

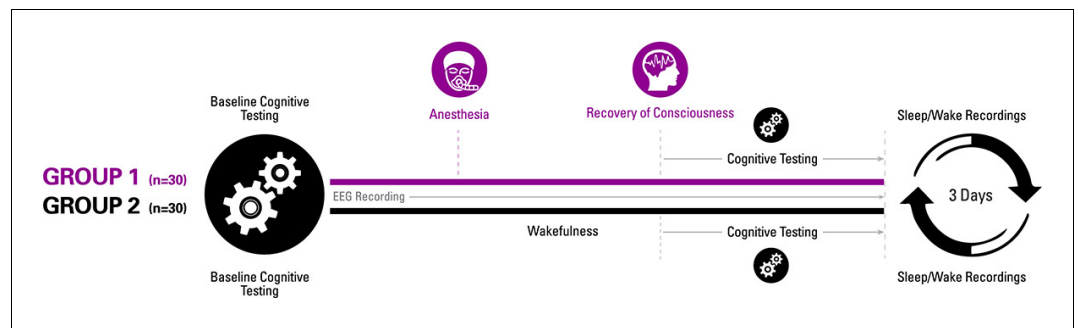


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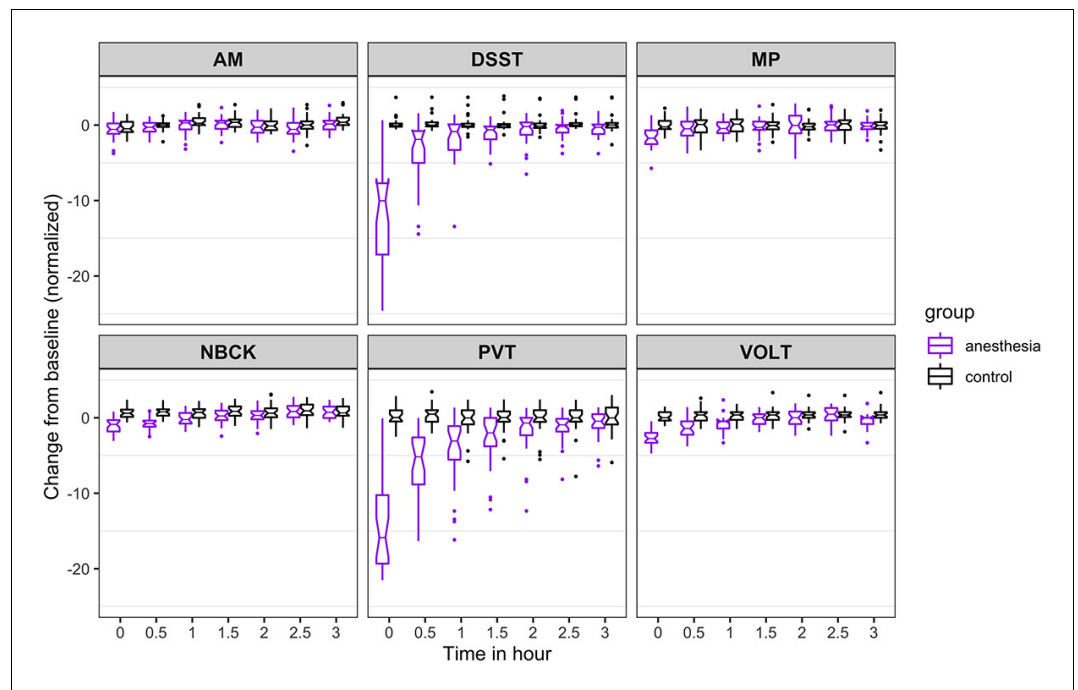
## Figures and figure supplements

