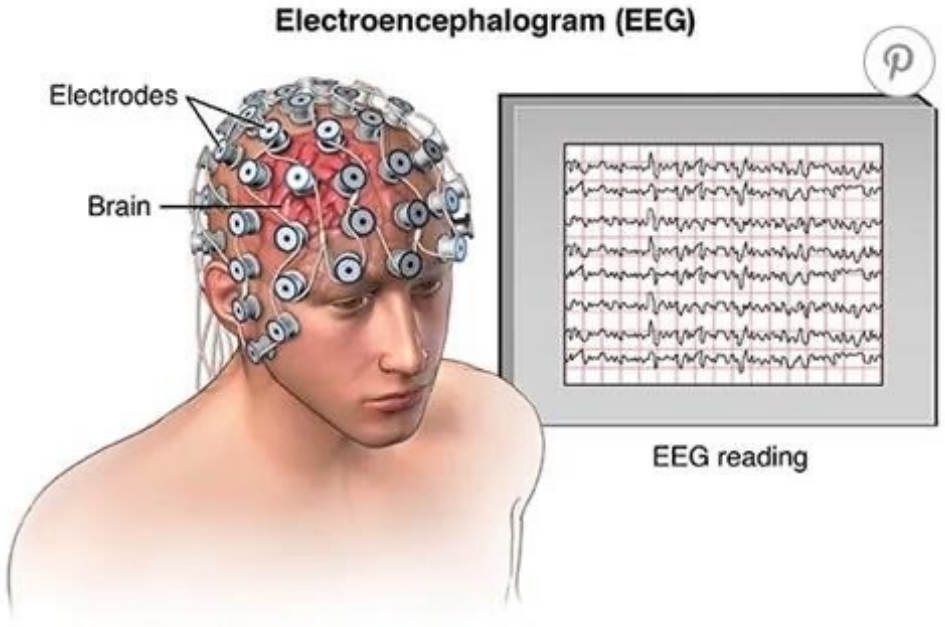
NEUR 265

March 18th, 2024

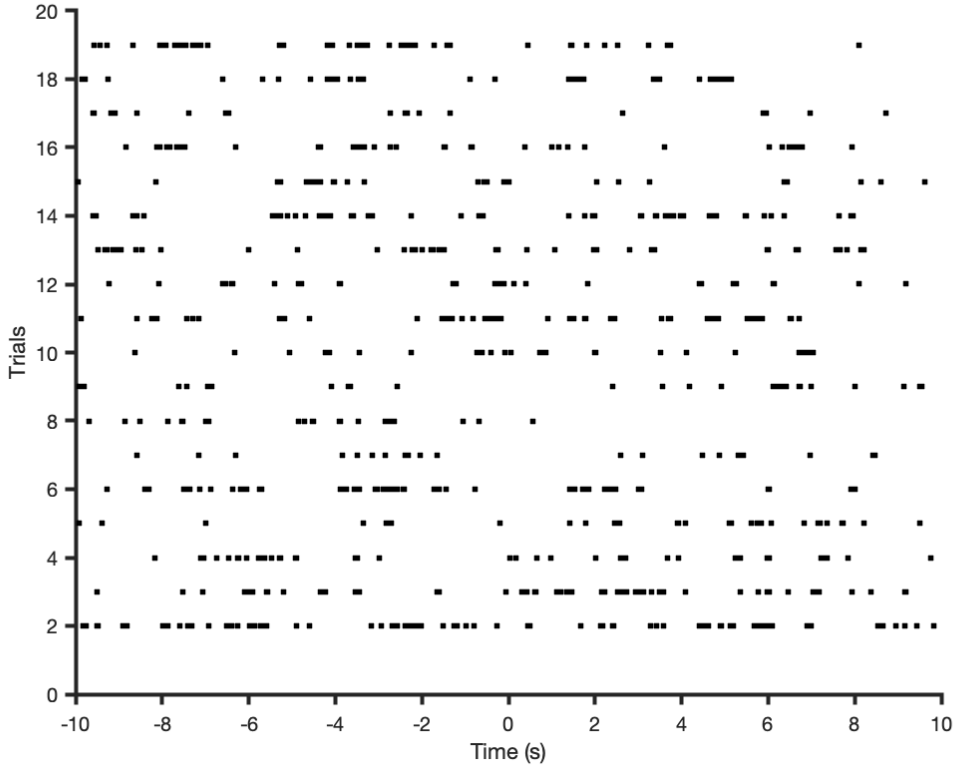
Ways of getting neuroscience data in a behaving animal

If it's from the scalp, it's called an electroencephalogram (EEG)

If it's from inside the brain, it's called a local field potential (LFP)



Electrophysiology – Biological Relevance



What do we know about action potentials?

