INTRODUCTION

As fMRI researchers increasingly tackle naturalistic, complex experimental paradigms, response reliability is often used in place of response amplitudes as a metric of each voxel’s responsiveness to a stimulus. A voxel’s response from one run is used as a model for the same voxel’s response in the other runs, a process that is repeated for every possible pairing of runs. Voxels with “reliable” responses are those that consistently show positive correlations across pairings (Hasson, 2004). This approach is especially useful in cases where the mapping from stimulus to response is not well characterized, such as the free viewing of a naturalistic movie. But the relatively unconstrained nature of these paradigms translates to a low contrast-to-noise ratio, so response reliability measures have much to gain from denoising techniques. To this end, we apply multi-echo independent component analysis (MEICA), a recently developed technique that has shown great promise in resting-state and task-based analyses (Kumst, 2012; Kuusk, 2013), to data from the free viewing of a naturalistic movie.

METHODS

Data Collection
GE 1T MR 3T MR scanner GE 3T GE scanner GE 3T head coil GE, 3T, 5T, 7T, 11T, 15T, 31T, 40 T, 57 T

Preprocessing
Data: Data are divided into two healthy adults (1M, 1F) collected over 9 days. (a) Echo2 data were spatially blurred with a 6mm Gaussian and used for the “Blurring” control analysis. (b) Components were removed at random until the same amount of variance as MEICA was removed. The result is used in the “CompRem” control analysis. (c) Noise was removed at random until the same amount of variance as MEICA was removed. The result is used in the “NoiseRem” control analysis. (d) Time courses were calculated for each voxel in each run and were correlated with the time-course on the other run to get a correlation coefficient. The N-1)/2 resulting correlation coefficients are averaged, and the result is mapped back on to the voxel’s position. To assess significance, the correlation coefficients are compared to a normal distribution with FDR correction (q<0.05) for multiple comparisons.

RESULTS

Response Reliability is Greater with MEICA

Newly Reliable Voxels are Mainly in Gray Matter

CONCLUSIONS

The addition of Multi-Echo ICA denoising to intra-subject correlation analysis in a naturalistic paradigm results in a much greater spatial extent of reliable activation. This suggests that many areas of the brain are involved in processing naturalistic stimuli but are too obscured to be apparent in standard ISC analyses. This result serves as a naturalistic-stimulus extension of recent findings that the low CNR of task-based fMRI studies generates numerous false negatives (Gonzalez-Castillo, 2012). These new observations may inspire new, more targeted studies: using reverse correlation analysis (Hasson, 2004), we may generate testable hypotheses about the roles of these regions in the processing of dynamic visual stimuli.

REFERENCES


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