Recovery of consciousness and cognition after general anesthesia in humans

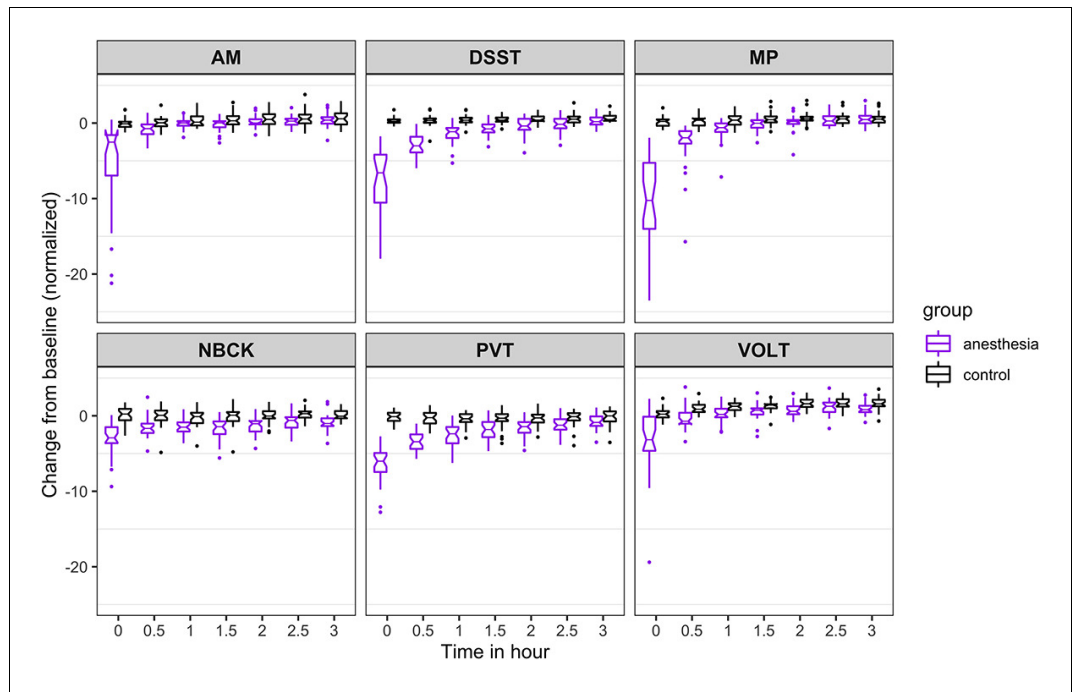
**George A Mashour et al**



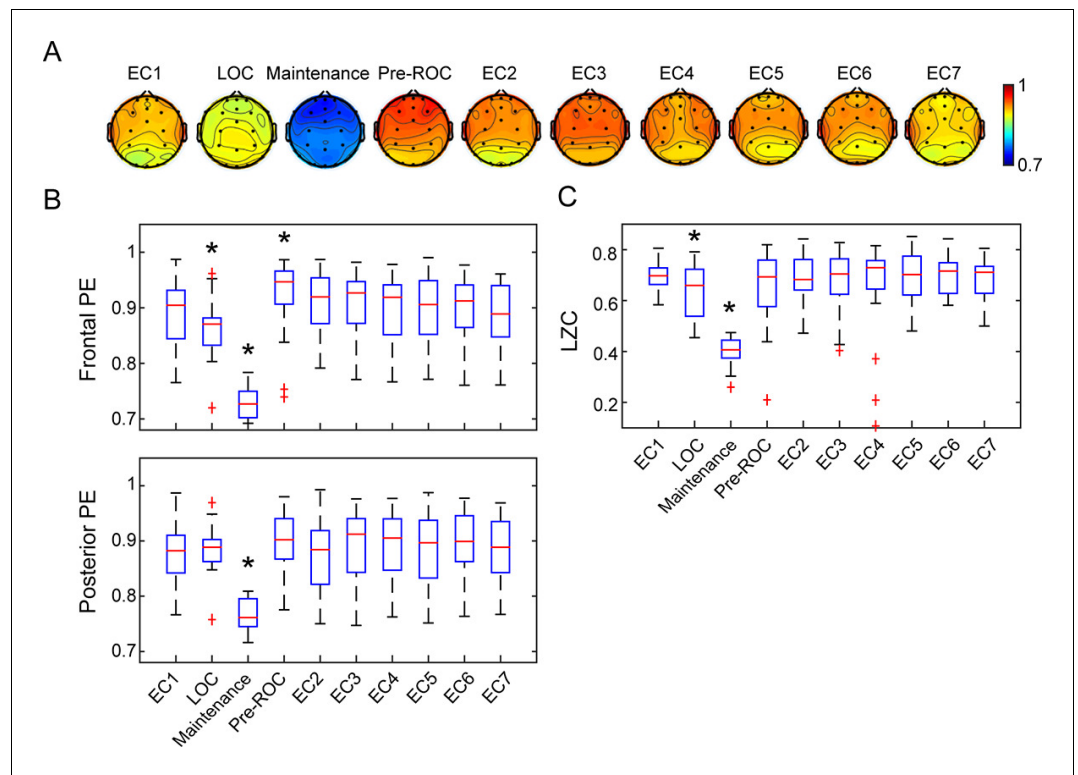
**Figure 1.** Experimental design. Participants were randomized to one of two groups for investigating recovery of consciousness and cognition after general anesthesia. Sleep-wake actigraphy data were acquired in the week leading up to the day of the experiment, which started with baseline cognitive testing followed by either a period of general anesthesia (1.3 age-adjusted minimum alveolar concentration of isoflurane) or wakefulness. Upon recovery of consciousness (or similar time point for controls), recurrent cognitive testing was performed for 3 hr. Actigraphy resumed for 3 days after the experiment.



