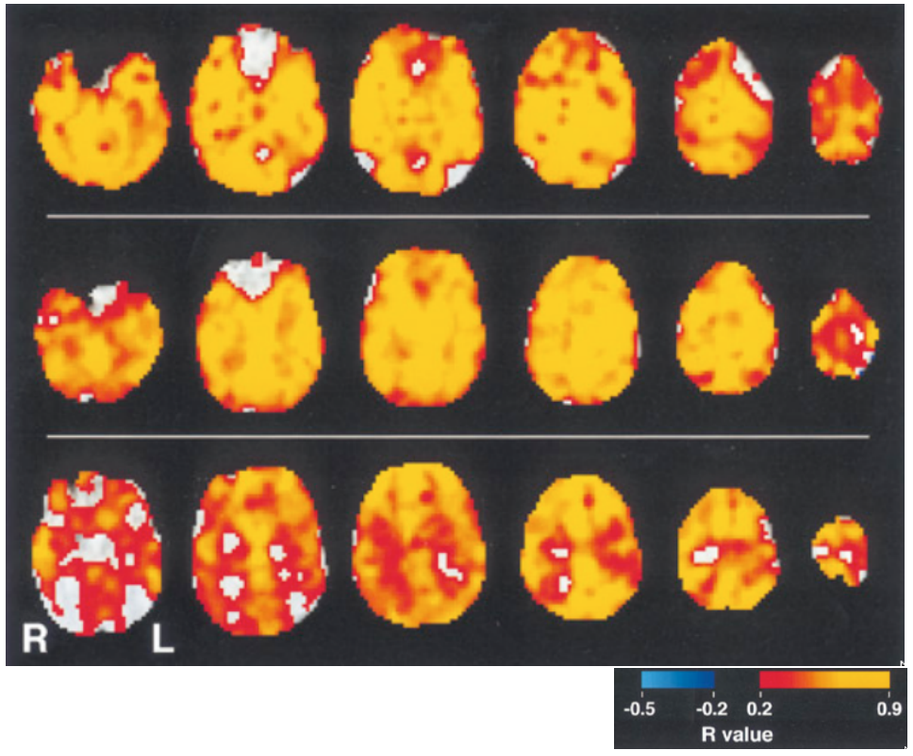
# Supplemental Figures

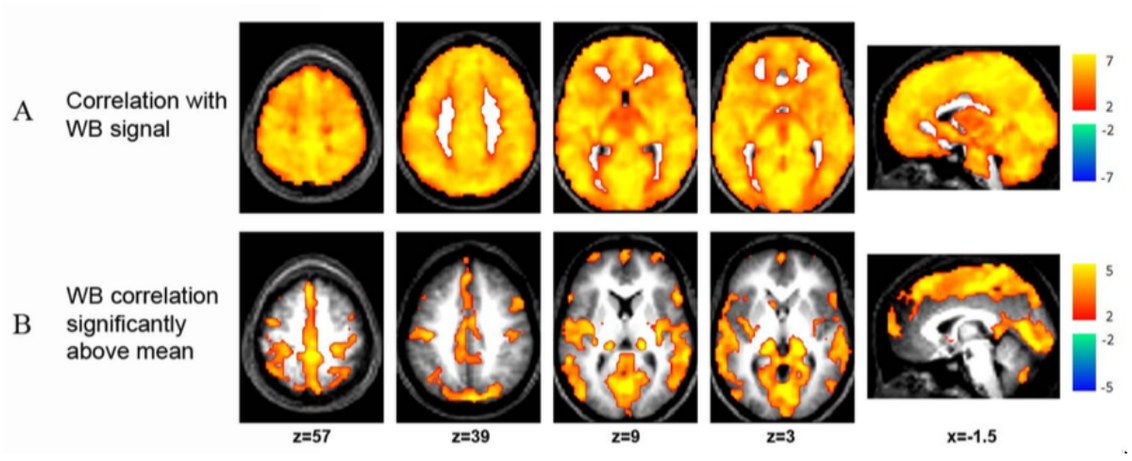
A)

Aguirre et al., 1997 (Figure 2)



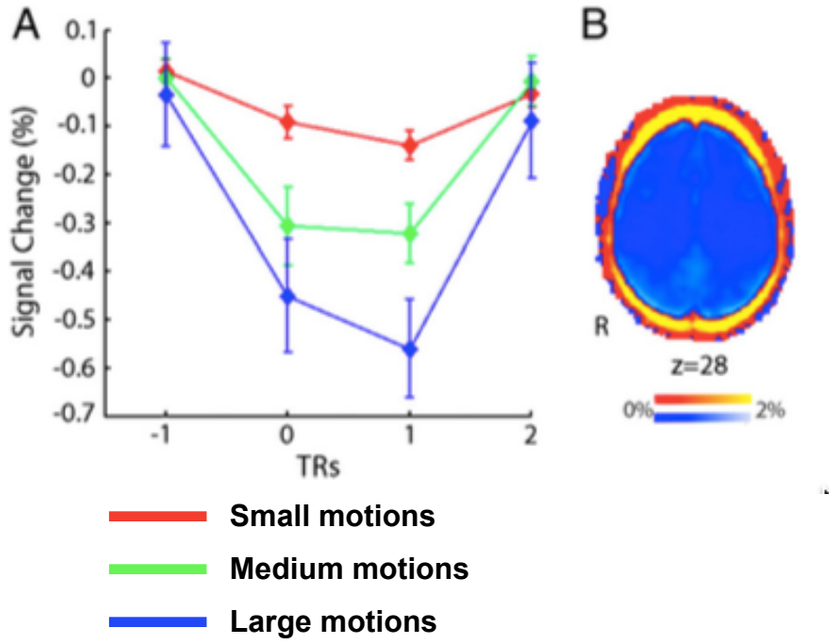

B)

