Visual area MT responds to local motion

Visual area MST responds to optic flow

Visual area STS responds to biological motion

Macaque visual areas
Flattening the brain

What is a visual area?

PhACT:
- Physiology
- Architecture
- Connections
- Topography

Physiology

Example: direction selectivity in V1

Architecture

Example: cytochrome oxidase staining in human visual cortex
Connections

Example: connections in monkey visual cortex

Topography

Each visual brain area contains a map of the visual world and performs a different function.

Topography (human V1)

Measuring retinotopic maps

Radial component

Angular component

Engel et al (1994)
Retinotopy: radial component

Flattening the human brain

Cortical segmentation & flattening

Retinotopy: angular component
**Visual cortical areas**

LO1 and LO2: Larsson & Heeger, J Neurosci (2006)

IPS1 and IPS2: Schluppeck, Glimcher, & Heeger, J Neurophysiol (2005)


**Functional specialization**

Match each cortical area to its corresponding function:

- **V1**: Motion
- **V2**: Shape
- **V3**: Color
- **V3A**: Texture
- **V3B**: Segmentation, grouping
- **V4**: Recognition
- **V5**: Attention
- **V7**: Working memory
- **LO1**: Mental imagery
- **IPS1**: Decision-making
- **IPS2**: Sensorimotor integration
- **Etc.**: Etc.

**Cortical area MT is specialized for visual motion perception**

- Neurons in MT are selective for motion direction.
- Neural responses in MT are correlated with the perception of motion.
- Damage to MT or temporary inactivation causes deficits in visual motion perception.
- Electrical stimulation in MT causes changes in visual motion perception.
- Computational theory quantitatively explains both the responses of MT neurons and the perception of visual motion.
- Well-defined pathway of brain areas (cascade of neural computations) underlying motion specialization in MT.

**Neurons in MT are selective for motion direction**
MT responses correlated with motion perception

Damage to MT causes deficits in motion perception (Akнетопия: motion blindness)

Microstimulation in MT changes motion perception

Human MT
Beware of circular reasoning in brain mapping

1. Hypothesize that there is a particular visual/cognitive process that is localized to a functionally specialized brain area.
2. Design an experiment with two stimuli/tasks, one of which you believe imposes a greater demands on that cognitive process.
3. Run the experiment and find sure enough that there is a brain area that responds more strongly during trials with high demand on that visual/cognitive process than low demand trials.

What can you conclude from this?

Topography in human MT

Direction-selective adaptation in human MT

Direction-selectivity across visual areas
Is MT specialized for only visual motion perception?

- Neurons in MT are also selective for binocular disparity.
- Neural responses in MT are also correlated with the perception of depth.
- Motion discrimination performance mostly recovers following carefully circumscribed lesions to MT in monkeys.
- Electrical stimulation in MT causes changes in stereo depth perception.

Even so, computational theory quantitatively explains the responses of MT neurons.