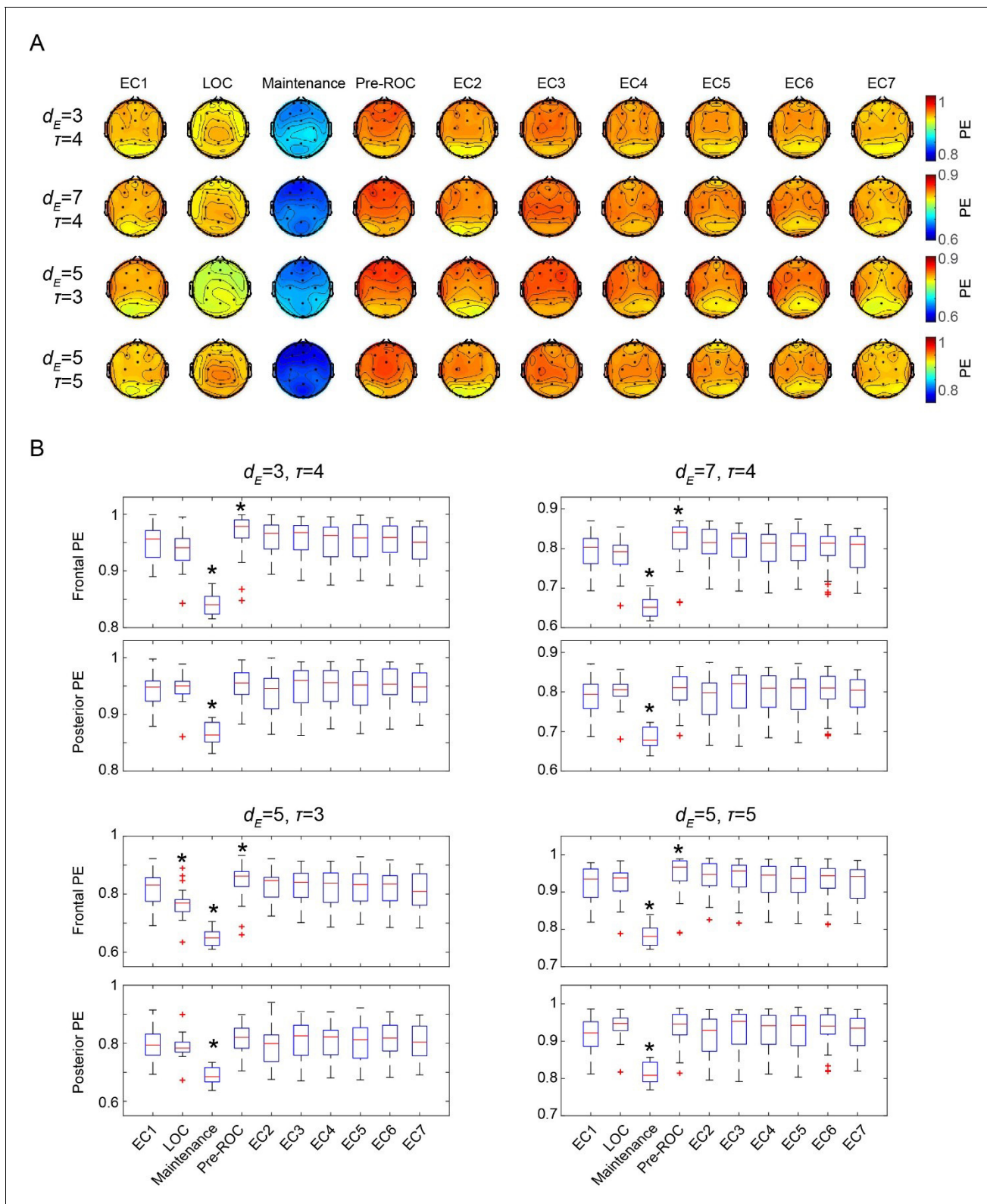
**Figure 2.** Time course for recovery of (normalized) accuracy in cognitive task performance after general anesthesia (time 0 is just after recovery of consciousness in the group that was anesthetized). AM, Abstract Matching; DSST, Digit Symbol Substitution Test; MP, Motor Praxis; NBCK, Fractal 2-Back; PVT, Psychomotor Vigilance Test; VOLT, Visual Object Learning Test. The six cognitive tests are all represented.

