WHY 7 TESLA FMRI IS NEEDED TO STUDY DEPRESSION?

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BACKGROUND: Although the DMN is regarded as a homogenous network, increasing evidence demonstrates dissociation between anterior and posterior cortical midline regions in MDD patients. Anterior portions of the DMN are more strongly affected in MDD, with increased low-frequency fluctuation (ALFF) band compared with healthy subjects. Posterior portions of the DMN generally show larger BOLD signal change and consistency within and between subjects, suggesting anterior portions might not have been probed with high sensitivity in healthy subjects. BOLD signal changes associated with brain function are higher by, at least, a factor of 2 at 7T compared to 3T, suggesting increased sensitivity for detection of lower intrinsic temporal correlations. Our objective was to test whether ultra-high field might offer a sensitive tool for characterization of the topological organization of the DMN in a more finely grained spatial scale, specially needed for anterior cortical midline regions.

METHODS: BOLD data were acquired at 3 and 7T at different isotropic spatial resolutions (1mm, 1.5 mm and 2 mm) from five healthy subjects. The spatial structure of the DMN was assessed using a seed-based analysis method (ventral, rostral and dorsal MPFC seed-ROIs). Magnitude of both, temporal and spatial correlation coefficients, were assessed across field strengths and resolutions. For the analysis of the Default Network architecture, network graphs and betweenness-centrality measures were also compared across field strengths using graph-analyses techniques.

RESULTS*:* 7T fMRI revealed intricate cortical structures representing a not henceforth seen architecture of the default network. Comparing results between multiple resolutions we showed that the smaller voxel volumes (1 and 1.5 mm isotropic) permitted separations of detailed spatial features within the anterior- and posterior-DMN patterns as well as a better function to anatomy correspondence. We also show that the spatial pattern of the anterior DMN was improved at 7T (more active voxels) and the magnitude of temporal correlations within the anterior DMN was on average 65% greater than those for 3T. For the dorsal ("dorsal medial prefrontal cortex subsystem") and ventral MPFC nodes ("medial temporal lobe subsystem"), network graphs showed at higher field strengths an increased pattern of correlations within subsystems and elevated betweetness-centrality, modifying the topological organization of these brain regions within the DMN.

CONCLUSION: Advantages of ultra-high field (7T) allowed us to measure brain connectivity in areas of lower intrinsic network correlation within the DMN in healthy subjects. As such, using ultra-high field will benefit fcMRI in a way that is crucial in characterizing DMN in depression and elucidate the presence of previously unknown nodes within the anterior DMN that are not observed at lower field strengths.