



The contribution of specific functional networks to individual variability

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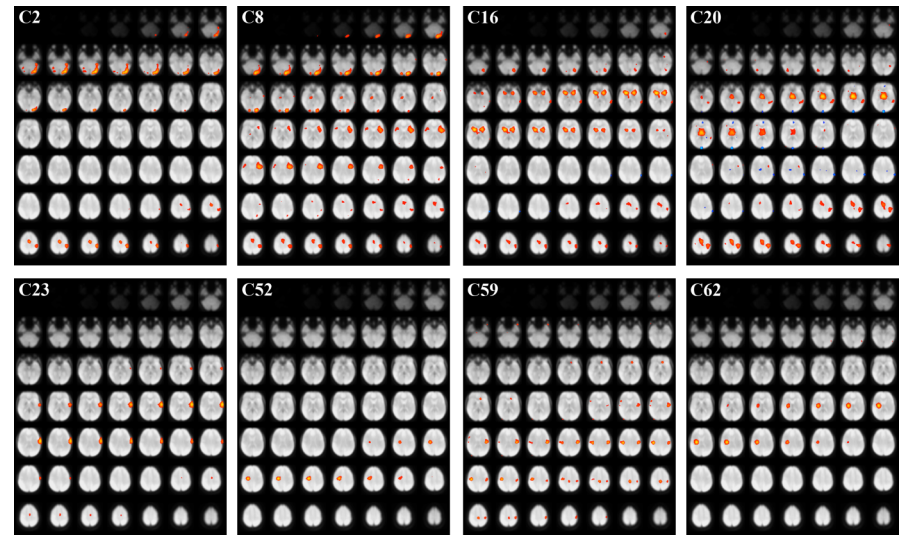
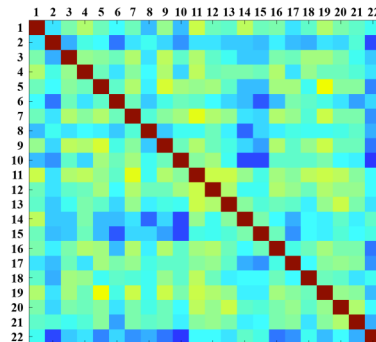
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INTRODUCTION. Individual differences in brain activity are a critical area of research in the struggle to understand the human brain. Recently, Miller et al. (2002) have used a whole-brain correlation technique to investigate inter-individual variability in fMRI results. The question that we sought to answer with this study was whether these whole-brain inter-individual differences in fMRI results could be localized to specific functional networks within the brain.

METHODS. We acquired fMRI data from 22 participants on an old/new episodic recognition task. Subjects were instructed to report whether each displayed word was old (previously seen during encoding) or new (the first time seen). Conversion of the raw DICOM data, realignment of the functional timeseries, spatial normalization to the ICBM-152 template space, and Gaussian smoothing were all completed using SPM5, as were standard subject-level modeling procedures. We then conducted the standard Miller cross-correlation analysis to quantify inter-individual variability in the task>rest contrast across subjects. To investigate independent functional networks across the group we used an independent components analysis (ICA) approach. We used the MELODIC toolbox from the FSL software suite to perform a joint tensor-ICA decomposition of the entire dataset (Beckmann and Smith, 2005). This results in a three-way decomposition representing the different signals and artifacts present in the data in terms of their temporal, spatial and subject-dependent variations.

SUBJECT VARIABILITY. The figure to the right shows the cross-correlation matrix of correlation values for each subject pair. The average inter-subject correlation was 0.43 with a range of 0.16 to 0.62. We calculated the mean correlation value for each subject as a measure of inter-subject distance. We then correlated this value with the subject/session mode of each ICA component to identify those components whose variability was significantly related to the calculated inter-subject variability.



COMPONENT RELATIONSHIPS. There were 146 components that resulted from the ICA analysis. An analysis of the component timecourses using the FSL FEAT toolbox revealed that a subset of 56 components had activity that was significantly related to the task. The subject/session mode of 8 out of the 56 components was determined to be significantly correlated ($r = 0.36$ to 0.45 , $p < 0.05$) with the inter-individual variability in the whole-brain results using the Miller approach. The spatial extent of these components is displayed in the above figure. The results support the hypothesis that separable functional networks within the brain are driving the whole-brain differences observed using the Miller et al. method. However, the multiple comparisons problem of correlating across so numerous ICA components remains unresolved.

Beckmann CF and Smith SM. (2005). Tensorial extensions of independent component analysis for multisubject fMRI analysis. *NeuroImage*, 25(1): 294-311.

Miller MB, Van Horn JD, Wolford GL, Handy TC, Valsangkar-Smyth M, Inati S, Grafton S, and Gazzaniga MS. (2002). Extensive individual differences in brain activations associated with episodic retrieval are reliable over time. *Journal of Cognitive Neuroscience*, 14(8): 1200-14.