Fox et al., 2009 (Supplemental Figure 3)




C)

Satterthwaite et al., 2013 (Figure 3)




D)

Kastrup et al., 1999 (Figures 2 and 1)

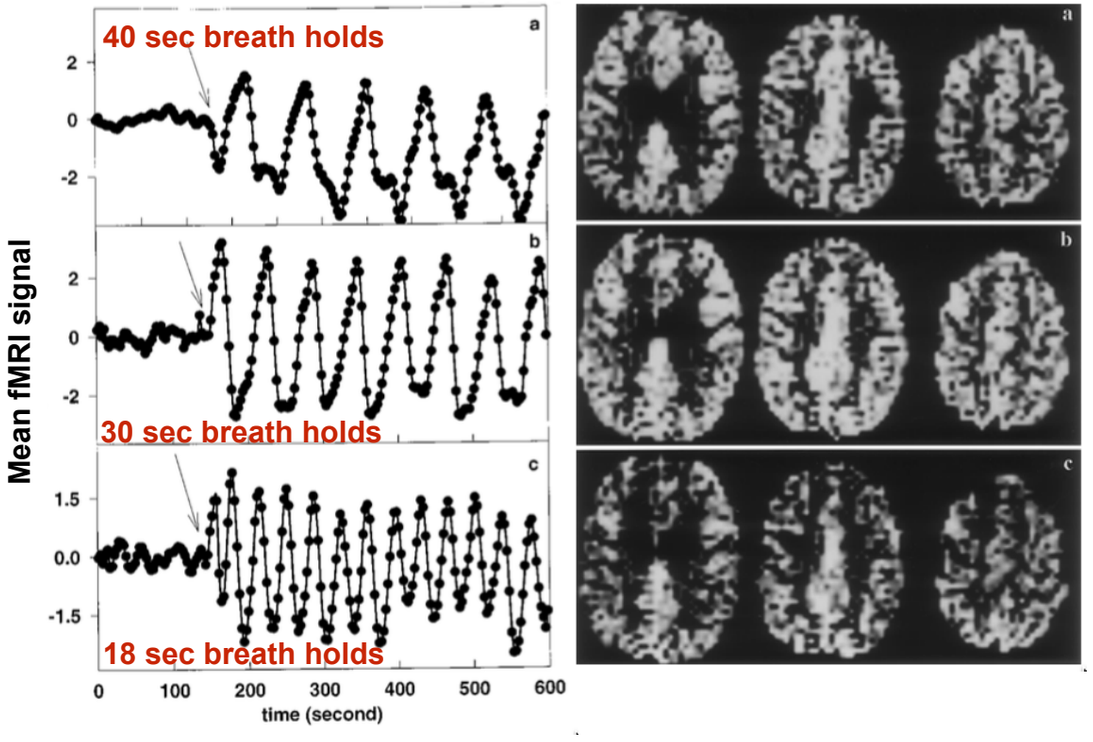



**Figure S1: Relevant images from prior literature.** A) 3 GSCORR maps in [Aguirre, 1997]. B) Group GSCORR map from [Fox, 2009]. C) fMRI signal modeled during and after head motion in [Satterthwaite, 2013]. D) fMRI activation maps and mean signals associated with repeated breath holds of varying duration in [Kastrup, 1999].

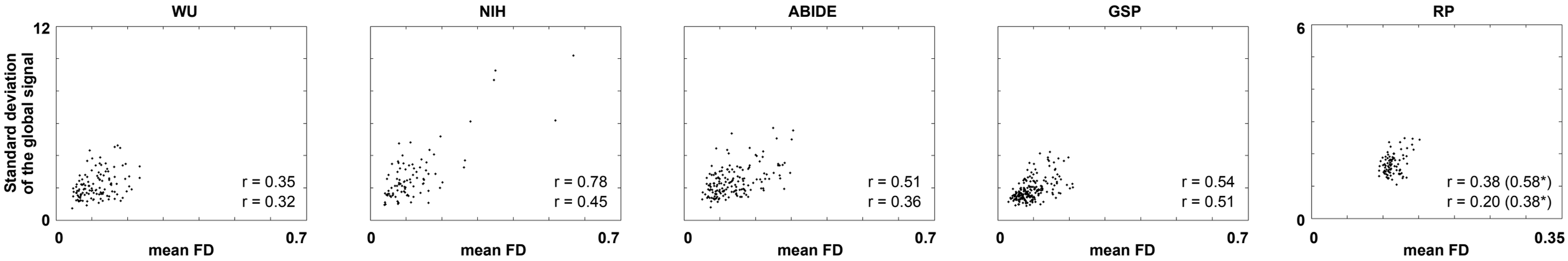



**Figure S2: Motion indexes variance in the global signal**. For each cohort, mean FD and global signal standard deviation are plotted for each subject. Top r value is the correlations of these values across all subjects, the bottom r value excludes “high-motion” volumes with FD > 0.5 mm. Starred values in the RP dataset reflect a modified motion measure: in the RP dataset, the sampling rate is rapid enough that FD captures periodic respiratory motion (see the small FD bumps in RP plots in Figure 2, more easily seen in Video 2); if the proportion of a scan with FD > 0.3 mm is used as the index of motion in these data (which removes the influence of these small cyclic motions), the correlation between motion and global signal standard deviation increases from r = 0.38 and 0.20 to r = 0.58 and 0.38.

