Quote of the Day

“When we remember we are all mad, the mysteries disappear and life stands explained.”

Mark Twain (1835 - 1910)

Assignments

- Read Chapters 10 and 11 in the Course Pack. Make a list of any terms that you don’t understand and/or any questions that you may have.
- Start working on Study Guide 2 (Somatosensory system).
- Exam 2 is coming up on Monday, November 9. This exam will cover the somatosensory system, and whatever part of the visual system has been covered by then.

Key Concept: Parallel Pathways

Different aspects of a sensory stimulus may be processed in different neural pathways.

For a somatosensory stimulus, a single physical object could provide information about pressure, temperature, pain, etc., which could be thought of as different modalities.

Parallel pathways can also selectively process specific aspects of a stimulus within a single modality.

Somatosensory pathways in the CNS

- Information travels from the dorsal column nuclei in the medulla to the ventral posterior nucleus in the thalamus.
- From the thalamus, information is sent to the primary somatosensory cortex.

The somatosensory cortex

- The motor cortex lies just in front of the somatosensory cortical area.

Representation of the body across the somatosensory cortex

- The cortical representation of each body part may be greatly expanded or contracted relative to its true size.
- The amount of expansion or contraction is referred to as the cortical magnification factor.

The homunculus
The cortical motor representation

- The parts of the body are also represented in the motor cortex.
- Each body part has a different magnification factor, so that there is a motor homunculus as well as a sensory one.
- Stimulation of motor cortex causes movement in the corresponding body part.

Topographic mapping in somatosensory cortex

- Each specific part of the body is represented within a different part of the cortex.
- These representations together form a topographic map of the body.
- The general definition of a topographic map is a spatially organized neural representation of a stimulus parameter (in this case, points on the body).

Key Concept: Hierarchical levels of cortical processing

There is an orderly representation of that parameter across a neural array.

Somatosensory cortical representations vary across species

- For each species, the relative importance of each body part is different. This is reflected in the cortical representation.

In animals with whiskers, the whisker representation occupies a large part of somatosensory cortex

- In rats, the whisker representation is called “barrel cortex”

The star-nosed mole has a specialized structure on its snout for somatosensory and electrosensory processing. The “star” has a greatly expanded representation in the cortex.

There are multiple somatosensory representations in the cortex.

- Input from the thalamus first goes to the primary somatosensory cortex.
- Adjacent to the primary area are other “higher-level” areas where neurons’ response properties are more complex.

Key Concept: Hierarchical levels of cortical processing
Physiological properties of somatosensory neurons: receptive fields

- Neurons in the somatosensory system have receptive fields that vary in size depending on body location.

Receptive fields of somatosensory neurons have a center-surround organization

- The activity of any given thalamic or cortical neuron will be increased by stimuli on a specific part of the skin (yellow center).
- The same neuron's activity will be suppressed by stimuli in the surrounding area of the skin (blue surround).

Lateral Inhibition

- Neurons in the center of the receptive field (the part that causes excitation) send excitatory inputs to neurons in other areas.
- Neurons in the center of the receptive field also send inhibitory input to surrounding neurons. They receive inhibition from neurons in the surround (the part of the receptive field in which a stimulus causes inhibition of the neuron under consideration).
- One neuron's inhibition of surrounding neurons in called lateral inhibition.

Lateral inhibition sharpens the perception of pressure at a single point

- Neural activity is restricted to the representation of a single point
- Contrast is enhanced

Lateral inhibition sharpens acuity and aids in 2-point discrimination

- Without lateral inhibition, overlapping excitation adds. With inhibition, there is no addition in the area of overlap.
Key Concept: Lateral interactions among receptors or neurons

A stimulus that affects one neuron directly can affect other neurons indirectly, e.g., through lateral inhibition. Lateral interactions among neurons provide one of the fundamental mechanisms through which context influences our perception of a stimulus.

The cortex is a layered and columnar structure

- The cortex has input and output layers. A column is a vertical array of cells in each of the six layers.

There are multiple somatosensory representations in the cortex.

- Two such areas are SI and the posterior parietal area.

Parietal lesions can cause a “neglect” syndrome in which the patient becomes unaware of a part of the body or a part of the environment.

Columns in somatosensory cortex

- Within the region of cortex that represents a specific part of the body, there are many cortical columns.

- Cells in each column respond to a particular type of input (e.g., vibration, pressure, temperature ...)

Key Concept: Cortical Modules

Somatosensory “maps” can change based on experience