Parcelation of the human premotor cortex with DTI technique

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Object

The human premotor cortex is likely to include a mosaic of anatomically and functionally distinct areas, as in non-human primates, but its functional networks are only beginning to be understood. In this work we use the DTI technique to investigate the anatomical connectivity between the premotor cortex and the other part of the brain.

Methods

High resolution anatomical and diffusion-weighted images were acquired in 11 healthy right handed volunteers (age 20-32 yrs) using a 3 T MRI scanner.T1-weighted anatomical images were acquired using a 3D-FFE sequence in AP and RL phase directions (TR=35 ms, TE=5.7 ms, FA=50°, FOV:230×230×180 mm; voxel:0.479×0.479×0.50 mm3; 360 slices; sagittal). Diffusion-weighted data were obtained using a SE-EPI sequence (FOV: 240x240x120 mm; voxel:1.875×1.875×2.1 mm3; 57 slices; phase direction AP). Isotropically distributed diffusion weightings were used along 64 directions with a b value of 1000 s.mm-2. Each b0 was the average of 7 volumes.
To check for repeatability, acquisition of diffusion-weighted images was repeated in one subject, both within the same session and in sessions performed several days apart.
Data were processed using probabilistic tractography (FDT tool included in FSL package) and a maximum of two fiber orientations was modeled for each voxel. The seed (BA6) was selected on the Juelich Histological Atlas and the 11 targets were derived from the WFU Pick Atlas tool. The amount of spatial overlapping between the parceled region was computed.
Single subject analysis was performed in different ways in order to check for repeatability. In particular we tested the eddy current correction step (ECC) as implemented in FSL package and different paths of coregistration as illustrated in Fig1.
Multi-subjects analysis was performed in a fashion based on the results of the single-subject analysis.

Results.

Single subject: The robustness and validity of the different approaches were checked in one subject, repeating the study over 9 sessions performed several days apart. Analysis also highlight that Eddy Current Correction step was not as crucial as the choice of the coregistration way .
Multi-subject analysis: The anatomical connectivity procedure identified 4 regions (Fig2 and table 2): the caudal and rostral Dorso Medial Premotor cortex (DMPc-caud, DMPc-rostr), Ventro Lateral Premotor cortex (VLPc), and Dorso Lateral Premotor (DLPc).

Conclusions

In this work we parcel the human premotor cortex using DTI technique together with the probabilistic approach. Through single-subject analysis an optimized processing procedure was defined. The multi-subject analysis revealed 4 main regions with different anatomical connectivity.

	Amount of spatial overlapping			
	w ECC and simple path	w/o ECC and simple path	w ECC and cmplx path	w/o ECC and cmplx path
VLPc	21%	21%	62%	63%
DLPc	40%	31%	64%	63%
DMPc -caud	34%	35%	73%	71%
DMPc -rostr	24%	2%	38%	45%

Table 1: Single subject analysis 9/9 sessions - Amount of spatial overlapping for each parceled region and for each different data processing

	Amount of spatial overlapping
VLPc	41%
DLPc	62%
DMPc -caud	43%
DMPc -rostr	37%

Table 2: Multi-Subject analysis 9/11 subjects: amount of spatial overlappingfor each parceled region

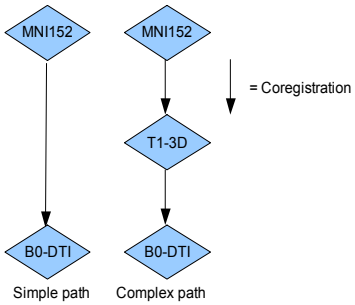

Fig 1: Different data processing

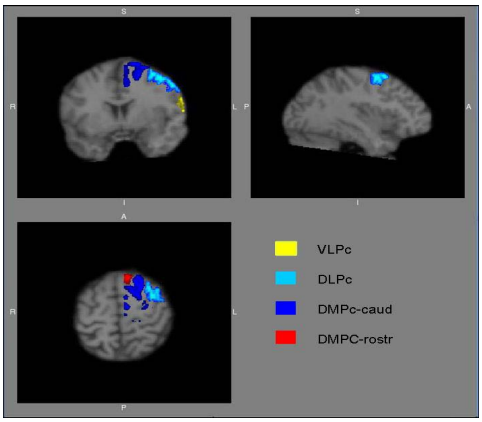

Fig 2: Parceled regions