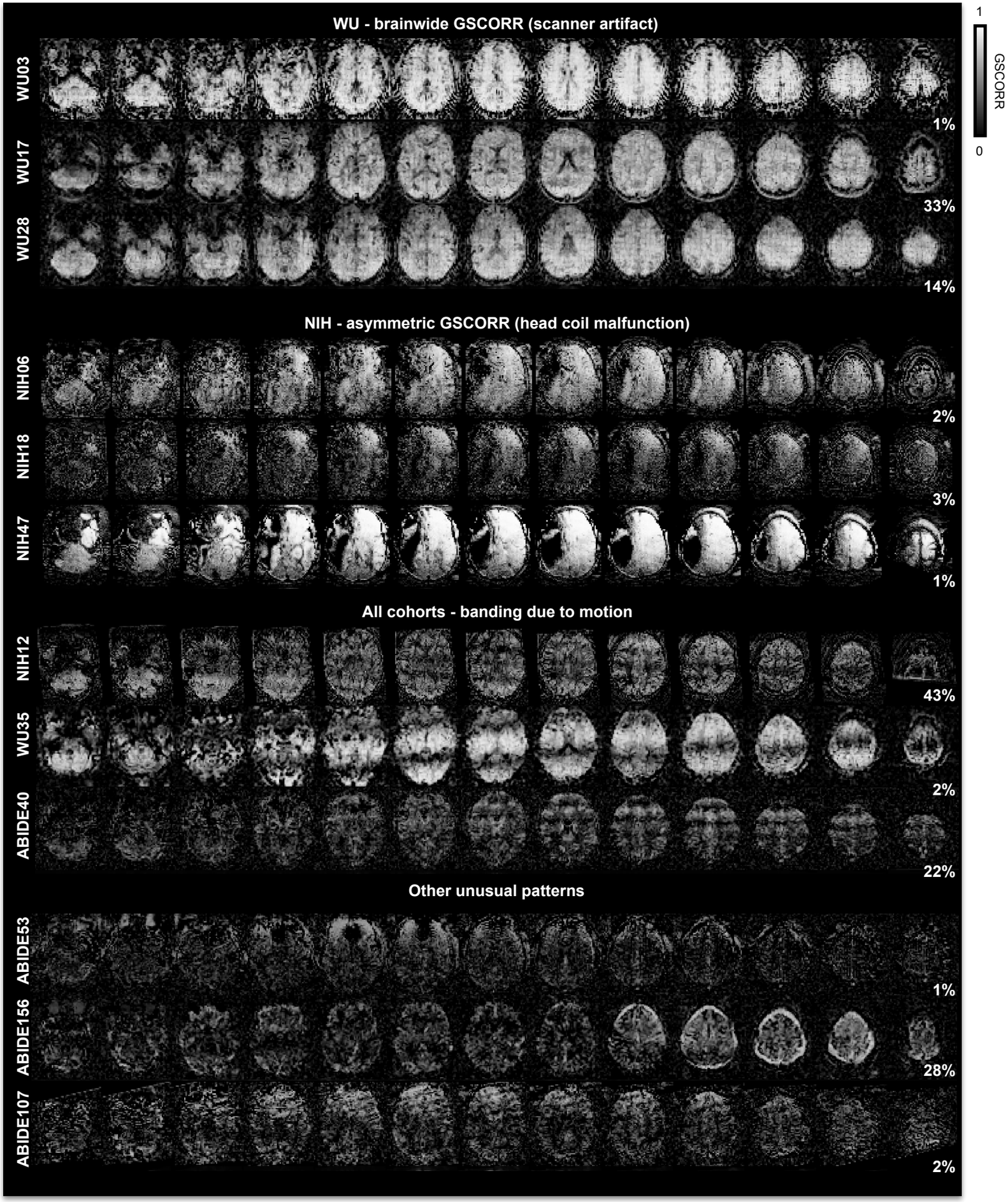



**Figure S3: Atypical GSCORR maps**. Examples of unusual GSCORR maps.

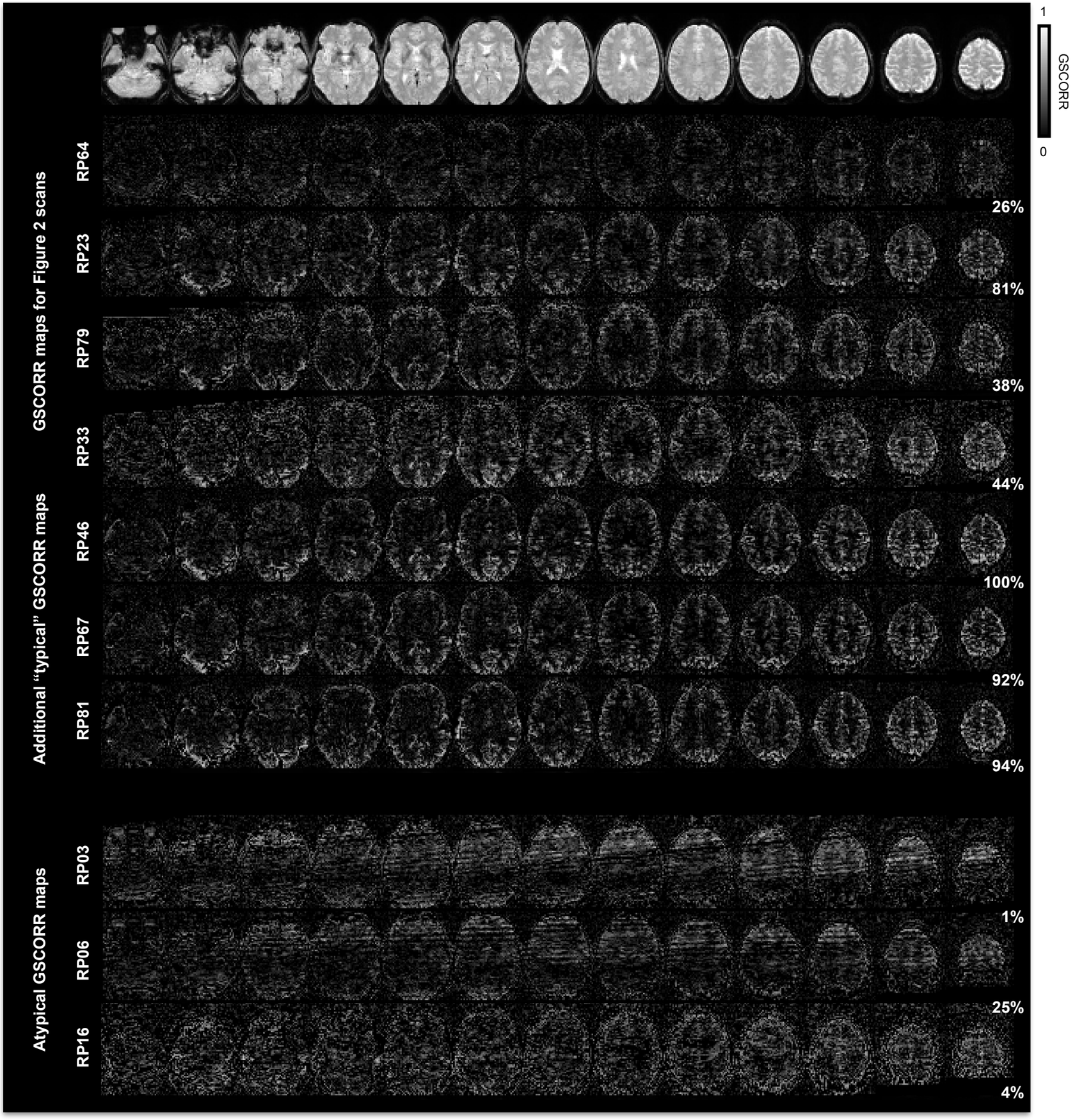



**Figure S4: GSCORR maps in the RP dataset**. GSCORR maps for the scans shown in Figure 2, with additional illustrations of typical and atypical GSCORR maps. The first half of the 84 scans studied contained many more atypical maps than the latter half of scans. Median GSCORR in the RP dataset was therefore calculated as the median of scans 43-84.

