

ELEC ENG 791 Lecture 3A

Jan 19, 2015

Sensory and Neural Organization

Frequency Coding

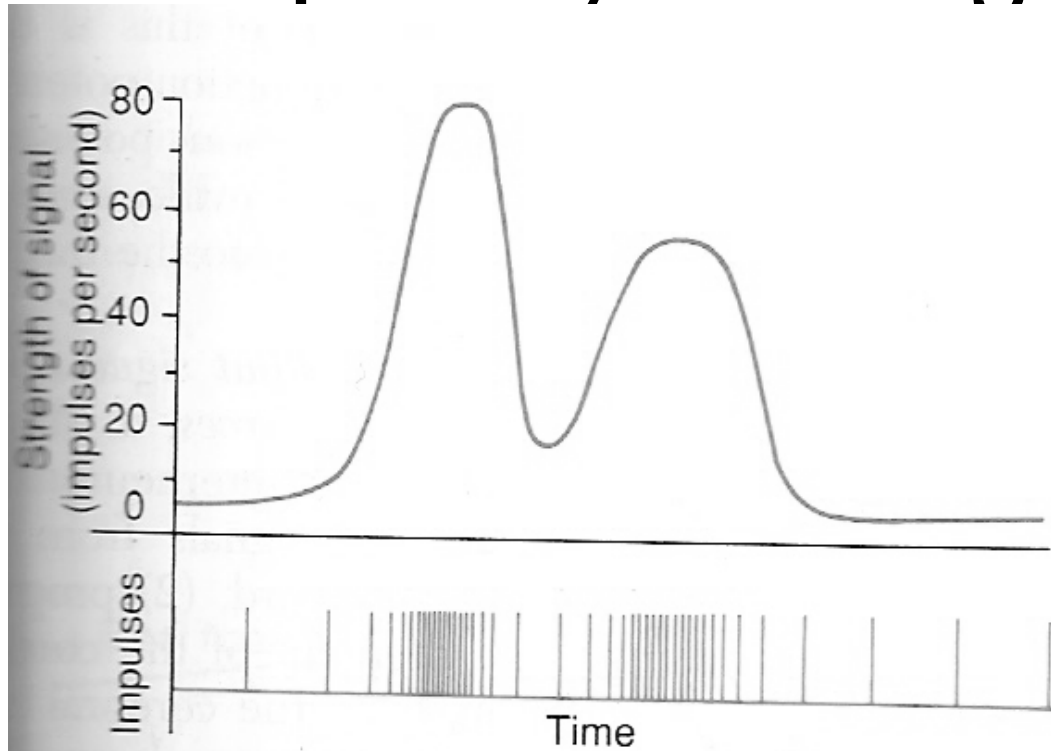


Figure 46-8. Translation of signal strength into a frequency-coded series of nerve impulses, showing *above* the strength of signal and *below* the separate nerve impulses. This is an example of *temporal summation*.