Action potential qualities?

Given what we know, what dependent variables should we use when relating action potentials with some kind of behavior?

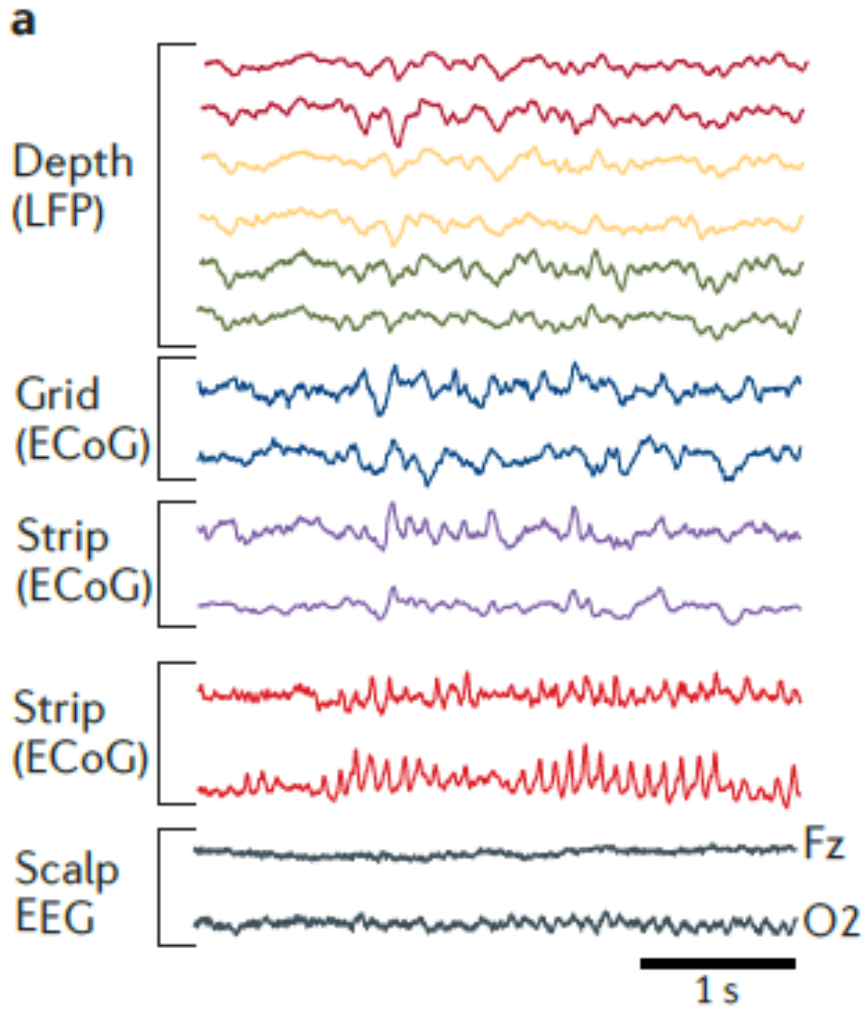
Electrophysiology – Biological Relevance

The EEG and LFP are much more ambiguous

Driven by extracellular post-synaptic potentials in “field” of neurons surrounding electrode