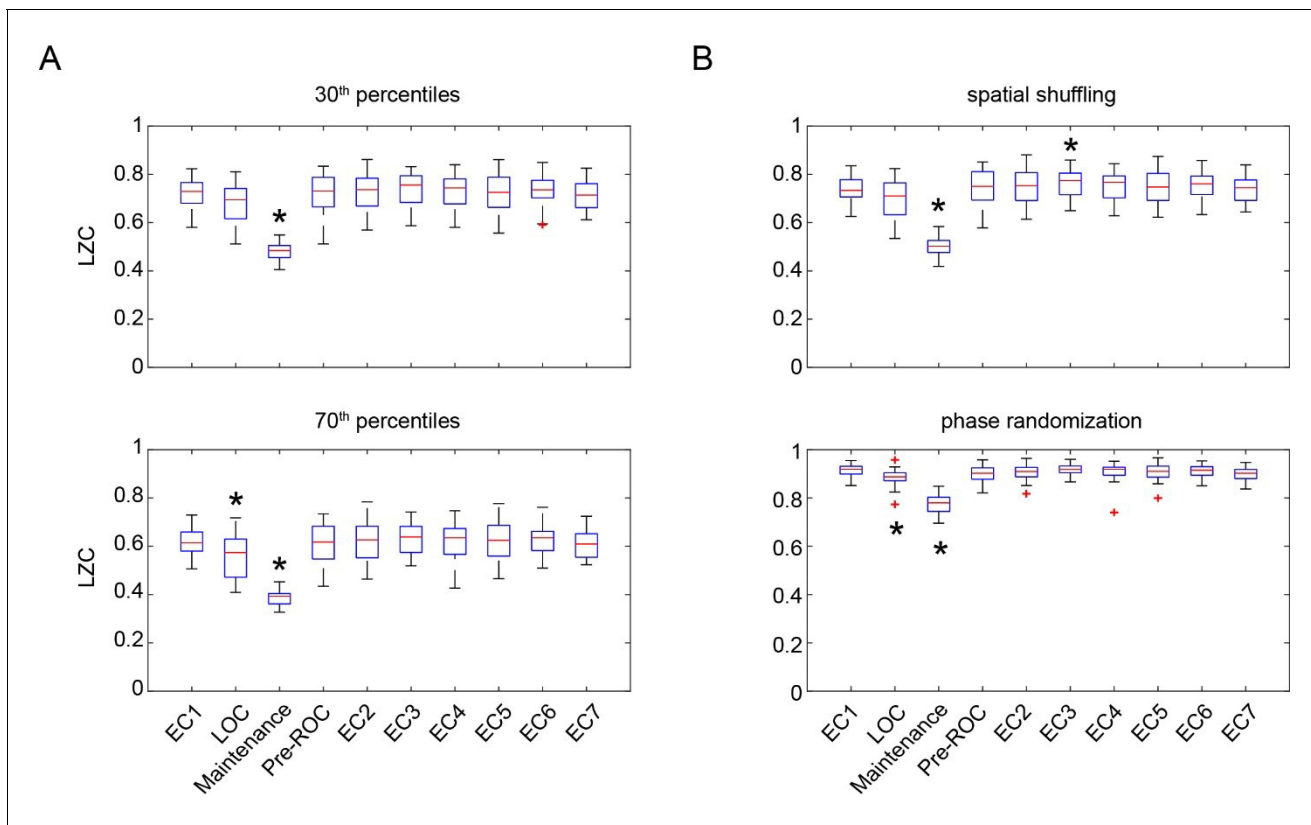


**Figure 3.** Time course for recovery of (normalized) speed of cognitive task performance after general anesthesia (time 0 is just after recovery of consciousness in the group that was anesthetized). AM, Abstract Matching; DSST, Digit Symbol Substitution Test; MP, Motor Praxis; NBCK, Fractal 2-Back; PVT, Psychomotor Vigilance Test; VOLT, Visual Object Learning Test. The six cognitive tests are all represented.