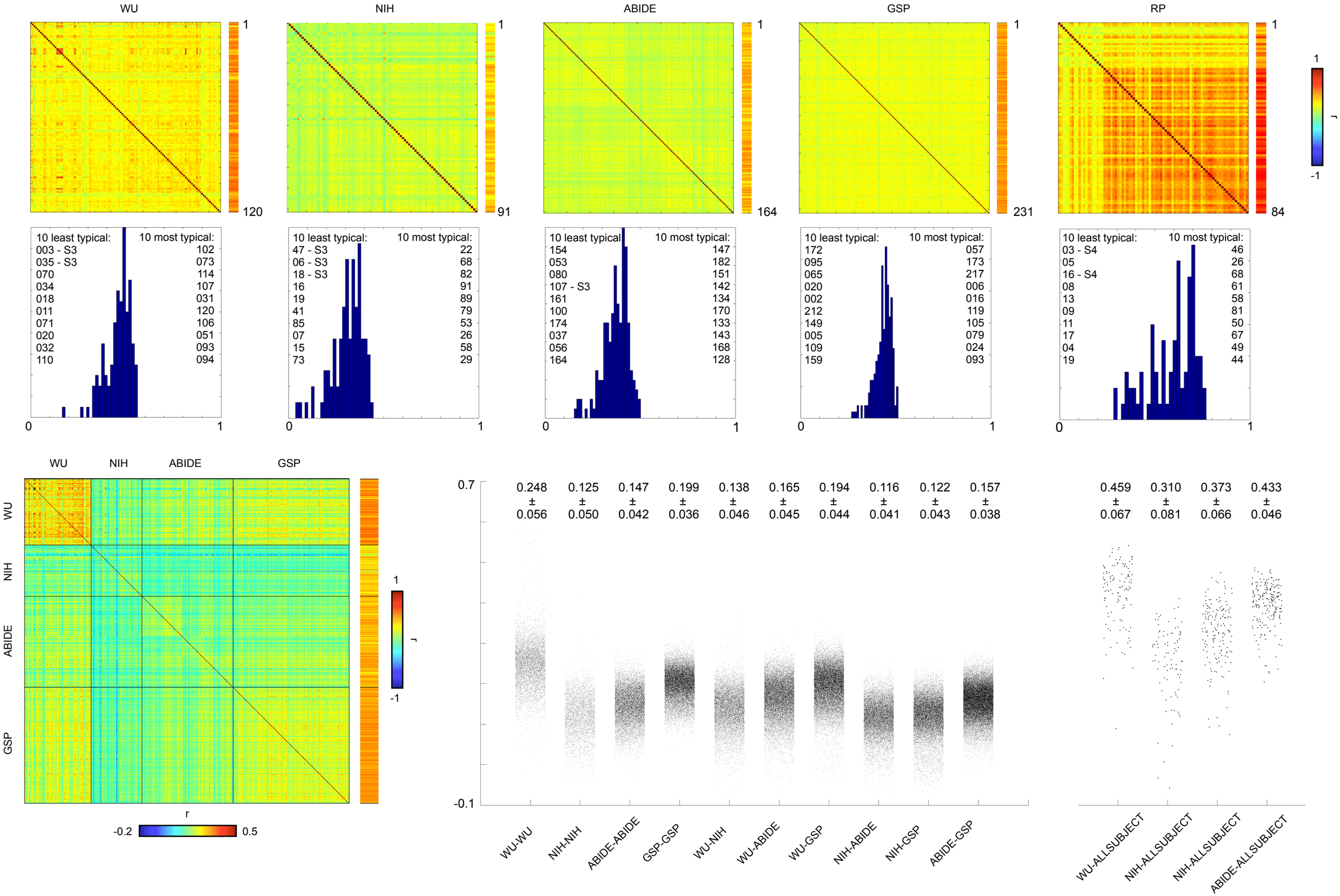



**Figure S5: Variability in GSCORR maps**. Top matrices show correlations of GSCORR maps within each cohort. Using the WU, NIH, ABIDE, and GSP data, which are all registered to the same atlas, the median cross-subject GSCORR across cohorts was calculated (the ALLSUBJECT map). The columns to the right of each matrix show the correlation of each subjects GSCORR map with the ALLSUBJECT map, and the histogram displays the values in the column. The 10 subjects with highest and lowest correlations to the ALLSUBJECT map are listed in the histogram. For the RP cohort, which exists in a different atlas space, the median GSCORR image within the RP cohort served as the ALLSUBJECT map. The matrix at bottom replots the matrices at top, but now with all cross-cohort comparisons also included (the matrix is on a different color scale to make differences easier to see; the column is on the same colorscale as above). The scatter plots show the values in the matrix and the column. Differences between cohorts in the magnitudes of correlations are highly significant.