The Neuronal Pool

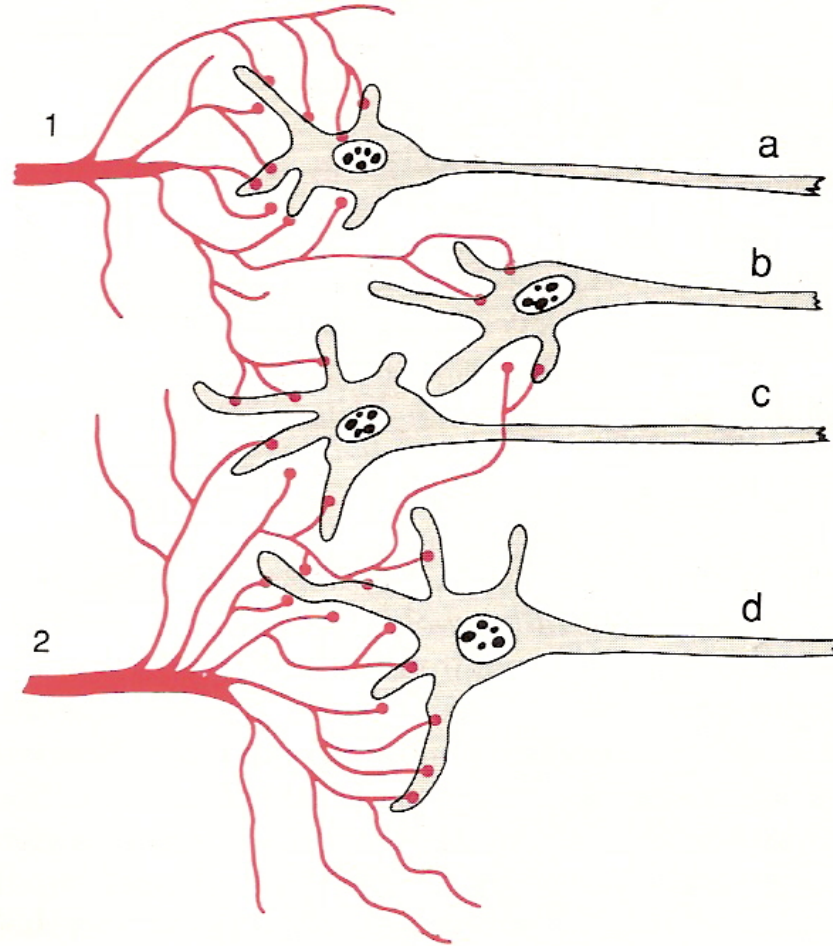
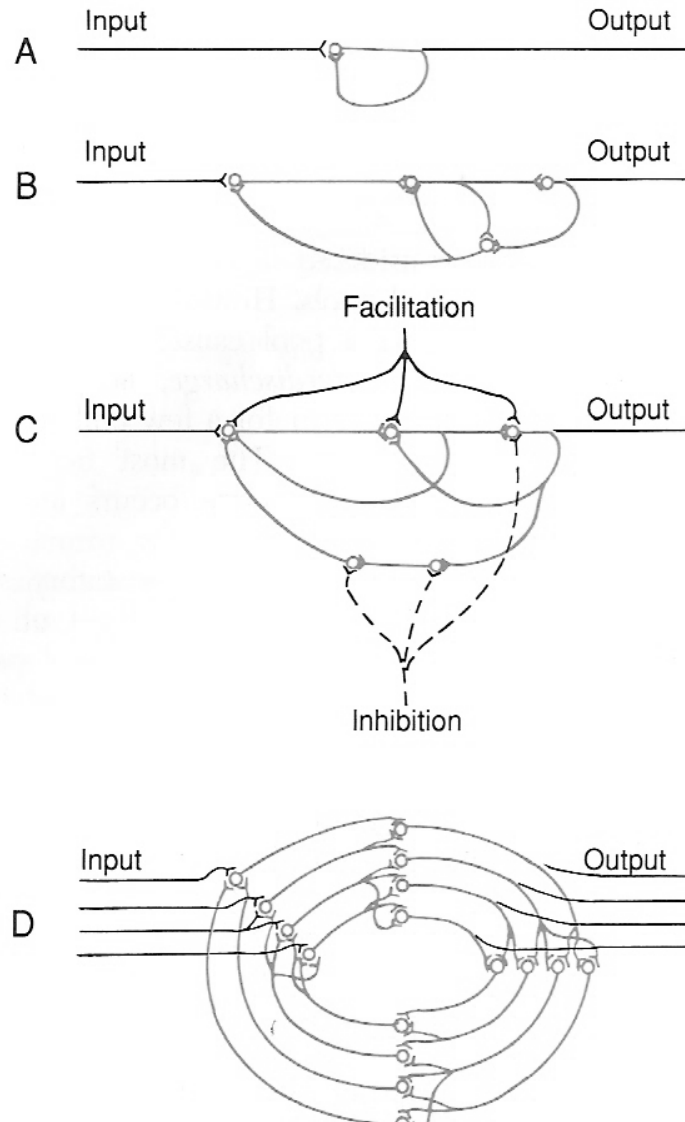


Figure 46-9. Basic organization of a neuronal pool.

Threshold and Subthreshold Stimulation

- Large numbers of synapses must discharge simultaneously for cell to “fire”
- In neuron pool some neurons are in excited or liminal state if they fire due to a given input.
- In neuron pool some neurons in subthreshold or subliminal state if they have synaptic inputs but insufficient to “fire”

Reverberant Circuits



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Figure 46-14. Reverberatory circuits of increasing complexity.

