NeuroSpeech Project

DATE OF DEMAND	June 2013
MAIN INVESTIGATORS	Serge Pinto
LABORATORY	Laboratoire Parole et Lange (LPL)
PLATFORM	Functional Magnetic Resonance Imaging (fMRI)
PROJECT TITLE	Neurospeech – Understand the motricity/language interface: study of normal and pathological speech in fMRI
AIM	Study in Parkinson's disease the phonological and lexical effects on cerebral activations of word and non-word reading
CREx CONTRIBUTION	DATA PROCESSING Elaboration of Pipelines written in Matlab language in order to automatically process fMRI data. These scripts are based on existing routines from Statistical Parametrical Mapping (SPM) software (temporal and spatial corrections of raw functional images, segmentation of anatomical data, coupling anatomical and functional data, normalization, smoothing and statistical analyses using general linear methods) and add extract elements such as the control of image quality and the comparison of several methods on a same graphical representation (known as "glass view" in SPM). Four analyses were conducted: - Parametric statistical analysis by 2 methods of normalization: normalization by segmenting the individual anatomical image and normalization though a standard brain (atlas of the Montreal Neurological Institute) - Parametric statistical analysis based on 3 methods of segmentation « Segment » on SPM8, « New Segment » on SPM8, and Segmentation using VBM8 (Voxel Based Morphometry) - Psycho-Physiological Interaction Analysis (PPI) - Non-parametric statistical analysis (the SPnM toolbox)
	PUBLICATION OF RESULTS Writing the methodology part related to the fMRI data acquisition and processing and making the figures to report the results in international reviews (see Annex)

ANNEX

I. SHORT DESCRIPTION OF EXPERIMENTAL PROTOCOL

fMRI task. The participants were required to read aloud words and pseudo-words based on variable phonological structure: **C**onsonant-**V**owel (CV) or **C**onsonant-**C**onsonant-**V**owel (CCV) structure.

Independent variable: BOLD signal on each voxel.

Dependent variables

- 2 levels for the lexical factor: word and pseudo-word
- 2 levels for the phonological factor: CV and CCV

II. DATA ACQUISITION AND PREPROCESSING

Data acquisition was performed on a 3-T MEDSPEC 30/80 AVANCE imager (Bruker, Eittlingen, Germany) at the fMRI centre of Marseille, France. Functional images were acquired using a T2*-weighted gradient-echo planar sequence with 32 interleaved slices (repetition time = 2133 ms, echo time = 30 ms, field of view = 192 mm, 64×64 matrix of 3×3×3 mm voxels). Whole brain anatomical MRI data was then acquired using high-resolution structural T1-weighted image (MPRAGE sequence, resolution 1×1×1 mm) in the sagittal plane. The fMRI data were pre-processed and analyzed using SPM8 software (Welcome Institute of Cognitive Neurology, London, UK). The first five volumes of each run (300 volumes per session; 2 sessions) were discarded in order to ensure that the longitudinal relaxation time equilibration was achieved. Pre-processing comprised within-subject spatial and temporal realignment, spatial normalization of images to a template in standard space Montreal Neurological Institute (MNI), and a spatial smoothing.

First, pre-processing consisted in spatial and temporal realignment. Second, the high-resolution structural T1-weighted image was coregistered to the mean EPI image.
Third, MRI volumes were processed with SPM8's New Segment option to generate grey matter (GM), white matter (WM) and deformation field images of the participants.
Fourth, the spatial normalization to MNI was performed using the combination of deformation field, coregistred structural and sliced functional images.
Last, each participant's normalized functional data was spatially smoothed using an 8 mm full-width at half isotropic Gaussian kernel. A high-pass filtering was also used at this stage with a cut-off period of 128 s to remove from analysis low frequencies corresponding to breathing or heartbeats.

III. STATISTICAL ANALYSIS: WHOLE BRAIN ANALYSIS USING GLM

For each subject, a General Linear Model (GLM) was generated. It included, for each of the two sessions, 11 regressors modelling the (i) 4 combinations of the lexical and phonological factors (i.e., words_CV, words_CCV, pseudo-words_CV, pseudo-words_CCV, (ii) 1 condition of rest, and (iii) and 6 parameters for controlling the head movements (the head position was indicated by translation and rotation parameters).
In a group analysis of variance (random effects analysis), one regressor per subject was modelled using SPM software.

The main result is illustrated on the Figure 1.

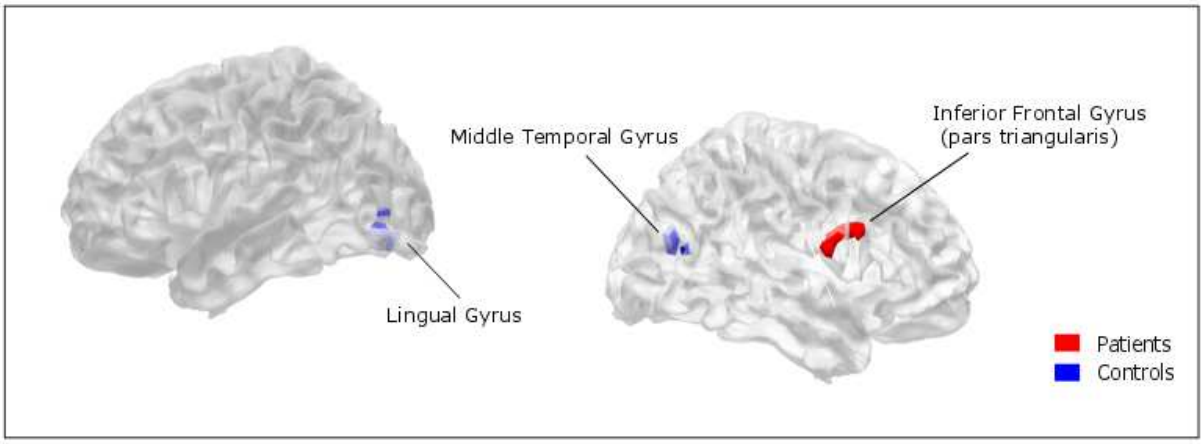

Figure1. The brain statistical maps (thresholded at p < .001, uncorrected) were presented as a function of phonological factor (by subtracting the activation of CV from the activation of CCV) distinctly for patients (significant activation, respectively in red and blue colour). Only significant clusters thresholded at p < .05 with a Family-Wise Error correction bare presented here.