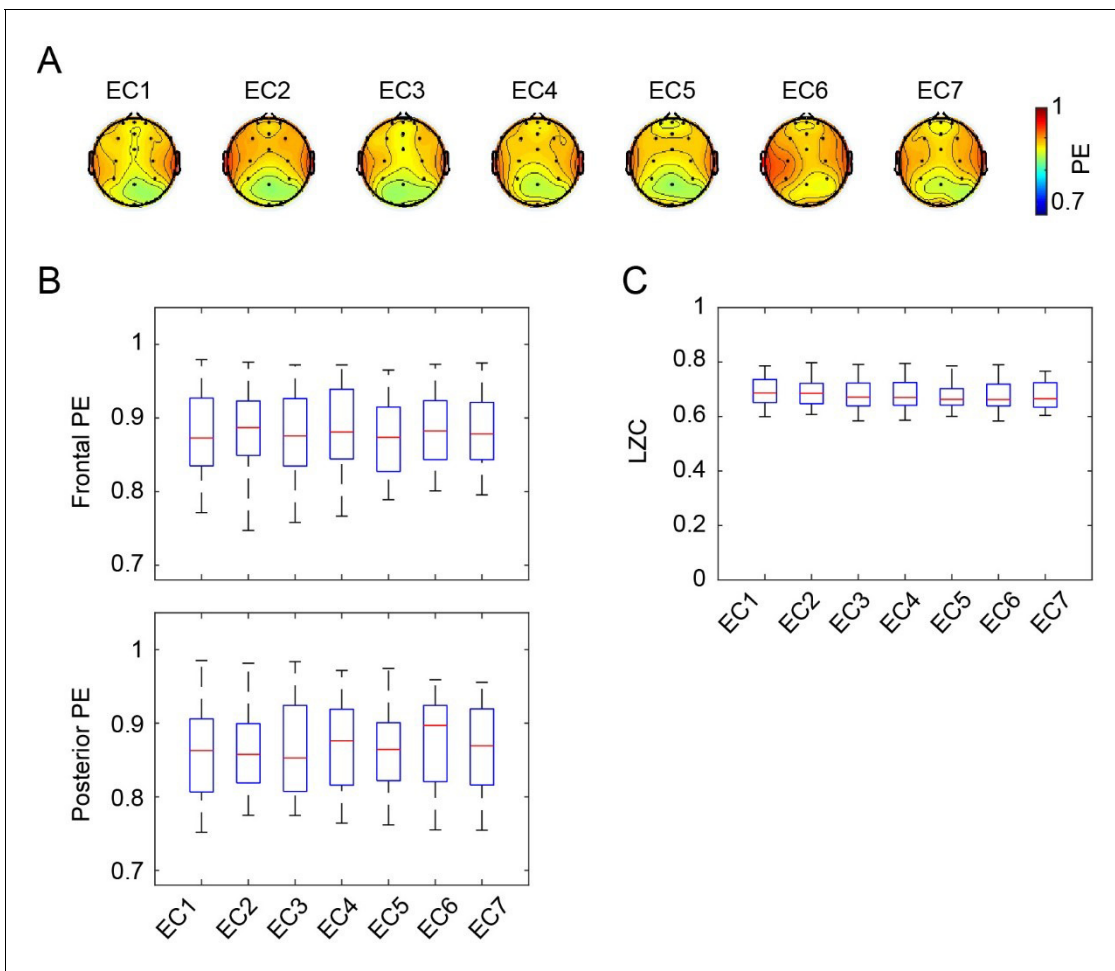


**Figure 4.** Cortical dynamics before, during, and after general anesthesia. (A) Scalp topographic maps of the group-level permutation entropy (PE; median average across  $N = 30$  participants) at the ten studied epochs. (B) The box plots of average PE values in frontal (Fp1, Fp2, Fpz, F3, F4, and Fz) and posterior channels (P3, P4, Pz, O1, O2, and Oz) for the studied epochs. On each box, the central mark is the median, the edges are the 25th and 75th percentiles, the whiskers extend to the most extreme data points determined by the MATLAB algorithm to be non-outliers, and the points deemed by the algorithm to be outliers are plotted individually (red cross). (C) The box plots of LZC values for the studied epochs. EC = eyes closed resting state (EC1 is baseline consciousness, EC2-7 are post-emergence just prior to cognitive testing), LOC = loss of consciousness, Pre-ROC = 2 min epoch just before recovery of consciousness. \*indicates significant difference relative to EC1, using linear mixed model analysis (Bonferroni-corrected  $p < 0.05$ ).



