conflict tasks. We believe that systematically making the link between individual structural and functional data will lead the way to resolve many of the current neuroanatomical debates in cognitive neuroscience.

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