Broadband shifts in EEG power spectra are correlated with single-neuron activity in humans

Jeremy R. Manning, Joshua Jacobs, Itzhak Fried, and Michael J. Kahana

University of Pennsylvania, UCLA School of Medicine

1 Introduction
- We studied the relationship between the EEG power spectrum and the firing rates (FR) of individual neurons in the human brain.
- Other researchers have noted high correlations between the power of high frequency (γ) oscillations and FR.
- We developed a statistical framework to distinguish between broadband shifts in the EEG power spectrum and band-specific peaks.
- We also examined the correlation between FR and EEG power at narrow frequency bands, including γ.

Figure 1. a. Experimental setup. b. Two explanations for γ/FR correlation.

2 Methods
- The distribution of firing rates is divided into ten equally spaced bins.
- A power spectrum is created for each bin. These are used to compute mean fit height and maximum deviation. We then compute the correlation between firing rate and mean fit height (c) and maximum deviation (d).

Figure 2. Statistical framework. a. The distribution of firing rates is divided into ten equally spaced bins. b. A power spectrum is created for each bin.

3 Results
- Mean fit height vs. firing rate correlation
- Maximum deviation vs. firing rate correlation
- Fraction of peak frequencies
  - Positive broadband shifts are correlated with FR.
  - Power at low frequencies is more variable than at high frequencies.

Figure 4. a. Broadband shifts are more common than band-specific shifts. b. Example single-cell spectra exhibiting broadband shifts (left) and average spectra for each of five major brain areas (right). c. Which components of the EEG power spectrum significantly correlated with firing rate? d. Positive broadband shifts are correlated with FR for all brain regions.


4 Conclusions
- EEG power spectra exhibit broadband shifts when FR changes.
- Power at low frequencies is more variable than power at high frequencies.
- This explains why γ oscillations are the best predictor of FR.

Figure 5. a. Bibliography

5 Bibliography

For correspondence contact manning3@mail.med.upenn.edu