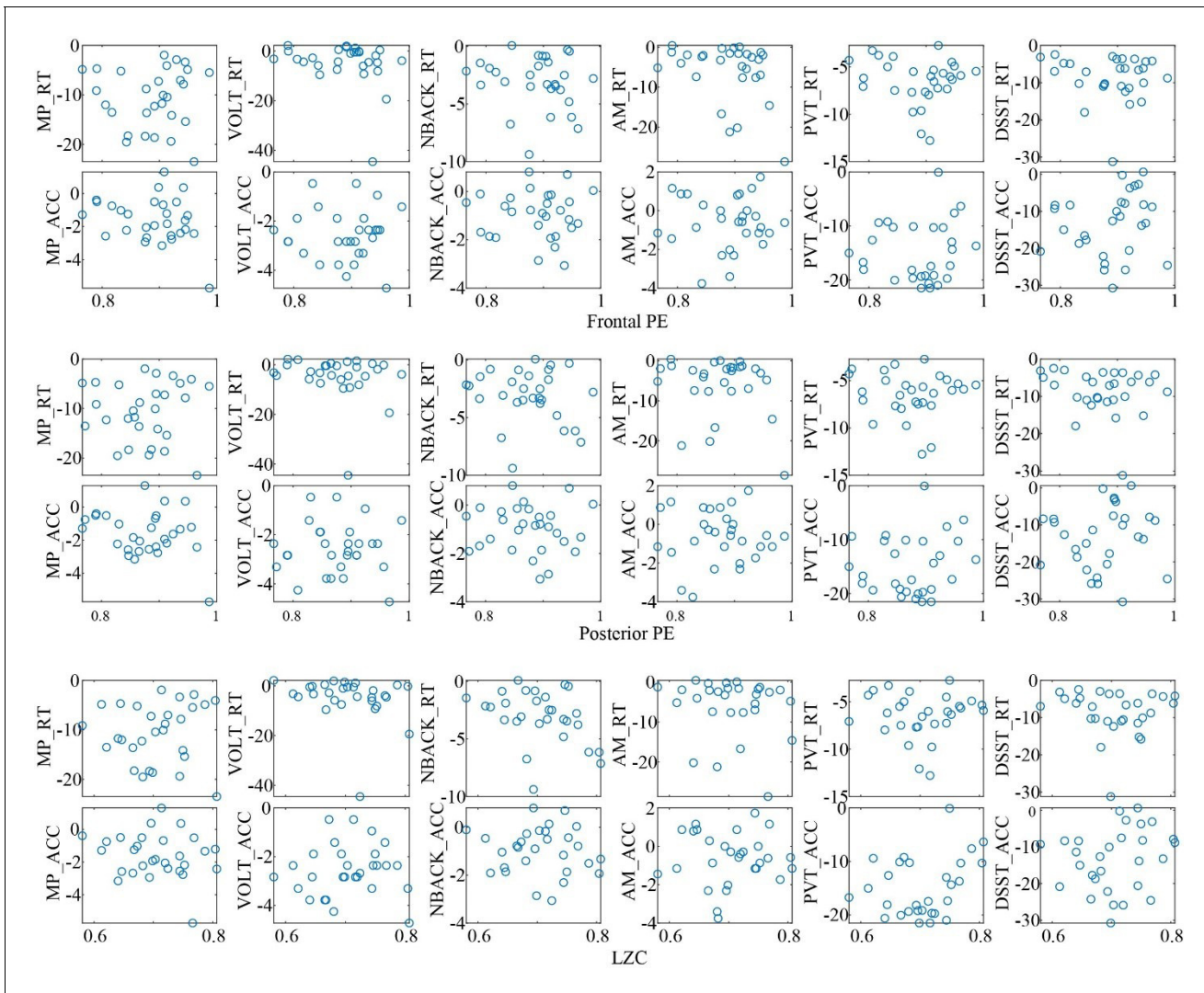


**Figure 4—figure supplement 2.** Confirmatory results of Lempel-Ziv Complexity (LZC). (A) Sensitivity of the LZC measure to the selection of threshold for binarization. (B) Confirmatory results of LZC by using spatial shuffling (top) and phase randomization (bottom) in the generation of surrogate data for normalization. The spatial shuffling method permutes the spatial order (at each time point) of the spatiotemporal matrix. The phase randomization method preserves the spectral profile of the signals and reflects the complexity changes beyond the power spectrogram. The description of the figure and the statistical results are same with those in **Figure 4C**.

