# Distributed source localisation of the M170 using multiple constraints

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**Introduction**

We tested recent methods for distributed source localisation using Restricted Maximum Likelihood (ReML) [1] on an MEG dataset that isolated the M170 component believed specific to faces. Unlike previous methods, multiple constraints on the covariance of the sources and/or sensor noise can be applied, and their weightings (hyper-parameters) estimated automatically from the data.

**Methods**

MEG data from a 151-channel CTF Omega system were acquired while 9 participants made symmetry judgments to faces and scrambled faces. The MEG epochs were baseline-corrected from -100 to 0ms, averaged over trials (approx 70 face and 80 scrambled trials) and lowpass filtered to 20Hz using SPM2. A time-window around the peak in the Global Field Power of the difference between the event-related field (ERF) for faces and scrambled faces that corresponded to the M170 was selected for each participant (mean window = 120-200ms). T1-weighted MRIs were also obtained with resolution 1x1x1mm3. Head-shape was digitized with a 3-D Polhemus Isotrak and used to coregister the MRIs with the MEG data. Segmented cortical meshes, with approximately 7200 dipoles placed at the vertices oriented normal to the greymatter, were successfully created for 8 of the 9 participants using Anatomist [2], and single-shell spherical head models were constructed using Brainstorm [3]. Multivariate source prelocalisation (MSP) [4] was used to reduce the number of dipoles to 1500. The localisations on the mesh were converted into 3D images, warped to MNI space using normalisation parameters determined from participants' MRIs using SPM2, and smoothed with a 20mm FWHM isotropic Gaussian kernel. These smoothed, normalised images were used to create an SPM of the T-statistic over participants (final smoothness approx 12x12x12mm).

**Results**

The mean M170 across participants and its scalp topography are evident in Figs 1-2. We compared two covariance constraints on the sources (equivalent to Gaussian priors in an empirical Bayesian context): the source activity probabilities from the MSP [4] and a Laplacian smoothness prior (like LORETA). An identity matrix was used for the noise covariance in sensor space. When using only the MSP prior, subtraction of the absolute values of the separate localisations for faces versus scrambled faces revealed activation of right fusiform (+51 -39 -15), $T(7)=6.61$, right middle temporal gyrus (+63 -69 +3), $T(7)=3.48$, and right parahippocampal gyrus (+27 -6 -18), $T(7)=3.32$, when thresholded at $p<.01$ uncorrected (Fig 3-4). Direct localisation of the differential ERF also revealed differential activity near right fusiform (+39 -42 -3), $F(1,7)=48.9$, and right middle temporal gyrus (+45 -60 +12), $F(1,7)=16.4$. When using the Laplacian prior only, the results (including the model evidence) were similar, but not as reliable or extensive.

**Conclusion**

The M170 appears to be generated in posterior ventral temporal cortex, as well as the lateral temporal cortex we hypothesised for the N170 recorded with ERPs [5], possibly reflecting differential sensitivities of MEG and EEG as a function of dipole orientation [6]. Future work will explore the use of further priors, including group normalised fMRI results.

**References**

1. Phillips et al, 2002, Neuroimage.
2. Rivière et al, 2000, NeuroImage (HBM00).
3. http://neuroimage.usc.edu/brainstorm/
4. Mattout et al, under revision, Neuroimage.
5. Henson et al, 2003, Cerebral Cortex.
6. Watanabe et al, 2003, Neuroscience.

Fig 1. M170 on right mid-temporal channel

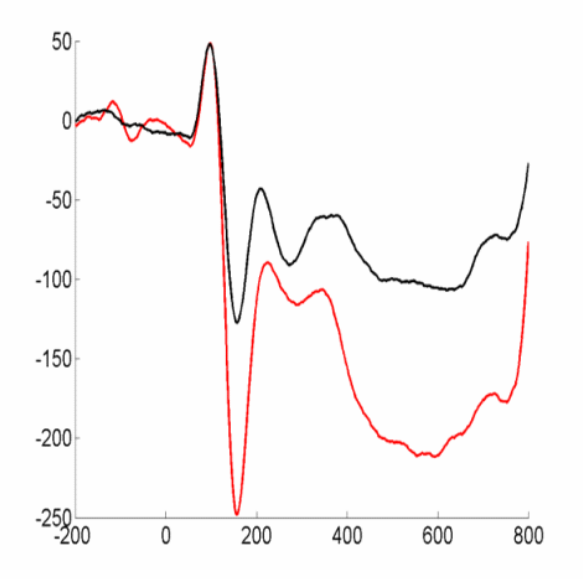


Fig 2. Scalp topography of M170

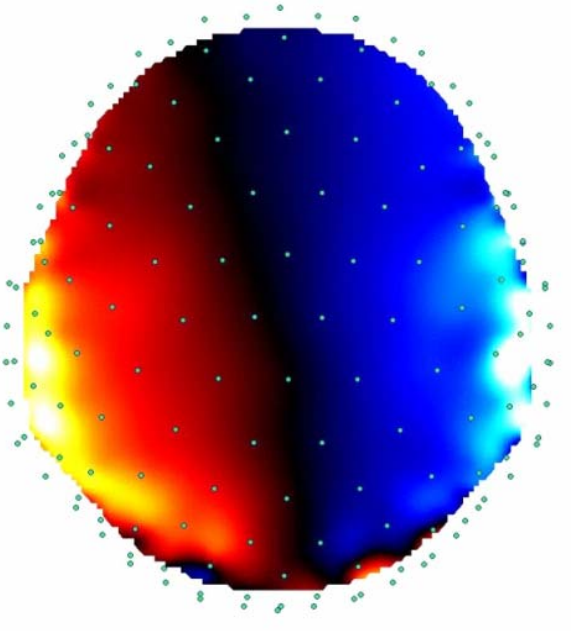

Fig 3. Ventral view of SPM{T(7)}, p<.01 uncorrected

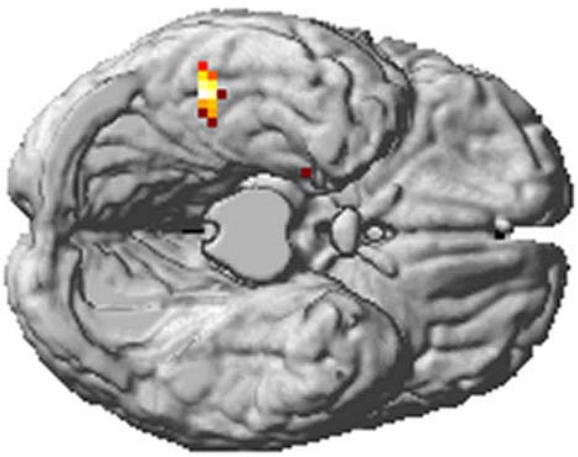

Fig 4. Lateral view of SPM{T(7)}, p<.01 uncorrected