Dissecting neuro-computational functions in EMEG source space

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We report here a new approach that can search representations of neural activity, captured by combined electro- and magneto-encephalographic (EMEG) whole brain recordings, to determine the neural distribution of appropriately and rigorously defined computational functions. We compare the predicted output of three candidate neuro-computational functions (relating to *loudness*, *pitch*, and *cohort* size) with the observed activity of EMEG source space reconstructions. The technique searches the whole brain, vertex by vertex, for a statistical match between predicted and observed patterns of activity, over different potential time-lags between signal input and the onset of neural computation.

We find evidence for a *loudness* computation running bilaterally in planum temporale at lags of 65 and 70 ms in the LH (at p=.05) and at 75 ms in the RH (p=.05). Evidence for a *pitch*-related computation peaks at lags of 65 ms in the LH p=.007 and at 85 ms in the RH p=.004 in Heschl's gyrus. The *cohort* function, tapping into the dynamics of spoken word-recognition, emerges later, at lags of 250 ms in LMTG (p=.01) and 235 ms in RSTG (p=.03), though with an earlier effect in RMTG at 65 ms (p=.02). The results for these three functions are consistent with the predictions of earlier neuro-imaging and behavioural studies, and indicate the potential of the technique to map out the computational infrastructure for complex cognitive capacities across any definable neurocognitive domain.