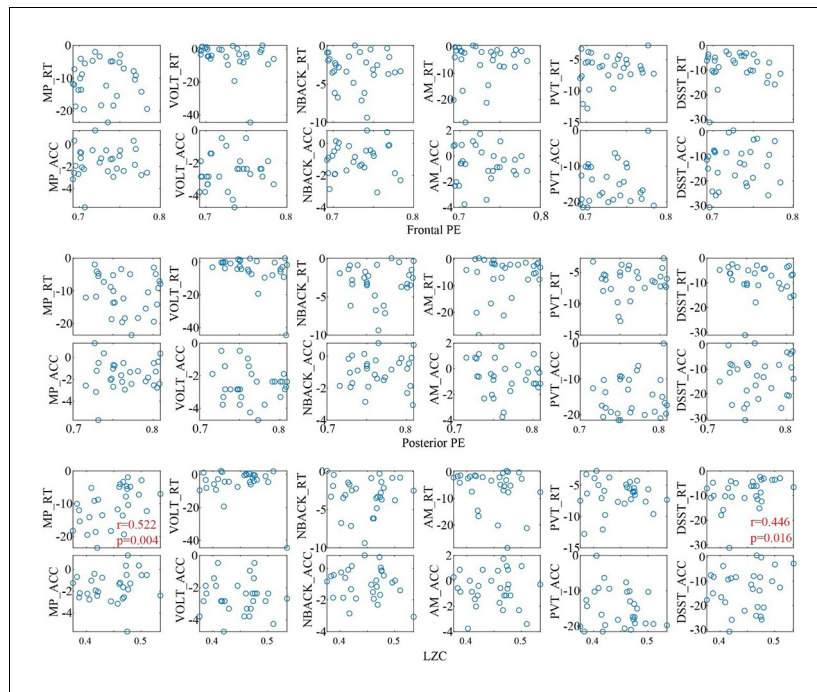


**Figure 4—figure supplement 3.** Cortical dynamics as assessed by permutation (PE) and Lempel-Ziv complexity (LZC) for the non-anesthetized control group. (A) Scalp topographic maps of the group-level PE at the seven resting-state eyes-closed (EC) epochs. (B) The box plots of average PE values in frontal and posterior channels for the studied epochs. (C) The box plots of LZC values for the studied epochs.

