

Supplementary Figure Legends

Supplementary Video Animated percent fMRI changes in 4 axial views displayed at 1s intervals from -20 to +26s relative to seizure onset. Data are the same as in Figure 4 (and Supplementary Figure 2), obtained from the group analysis of 51 seizures in 8 patients: 37 seizures in 7 patients during CPT or RTT and 14 seizures in 4 patients during VFT (3 patients with both CPT/RTT and VFT runs). The duration of all seizures was scaled to 6.6 s (the mean seizure duration), and the preictal, ictal and postictal periods were then temporally aligned across seizures. fMRI percent change increases (warm colors) and decreases (cool colors) are shown, with a display threshold of 0.5%.

Supplementary Figure 1 Changes in EEG signal power in frontal electrodes begin and end abruptly with seizures. Average time-frequency dynamics of spike-wave discharges in six channels (FP1, FP2, F3, F4, F7 and F8) from -20s to +26s relative to seizure onset. A total of 54 seizures in 9 patients were analyzed: 40 seizures in 8 patients during CPT/RTT; 14 seizures in 4 patients during VFT (3 patients with both CPT/RTT and VFT runs). Analysis was by short-time Fourier Transform. All ictal periods were scaled to the mean seizure duration (6.6 s) as in Figure 1.

Supplementary Figure 2: Detailed fMRI percent signal change maps associated with seizures. Same data as Figure 4, but in 16 axial views from -20 to +26s relative to seizure onset at 1s time intervals. Data are from group analysis of 51 seizures in 8 patients: 37 seizures in 7 patients

during CPT or RTT and 14 seizures in 4 patients during VFT. fMRI percent change increases (warm colors) and decreases (cool colors) are shown, with a display threshold of 0.5%. The duration of all seizures was scaled to 6.6s (mean seizure duration), and the preictal, ictal, and postictal periods were then temporally aligned across seizures. Early fMRI signal increases were seen well before seizure onset (0s) in medial orbital frontal (OF), frontal polar (FP), cingulate (CG), lateral parietal (LP), precuneus (PC), and lateral occipital (LO) cortex. After seizure onset, fMRI increases progressed to also involve Rolandic (Ro), lateral frontal (LF) and temporal (LT) cortex. Following the end of seizures, fMRI increases were seen in the medial occipital (MO) cortex, and lastly in the thalamus (Th). fMRI signal decreases occurred later, and continued well after seizure end. Decreases were observed initially in medial/orbital frontal, cingulate, medial and lateral parietal cortex, followed by decreases in lateral frontal, temporal and occipital cortex, and basal ganglia. See also Supplementary Video (online) which presents the same data in animated format.

Supplementary Figure 3 Cortical and subcortical fMRI percent change maps during no seizure periods. We performed a group analysis using the same number of data segments, with identical timing with respect to behavioral tasks, and from the same patients as Figure 4 (and Supplementary Figure 2), but during times when no seizures occurred. fMRI percent change increases (warm colors) and decreases (cool colors) are shown, with a display threshold of 0.5%.

Supplementary Figure 4 Detailed fMRI percent signal change maps during no seizure periods. Same data as Supplementary Figure 3, but in 16 axial views, and at 1s time intervals. We performed a group analysis using the same number of data segments, with identical timing with

respect to behavioral tasks, and from the same patients as Supplementary Figure 2 (and Figure 4), but during times when no seizures occurred. fMRI percent change increases (warm colors) and decreases (cool colors) are shown, with a display threshold of 0.5%.

Supplementary Figure 5 7 anatomical VOIs chosen based on percent fMRI signal changes observed in Fig. 4, and segmented from SPM MRI template Colin27. VOIs were constructed from the standard MARSBAR regions as follows: Medial and orbital frontal (Cingulum_Ant + Frontal_Sup_Medial + Frontal_Med_Orb + Frontal_Sup_Orb + Rectus); Lateral frontal (Frontal_Inf_Oper + Frontal_Inf_Tri + Frontal_Mid + Frontal_Sup); Lateral temporal (Heschl + Temporal_Sup); Parietal (Angular + Parietal_Sup + Parietal_Inf + Supramarginal + Cingulum_Post + Cingulum_Mid (posterior half only) + Precuneus); Occipital (Calcarine); Rolandic (Paracentral + Precentral + Postcentral, all truncated below SI 52mm); and Thalamus (Thalamus).

Supplementary Figure 6 fMRI timecourses during no seizure periods. Mean fMRI timecourses in 7 anatomical VOIs (see Supplementary Figure 5 online for regions). We performed a group analysis using the same number of data segments, with identical timing with respect to behavioral tasks, and from the same patients as Figure 5, but during times when no seizures occurred. Red and blue curves represent the positive and negative HRF models obtained by convolving a boxcar function of 6.6s (mean seizure duration, shown in gray) with the canonical HRF of SPM2. Green dashed lines are standard deviation. Data for no seizure periods are the same as in Supplementary Figures 3 and 4.

Supplementary Figure 7 fMRI timecourses during absence seizures without time scaling. Mean fMRI timecourses in 7 anatomical VOIs (see Supplementary Figure 5 online for regions). Data are same as Figure 5, but timecourses were not scaled, rather each seizure onset time was simply aligned to $t = 0$. Group analysis of 51 seizures in 8 patients as in Figure 5. Red and blue curves represent the positive and negative HRF models as in the other Figures. Green dashed lines are standard deviation. Comparing timecourses with and without time scaling (Figure 5), the curves during pre-ictal period were identical. In the ictal and postictal times there were only small differences, with the lateral temporal and Rolandic regions showing stronger peak amplitudes, but the same overall shape.

Supplementary Figure 8 Individual mean fMRI timecourses of 7 subjects in CPT/RTT runs (A-G) and 4 subjects in VFT runs (H-K) in 7 anatomical ROIs (see Supplementary Figure 5 online for regions). Data and patients are the same as in Figure 5. Red and blue curves represent the positive and negative HRF models obtained by convolving a boxcar function of 6.6s (mean seizure duration, shown in gray) with the canonical HRF of SPM2.