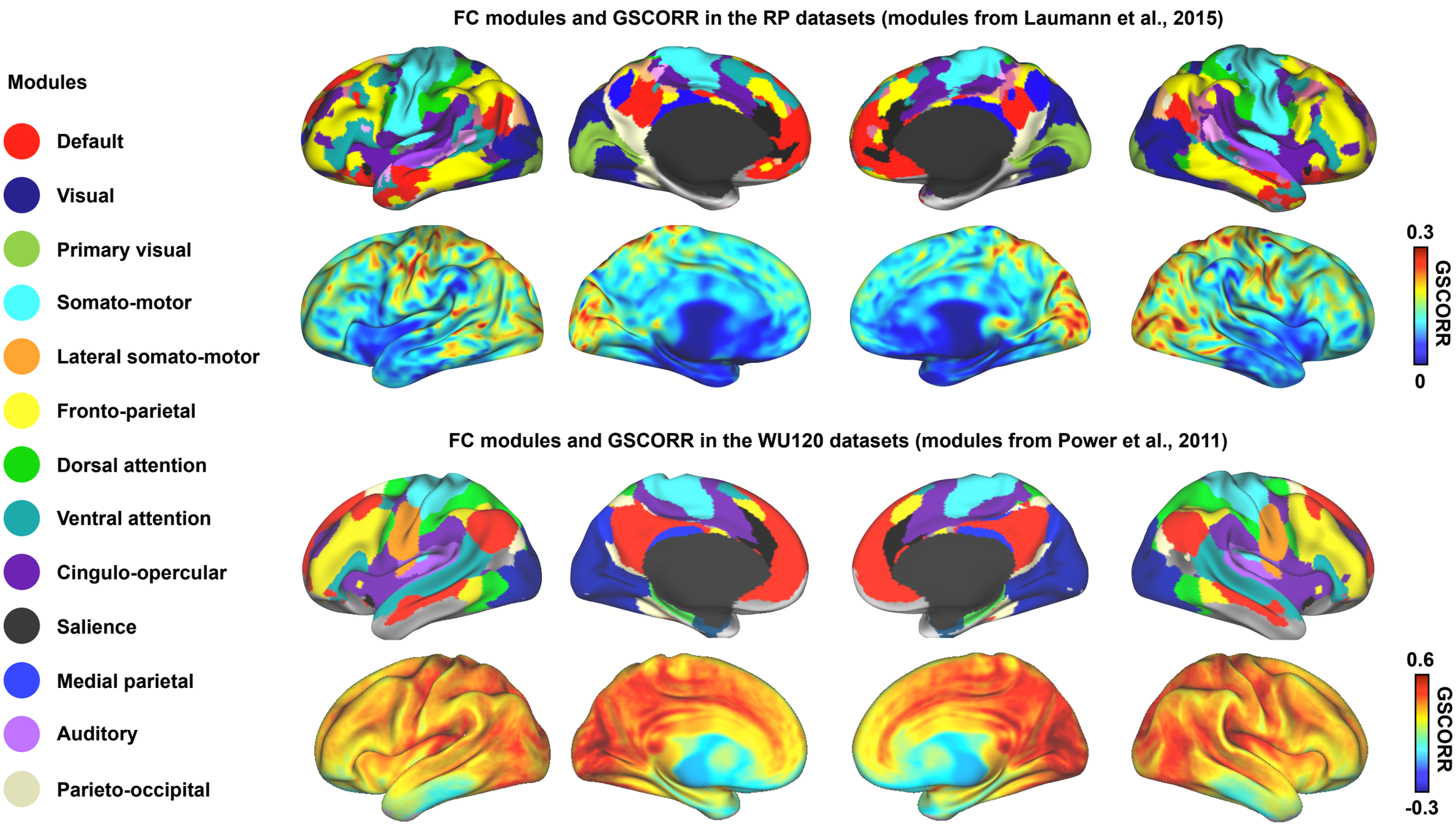
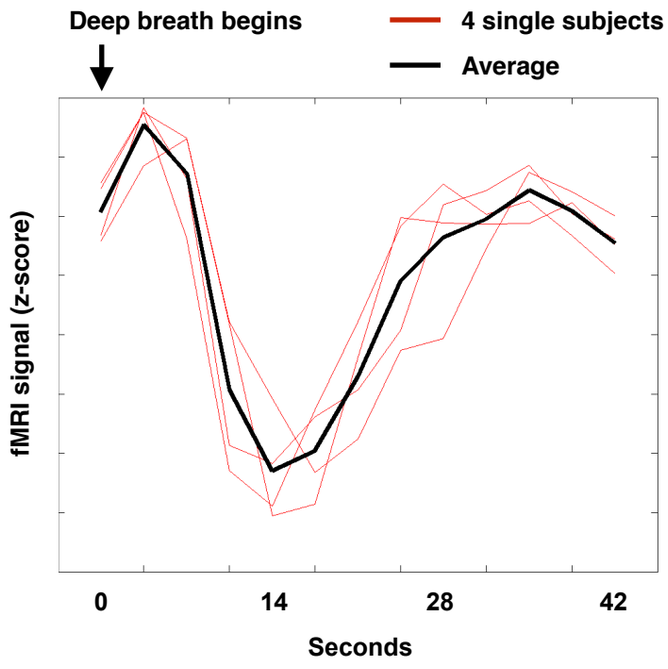
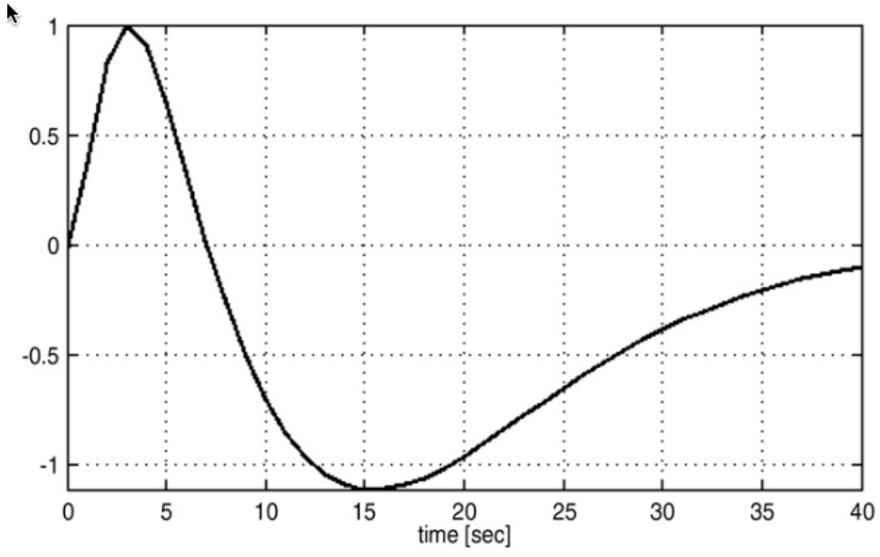



**Figure S6: Functional connectivity modules and GSCORR.** Resting state modules in RP and WU datasets are shown in the colored maps, GSCORR is shown on the same surfaces.

