Supplementary Data

Image Preprocessing

The preprocessing of structural magnetic resonance imaging images

The structural magnetic resonance imaging (sMRI) images were preprocessed using the preprocessing steps typically applied for Voxel based morphometry (VBM) (Ashburner and Friston, 2005; Good et al., 2001), employing the Matlab–based program SPM5 (Statistical Parametric Mapping, Welcome Institute, London, UK). Images were normalized to the 152 average T_1 Montreal Neurological Institute (MNI) template, and spatially normalized and segmented using the unified segmentation approach in SPM (Ashburner and Friston, 2005). Registration, bias correction, and tissue classification into gray matter, white matter, and cerebrospinal fluid tissue classes were combined within one generative Gaussian mixture model, which takes image-intensity nonuniformities and tissue probability maps into consideration. Then the segmented gray matter images were smoothed separately with 8-mm full width at half-maximum (FWHM) Gaussian kernel and masked by 0.1 gray matter mask, by which we removed the voxels with a value <0.1 from the analysis. The size of each processed image was $79\times95\times69$ voxels with a final voxel dimension of $2\times2\times2$ mm.

The preprocessing of the diffusion tensor imaging images included the following

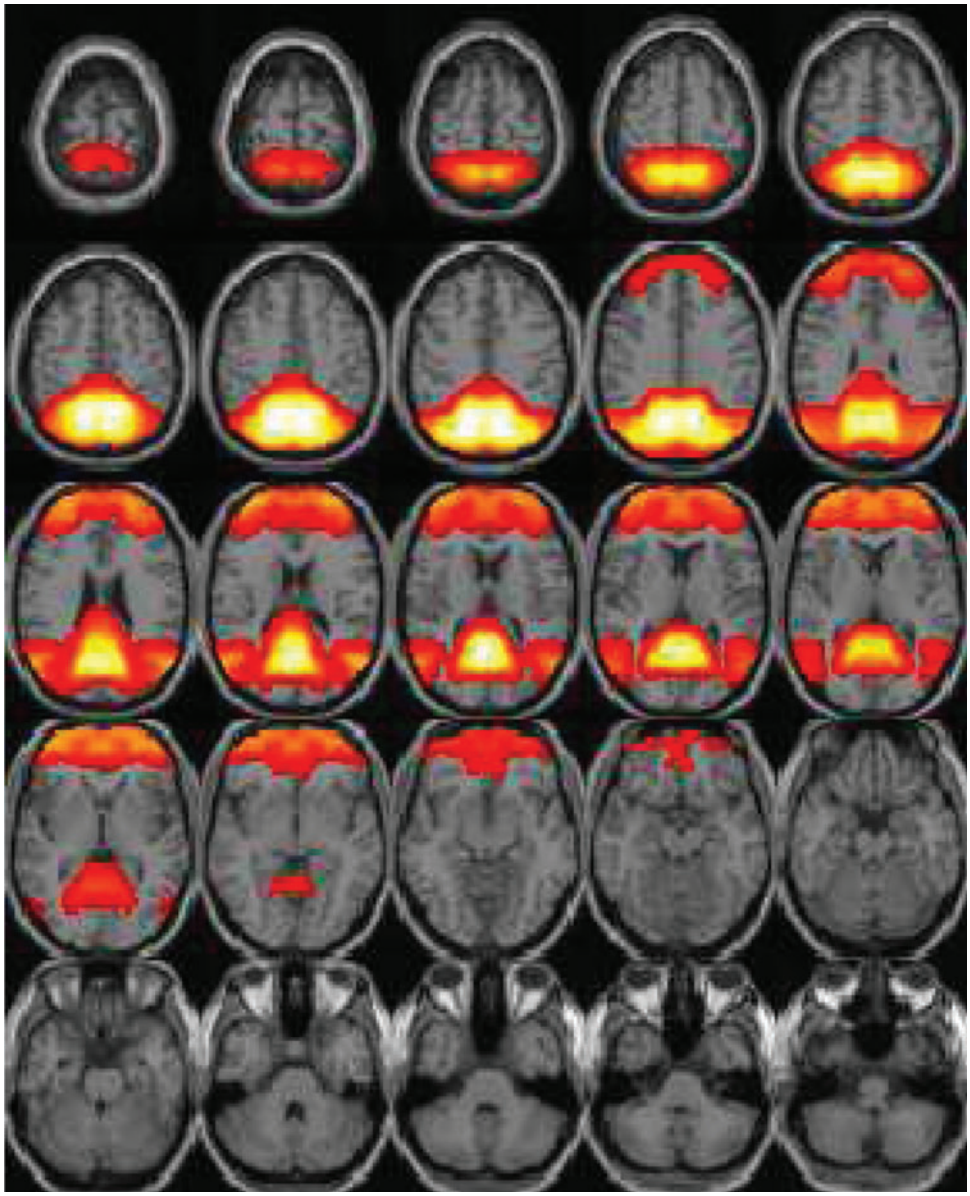
Data quality check. The diffusion tensor imaging (DTI) data quality was checked for (1) signal dropout due to subject motion, producing striated artifacts on images; (2) excessive background noise in the phase-encoding direction, due to an external radio frequency leakage in the MRI scan room or to subject motion; and (3) large amounts of motion in the absence of a signal dropout. If for a specific gradient direction any slice was found to have a problem, we decided to exclude the whole volume rather than some specific slices.

Normalization and smoothing. The DTI images were first extracted from the brain using the bet2 (FSL) program. The diffusion tensor and scalar diffusion parameters (axial diffusivity, radial diffusivity, and fractional anisotropy [FA]) were calculated by dtifit (FSL). The FA image was aligned to a FA template with a nonlinear registration algorithm, FNIRT (FMRIB's Nonlinear Image Registration Tool; FSL). A mean FA image was calculated from the spatially normalized images of each subject, and the FA image of each subject was normalized to this FA template using FNIRT. The normalized FA images were smoothed with an 8-mm FWHM Gaussian kernel and masked by a 0.1 white matter mask to remove the voxels outside the white matter. The size of each processed image was $79\times95\times69$ voxels.

Supplementary References

Ashburner J, Friston KJ. 2005. Unified segmentation. NeuroImage 26:839–851.

Good CD, Johnsrude IS, Ashburner J, Henson RN, Friston KJ, Frackowiak RS. 2001. A voxel-based morphometric study of ageing in 465 normal adult human brains. NeuroImage 14: 21–36.



SUPPLEMENTARY FIG. S1. An image of the default mode seed regions.