

20180111 COGS 107b Lecture Notes

Cabinet COGS107b Lecture Notes

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Vocabulary

Tactile Sensation (touch sense or mechanoreception)

Proprioception and touch sense

Ganglion cell types: breakdown by conduction speed

Discrete vs. Continuous

Touch receptors in the skin

Response Field

Sustained vs. Transient responses

Two-point discrimination

Pacinian Corpuscles = frequency-dependent sensitivity to vibration

Meissner's corpuscles = low-frequency vibration sensitivity

Dorsal root ganglion pathways to the brain

Somatosensory Cortex

Primary Somatosensory cortex: within-region (column) processing

S1: direction-selective surround inhibition

S2: response fields expand across digits, but maintain directional selectivity

Vocabulary

- Posterior Parietal Cortex (PPC) → integration
 - Responsible for pulling together disparate information in the brain.
- Transient vs. Persistent
 - Short term response vs. Long term response
 - Rapidly adapting vs Slowly adapting
- Segregation vs. Integration
 - Neurons firing to different neurons vs. firing to the same neuron.
- Forms of information
- Topographic representation
- Receptive/response fields

- E.g.: rods and cones in eye, place fields

Tactile Sensation (touch sense or mechanoreception)

Transforming stimulation to electrical signal so that the brain can understand it.

Topographic Representation: Neurons anatomically arranged in a systematic fashion such that those responding to similar features of a single sensory modality (vision or audition) are grouped into the same space in the brain.

related concepts: surround inhibition, the cortical column, the homunculus

Proprioception and touch sense

The 'all-axon' ganglion cell

Ganglion cell types: breakdown by conduction speed

- A α - proprioception - myelinated, very fast (70-120 m/s)
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- A β - mechanoreception - myelinated, pretty fast (40-70 m/s)
- A γ - thermoreception, nociception - myelinated, fast (12-36 m/s)
- C - nociception - unmyelinated, slow (0.5-2 m/s)

Discrete vs. Continuous

Digital vs. Analog

Action potential vs. generator potential

All-or-nothing vs. graded

Touch receptors in the skin

The Dorsal Root Ganglion extends to the skin and dendrites wrap around hair follicles.

When the hair is moved, stimulus is produced. This causes generator potentials and eventually action potentials.

Or...

The dendrites extend into a Pacinian Corpuscle (onion) or a Meissner's corpuscle (pancakes) or a Merkel disk (tree).

Response Field

- Excitatory response = More Action Potential(AP)
- Inhibitory response = fewer AP
- small vs large response fields
- inhibitory surround, complete vs. incomplete
- whole vs patchy

Experiment Probe a hand with an electrical probe and measure the (more or less) action potentials at the root ganglions.

Sustained vs. Transient responses

- Merkel Disks → slowly-adapting (sustained)
- Meissner/Pacinian Corpuscles → rapidly-adapting (transient)

Two-point discrimination

At what points on the body can a person perceive the difference between two points poking on the skin as being more less than 1mm.

Merkel Disc → Where is the stimulus

Pacinian Corpuscles = frequency-dependent sensitivity to vibration

At a certain frequency (~100-200Hz), the pacinian corpuscle will be highly sensitive to movement.

The psychophysical curve follows the response field.

Meissner's corpuscles = low-frequency vibration sensitivity

Slippage: Gravity causes objects to fall between your hands. Meissner Corpuscles help the mind continuously adapt so that you neight over or under grip.

Dorsal root ganglion pathways to the brain

- Segregated
 1. Dorsal Horn of the spinal cord
 2. Synapse to Cuneate nucleus
 3. Decussates to opposite side of spinal cord
 4. Synapse to ventral posterolateral nucleus of thalamus
- Integrated
 1. Layer II and III of somatosensory cortex

Somatosensory Cortex

- Primary somatosensory cortex: postcentral gyrus + posterior bank of central sulcus
- Contains 4 sub-regions

Primary Somatosensory cortex: within-region (column) processing

RA and SA project back and forth between layers.

S1: direction-selective surround inhibition

Stimulus direction changes on receptive field (finger).

S2: response fields expand across digits, but maintain directional selectivity

Irregular response fields.

