Title: Can I pick your brain? Simultaneous electrical recording and functional MRI during the resting state

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Structured Abstract:

Introduction:
The resting state is defined as the state in which one is not performing any overt task. The brain's activity during the resting state has consistently been shown to be a critical indicator of brain health, and abnormal resting state signals have been found to be biomarkers for many disorders, including schizophrenia, bipolar disorder, and multiple sclerosis. Following neural activation, neurons' increased metabolic demands are met with increased bloodflow--a process known as the hemodynamic response. In the resting state, it is unclear whether there is a one-to-one correspondence between these two processes. Better understanding this neuro-vascular coupling is imperative in forming a complete picture of the resting state.

Hypothesis:
There is a one-to-one correspondence between neural activity and the hemodynamic response during the resting state.

Methods and Results:
Functional MRI (fMRI) directly measures blood oxygenation in the brain, providing information on hemodynamic activity. Electroencephalography (EEG) directly measures neural activity. Thus, to test the hypothesis, fMRI (Varian 9.4-Tesla small-animal scanner) and EEG (via two implanted electrodes) will ultimately be performed simultaneously on the anesthetized small marmoset primate (n=1).

Performing EEG during an MRI scan presents challenges in acquiring usable data. Due to Faraday's law of electromagnetic induction, the alternating current from the scanner's gradient coils introduces severe artifacts in the EEG data. The post-processing technique known as average artifact subtraction (AAS) is capable of nearly completely removing this artifact. As a preparatory step, a simulated EEG experiment was performed in the scanner, and successful gradient artifact removal using AAS was achieved.

Discussion:
Confirming removability of gradient artifact from EEG data was an important step in proceeding with the grand scheme of the project. The next step is to perform fMRI on the subject prior to implanting the electrodes. This will serve to identify two nodes of activation where the two electrodes will be implanted. Following implantation, EEG will be performed outside the scanner, and then will be performed simultaneously with fMRI.