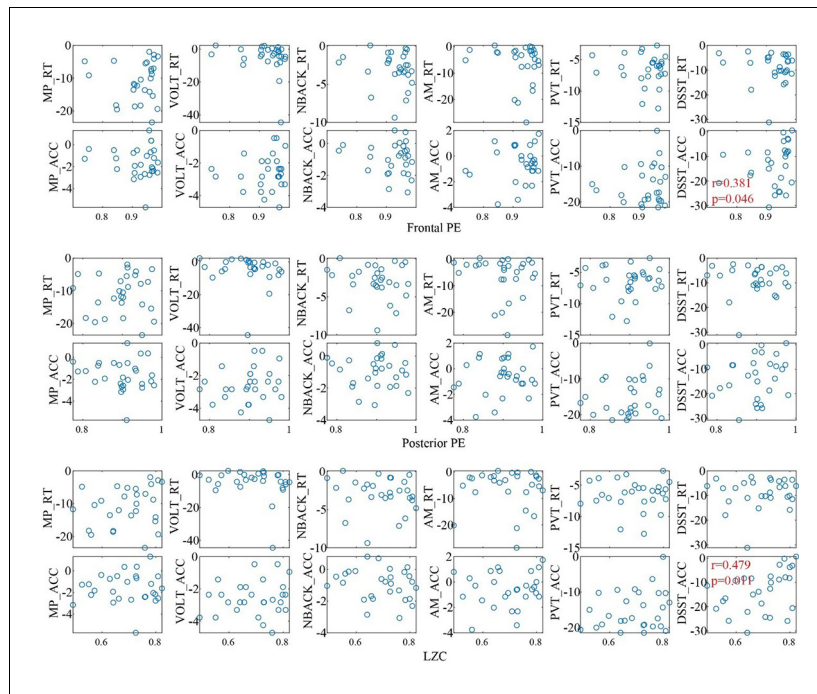




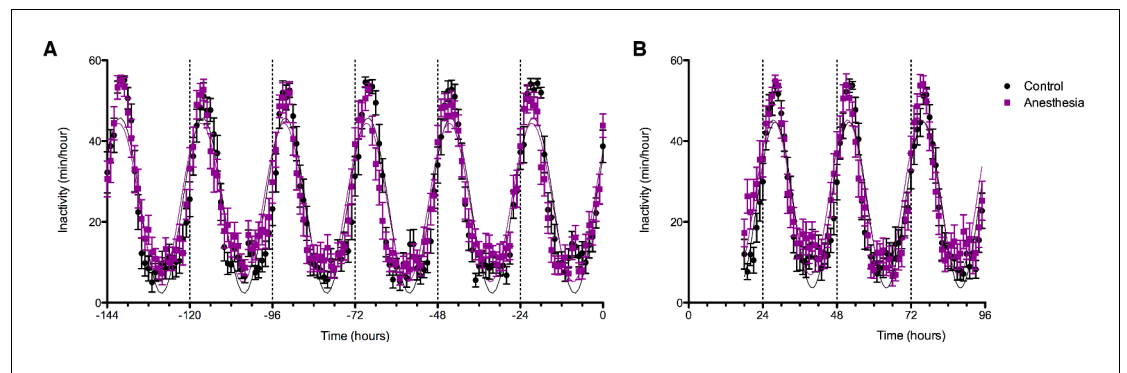
**Figure 4—figure supplement 4.** Associations between EEG measures during pre-anesthetic baseline (EC1) with the impairment of cognitive functions at emergence (just after recovery of consciousness). The EEG measures do not appear to be related to the degree of performance impairment via Spearman’s rank correlation analysis. AM, Abstract Matching; DSST, Digit Symbol Substitution Test; MP, Motor Praxis; NBACK, Fractal 2-Back; PVT, Psychomotor Vigilance Test; VOLT, Visual Object Learning Test; RT, Response time; ACC, Accuracy.



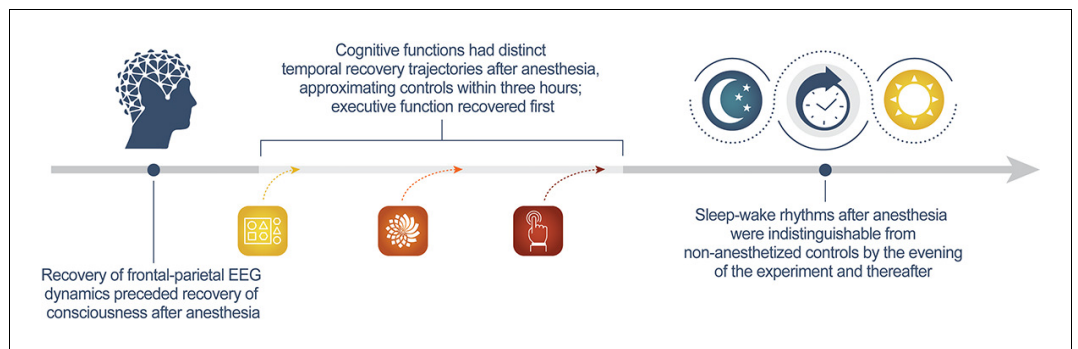
**Figure 4—figure supplement 5.** Associations between EEG measures during maintenance with the impairment of cognitive functions at emergence. Only significant correlations were indicated (Spearman’s rank correlation,  $p < 0.05$ ).



**Figure 4—figure supplement 6.** Associations between EEG measures during pre-ROC with the impairment of cognitive functions at emergence. Only significant correlations are indicated (Spearman's rank correlation,  $p < 0.05$ ).



**Figure 5.** Effects of anesthetic exposure on rest-activity rhythms. (A) Rest activity plots are displayed in the week prior to the study day for volunteers that were subsequently randomized to anesthetized (purple) or control (black) conditions. (B) Rest-activity rhythms in the same participants are displayed on the evening of the study day and for the ensuing days. Time = 0 corresponds to midnight on the evening of the study day.



**Figure 6.** Summary of the study findings.