What the EEG/LFP “looks like” is determined by where the electrode is

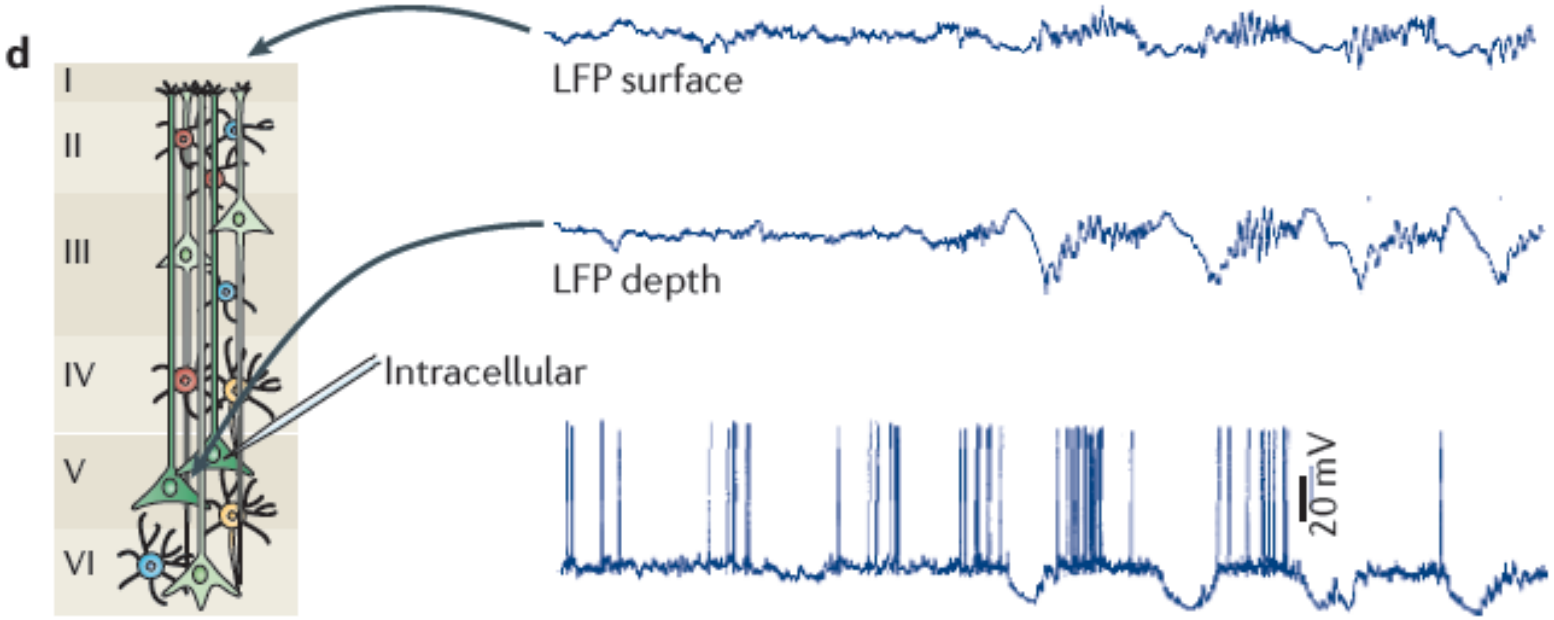
Buzsaki et al. (2012) *Nat. Rev. Neurosci.,* **13:** 407-420



Neurons have “sinks” and “sources” – a sink is an area of the neuron where cations move from the extracellular to intracellular space

Where would most “sinks” be located along a neuron?

In contrast, “sources” are areas of a neuron where cations move from intracellular space to extracellular space

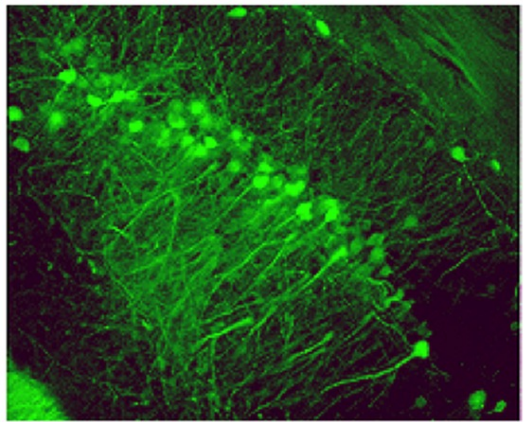


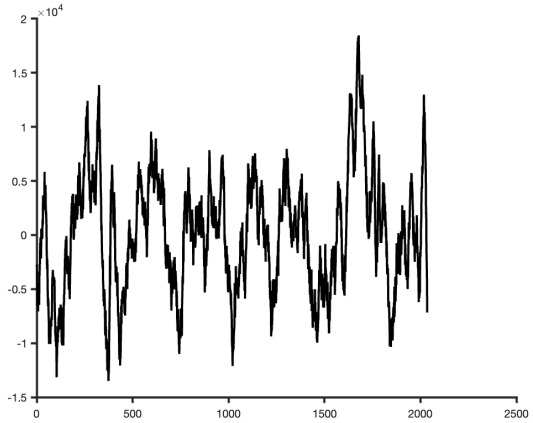
Electrophysiology – Biological Relevance

Physical distance between sinks and sources is called a “dipole”

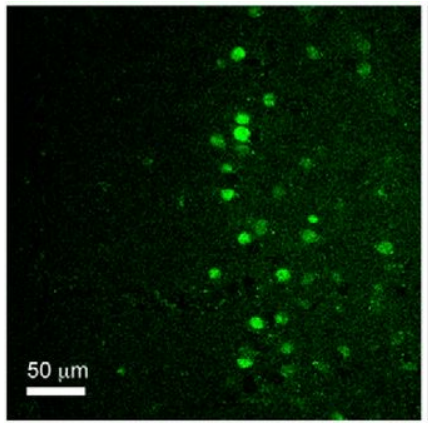
Dipole distance contributes to the “amplitude” of the LFP

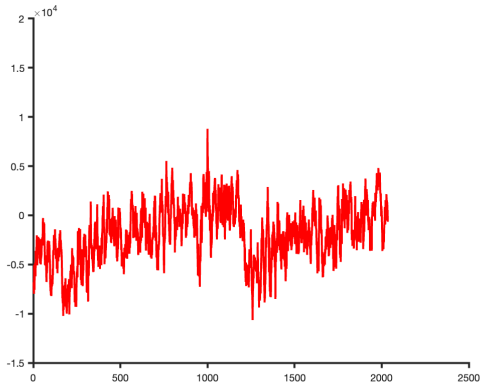
Hippocampus



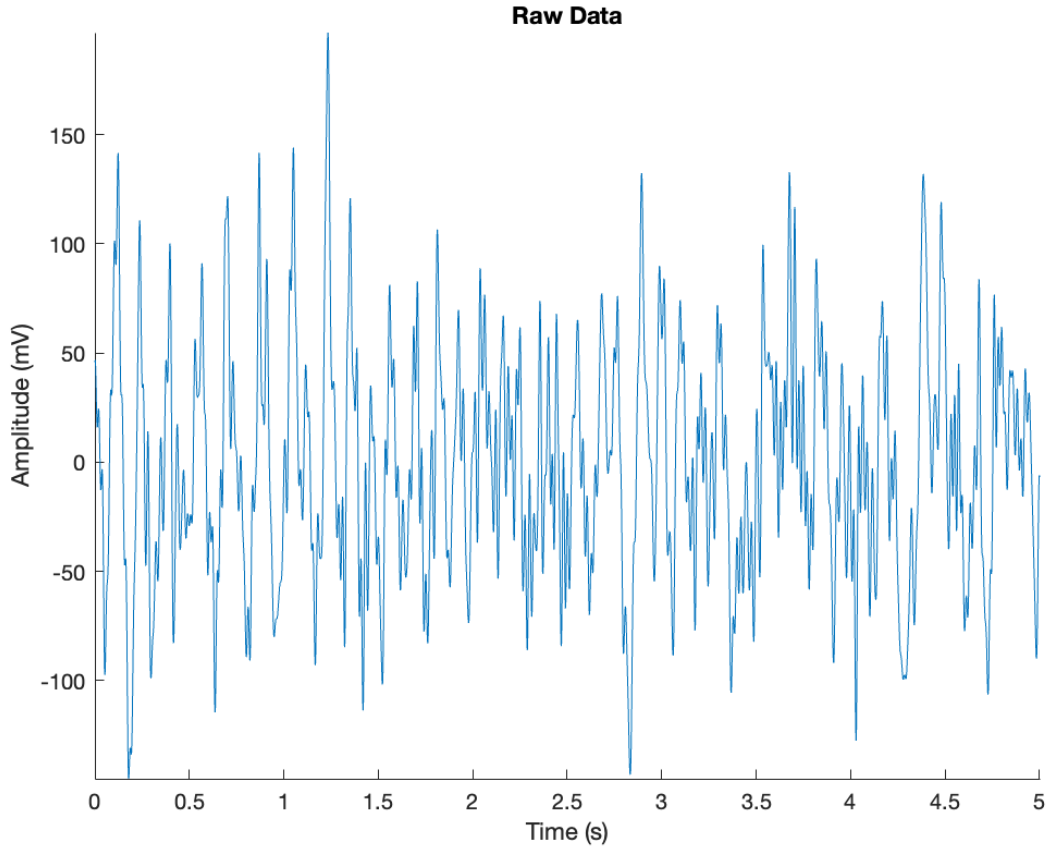


Cortex



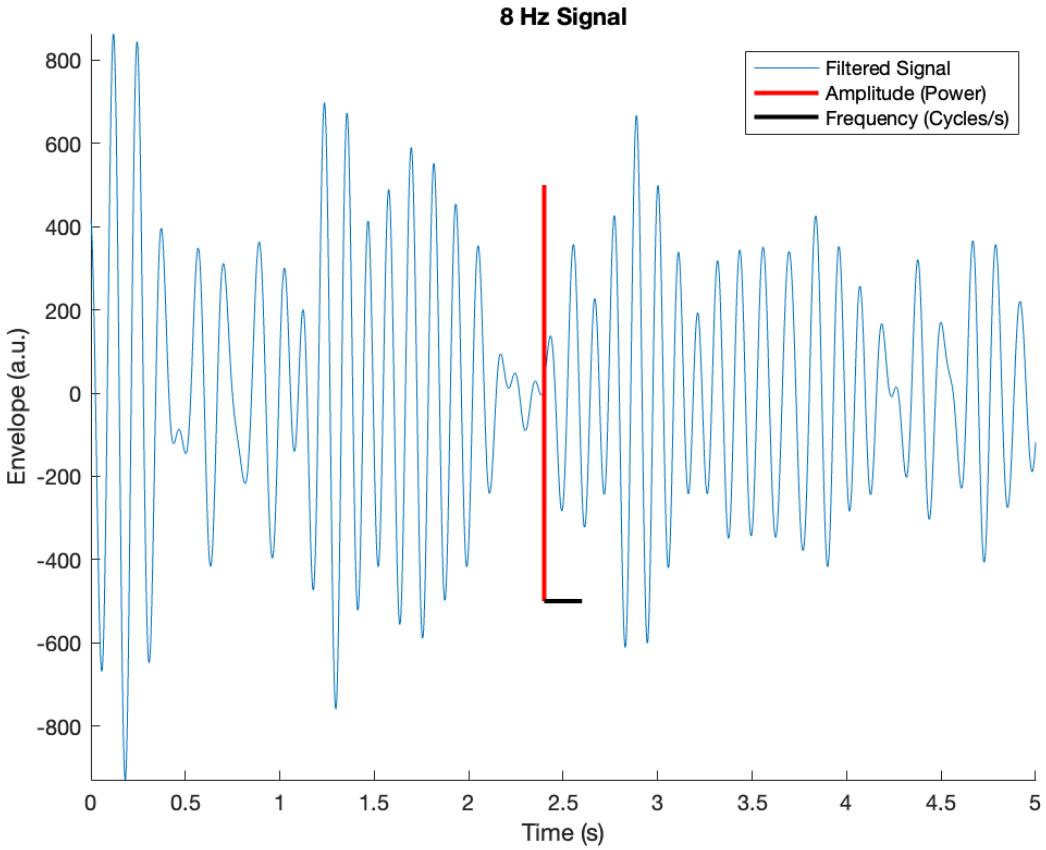


What do we think is important in the signal?



What do these data look like?

What do we think is important in the signal?

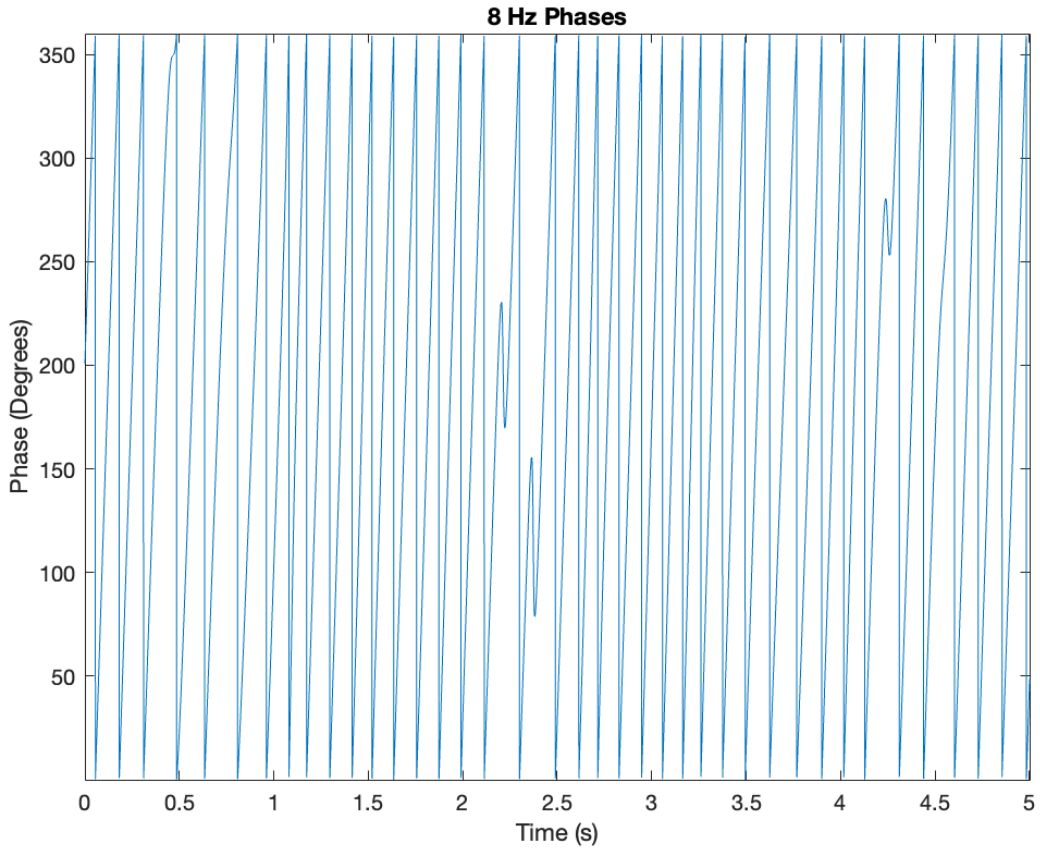


Power = Amplitude^2

What shape is a sine wave?

How do we define a “cycle”?

What do we think is important in the signal?



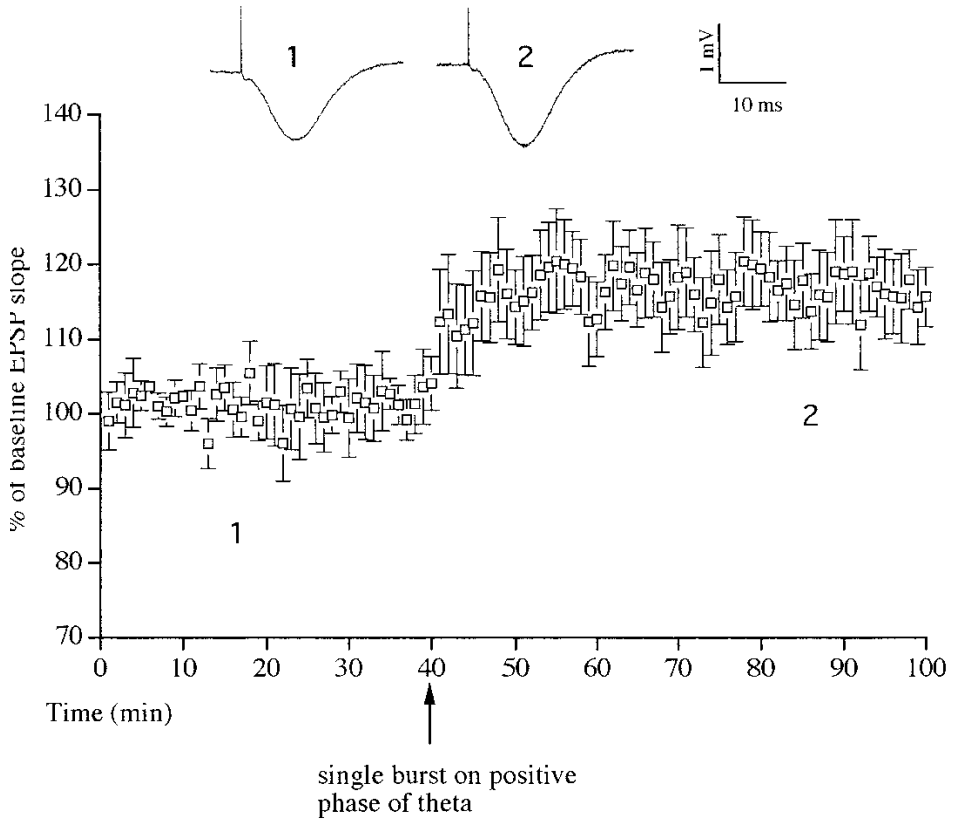
“Where” in the cycle do things happen?

Biological relevance of LFP – phase matters

In hippocampus, electrical stimulation at ascending phases of LFP induces long-term potentiation

In contrast, electrical stimulation at descending phases of LFP induces long-term depression

What does this tell you about characteristics of hippocampal neurons at different phases?

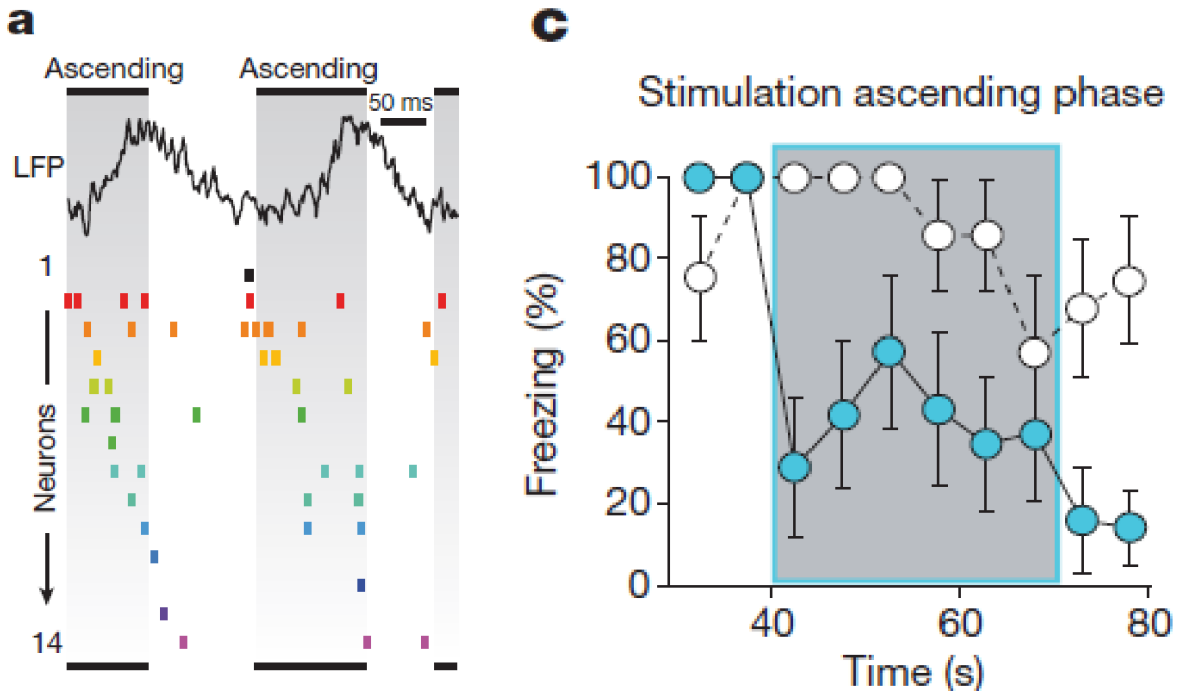


Holscher, Anwyl, and Rowan (1997), *J. Neurosci.*, **17:** 6470-6477

Biological relevance of LFP – phase matters

In prefrontal cortex, neurons tend to fire on ascending phases of LFP during fear behavior (freezing)

Optogenetic stimulation during ascending phases decreases freezing



Dejean et al., (2016). *Nature,* **535:** 420-424