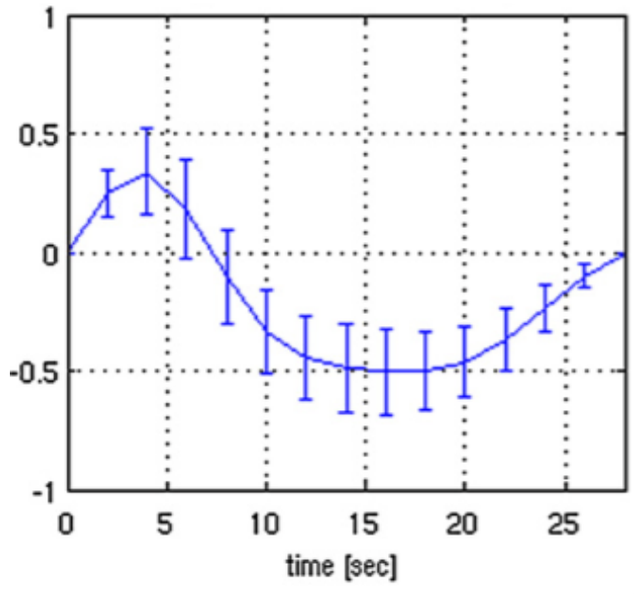
**Respiratory response function defined in NIH subjects from isolated deep breaths**




**Respiratory response function defined in Birn et al., 2008 from instructed deep breaths performed every 40 seconds (figure modified from Chang and Glover, 2009)**




**Respiratory response function defined in Chang and Glover, 2009 by signal deconvolution (with concurrent estimation of other filters) (figure modified from Chang and Glover, 2009)**




**Stillman et al., 1995: fMRI response to breath hold (apnea)**

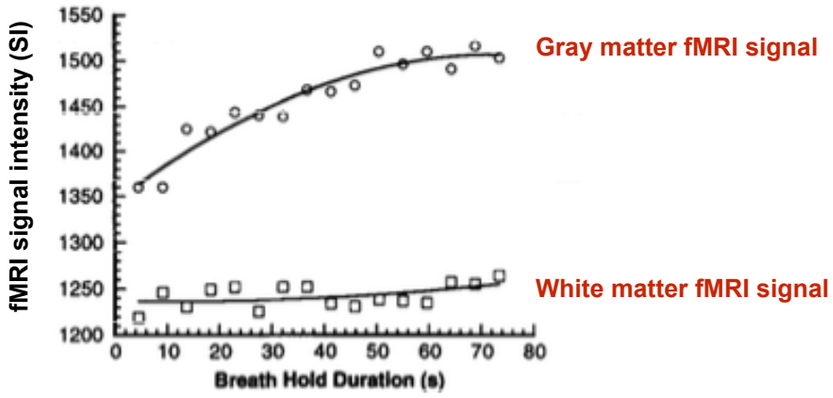



Fig. 1. Mean SI measurements as a function of breath hold duration. The solid curves represent the least squares fits to quadratic polynomials. It is seen that over the breath hold period the SI in the gray matter is approximately quadratic. There is no significant change in the white matter.

