SEMINARIO

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High-resolution functional MRI of human ventral brain

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Via delle Regole, 95 Mattarello (Trento) (see attached map below)

Abstract

Functional fMRI in the ventral brain using gradient-recalled EPI is problematic due to large magnetic susceptibility differences between bone, air, and tissue, primarily in the auditory canals and sphenoid sinus. This causes local magnetic field inhomogeneities, which leads to intravoxel magnetization dephasing with signal loss, and mislocalisation of signal (image distortion). These problems are sufficiently severe to have led investigators in the field to question the veracity of reports of activation in the amygdalae - an important ventral brain structure - (Merboldt et al., 2001) at 2T and lower field strengths.

It has long been established that these problems can be mitigated by using short effective echo times (TEeff), high in-plane resolution, and thin slices (Young et al., 1988). In preparation for a number of planned studies in emotion processing in healthy subjects as well as in schizophrenia, learned helpless and post-traumatic stress disorder, we systematically optimized these imaging parameters for the amygdale and 3 T. Regional magnetic field gradients were assessed via field maps acquired with a novel triple-echo acquisition (Windischberger et al., 2004), and the effect of in-plane resolution and slice thickness assessed via SNR in single-instance and time-series data. The optimum echo time was established maps of T2* acquired with the other parameters. The optimum parameters were established to be an oblique axial acquisition with 2 mm thick slices and 2 mm in-plane resolution, with an effective echo time of 46 ms. The high resolution protocol was established to lead to 60% higher time-series SNR (tSNR) in the amygdale than data acquired with standard parameters, despite being measured with twice the receiver bandwidth (Robinson et al., 2004).

Studies of emotion processing in healthy subjects have lead us additional conclusions about fMRI studies of the emotions in practice, particularly relating to physiological corrections and stimulus-correlated motion (Robinson et al., 2005). Using a cognitive paradigm and looking at
amygdala/hippocampus deactivations (as part of the Default Mode task-independent and resting state network (Raichle et al., 2001)) has allowed us to test our ability to detect amygdale signal changes with high resolution EPI (with 8 microlitre voxels) and intermediate resolution EPI (with 27 microlitre voxels) with two matched groups of seven subjects. Whilst mean B0 field gradients were the same in the two groups, as were mean signal changes, the higher SNR in the high resolution group allowed amygdale signal changes to be detected with significance only in the amygdale (Robinson et al., submitted), and the participation of the amygdale in the Default Mode - known from PET work - to be established in fMRI for the first time (Robinson et al., 2006).

References


Robinson, S., Pripfl, J, Bauer, H., Moser, E. The impact of EPI voxel size on SNR and the detectability of fMRI BOLD signal changes in the ventral brain. (Submitted)


Responsabile scientifico: dott. Jorge Jovicich
Driving directions to the LNiF at Mattarello: