Overview

- Kinds of attention
- Neuronal signatures
  - Firing rate and receptive field size
- Network signatures
  - Synchrony (spikes, LFP)
- Linking neuronal and network signatures
  - Neuromodulation
Top-Down vs. Bottom-Up Attention

- **Top-Down attention**
  - Goal-Directed
  - Voluntary
- **Bottom-Up attention**
  - Stimulus-Driven
  - Automatic

Garden of Earthly Delights (Bosch, c. 1500)

Corbetta & Shulman, Nature Rev Neurosci, 2002

Part I.
Neuronal signatures of attention
Attention’s effects on neurons and their receptive fields

- Enhances neural firing rate
  - Debates regarding nature of enhancement
  - Gain vs. Sensitivity
- Sharpens receptive field

Maunsell & Treue, TINS, 2006

Microstimulation mimics effects of attention

- Microstimulation of the SC mimics the behavioral effects of spatial attention
  - Enhances stimulus discrimination

Müller et al, PNAS, 2005
Microstimulation mimics effects of attention

- Microstimulation of the FEF mimics the behavioral and neuronal signatures of spatial attention in V4

2/11/2009
Bioe 332A, Winter 2009

Part II.
Network signatures of attention
Attention’s effects on synchrony
I. Spiking synchrony

• Spikes between neuron pairs in SII synchronize during tactile (vs. visual) attention


Attention’s effects on synchrony
II. Spike-LFP coherence

• Enhances spike-field coherence in the gamma-band

Interlude: What is an LFP?

Part III.
Linking the neuronal and network signatures
Hypothesis:
Neuromodulation by acetylcholine links the neural and network signatures of attention.

What is neuromodulation?

- Regulate/modulate synaptic transmission, firing properties etc
- Effects of neuromodulators varies widely with brain region
ACh mimics neuronal signature of attention in V1

Herrero et al, Nature 2008

ACh in OT enhances excitation

Data Courtesy: Alex Goddard
ACh in OT enhances inhibition

Data Courtesy: Alex Goddard

Preview: Modeling modulation

- ACh increases coupling strength between inhibitory neurons
- A phase transition to synchrony (Kuramoto model)

Data Courtesy: Alex Goddard

Daniels, 2005