**Poulin et al., 1996: arterial flow during forced, prolonged changes in blood gases**

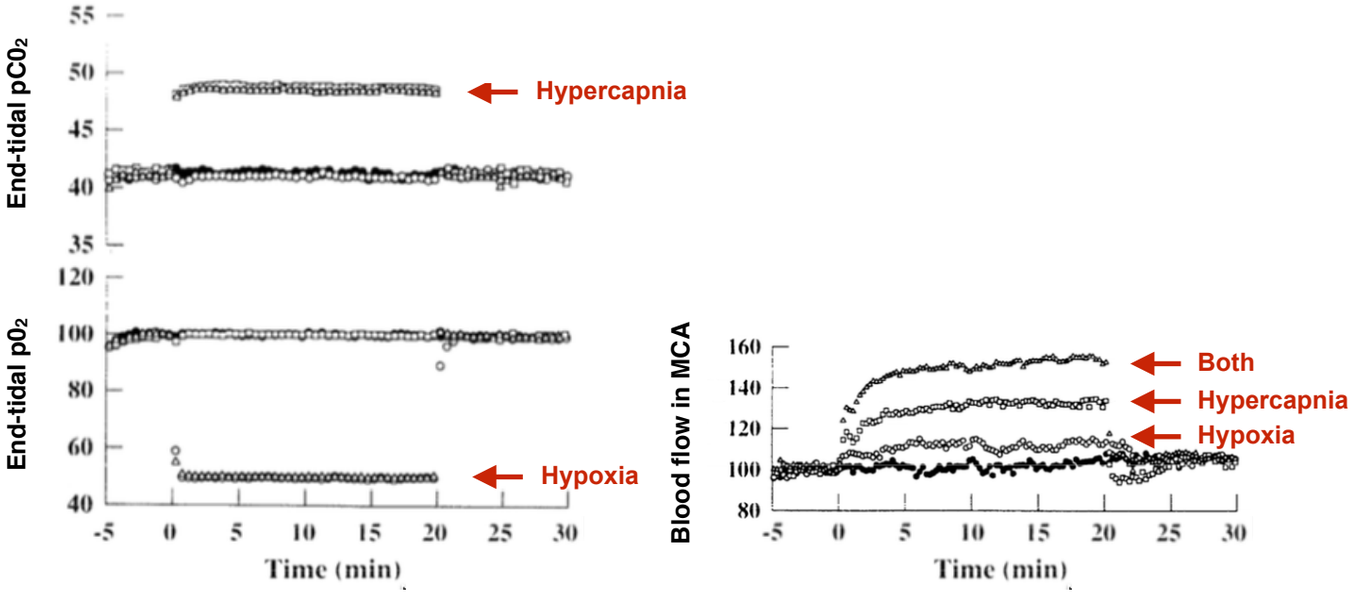



**Figure S7: Respiratory response functions (RRFs) defined in NIH subjects approximate published RRFs**. At top middle and top right, RRFs reported from prior studies. At top left, red traces show mean gray matter signal for 42 seconds after a deep inspiration on the respiratory belt trace for breaths in 4 subjects. These subjects and breaths (NIH36 TRs 111-123; NIH48 TRs 73-85; NIH49 TRs 112-124; NIH75 TRs 43-55) were chosen because the breath was temporally isolated before and after its occurance for a long period of time from other breaths or apparent artifacts. At bottom, relevant data from prior studies on blood flow and fMRI signal changes evoked by breath hold or forced changes in blood gases.

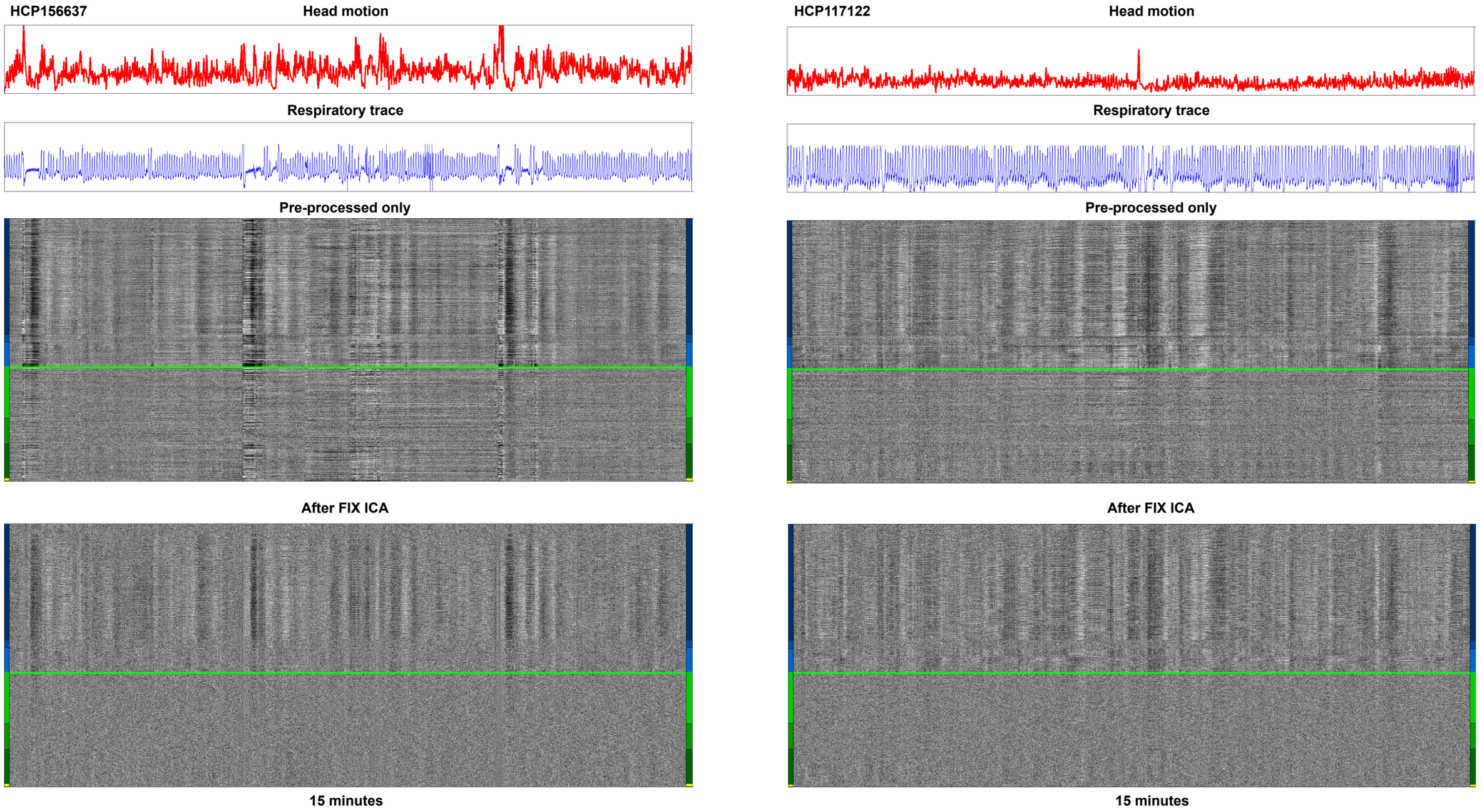



**Figure S8: HCP scans before and after FIX ICA.** Plots follow conventions from Figure 7 and Video 4. See Video 5 for such plots in all subjects of the “40 Unrelated Subjects” collection.