Facilitation and Inhibition

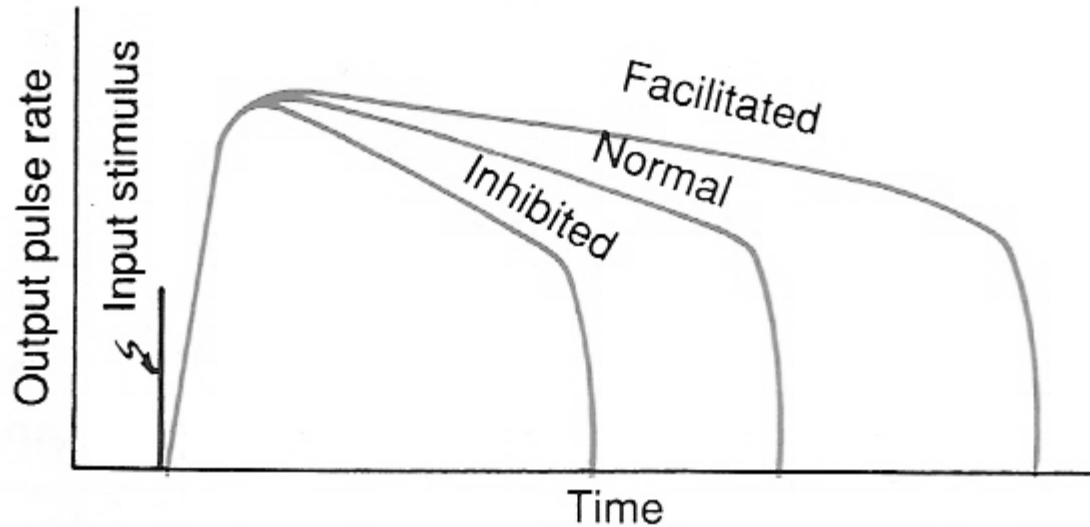


Figure 46-15. Typical pattern of the output signal from a reverberatory circuit after a single input stimulus, showing the effects of facilitation and inhibition.

Somatic Receptors e.g. Iggo Dome

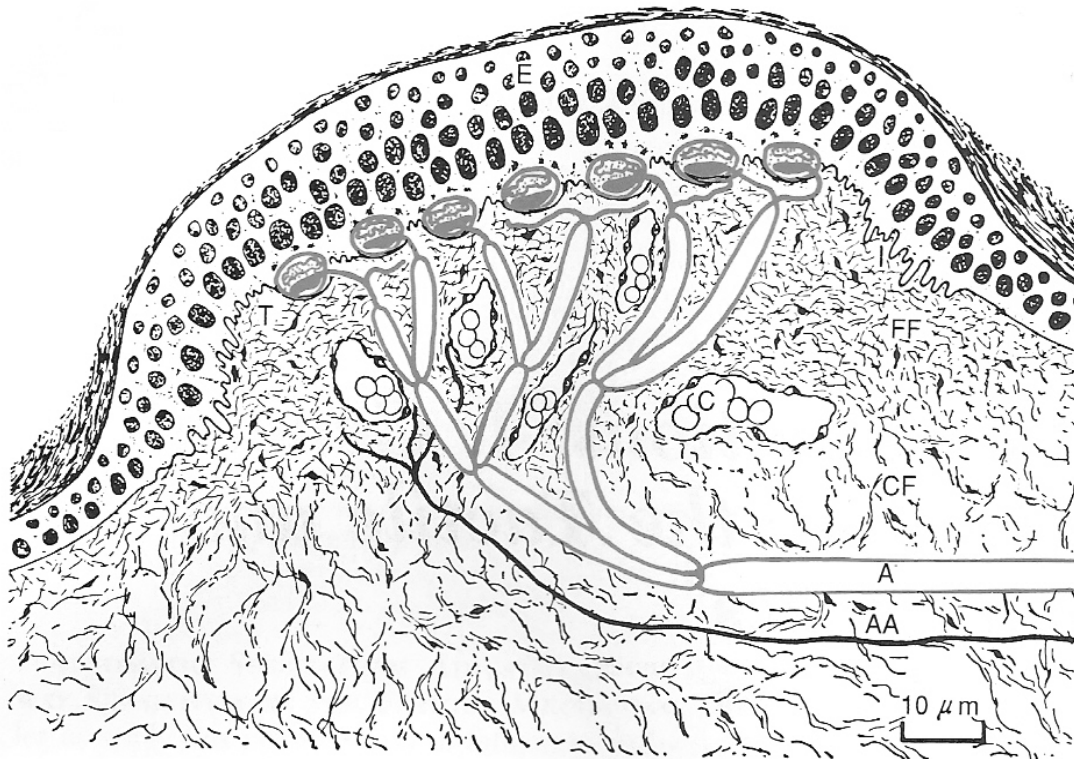


Figure 47-1. Iggo dome. Note the multiple Merkel's discs innervated by a large myelinated fiber and its tight association with the undersurface of the epidermal keratin. (From Iggo and Mountcastle, *J. Neurophysiol.*, 200:763, 1969.)

Sensory Pathways

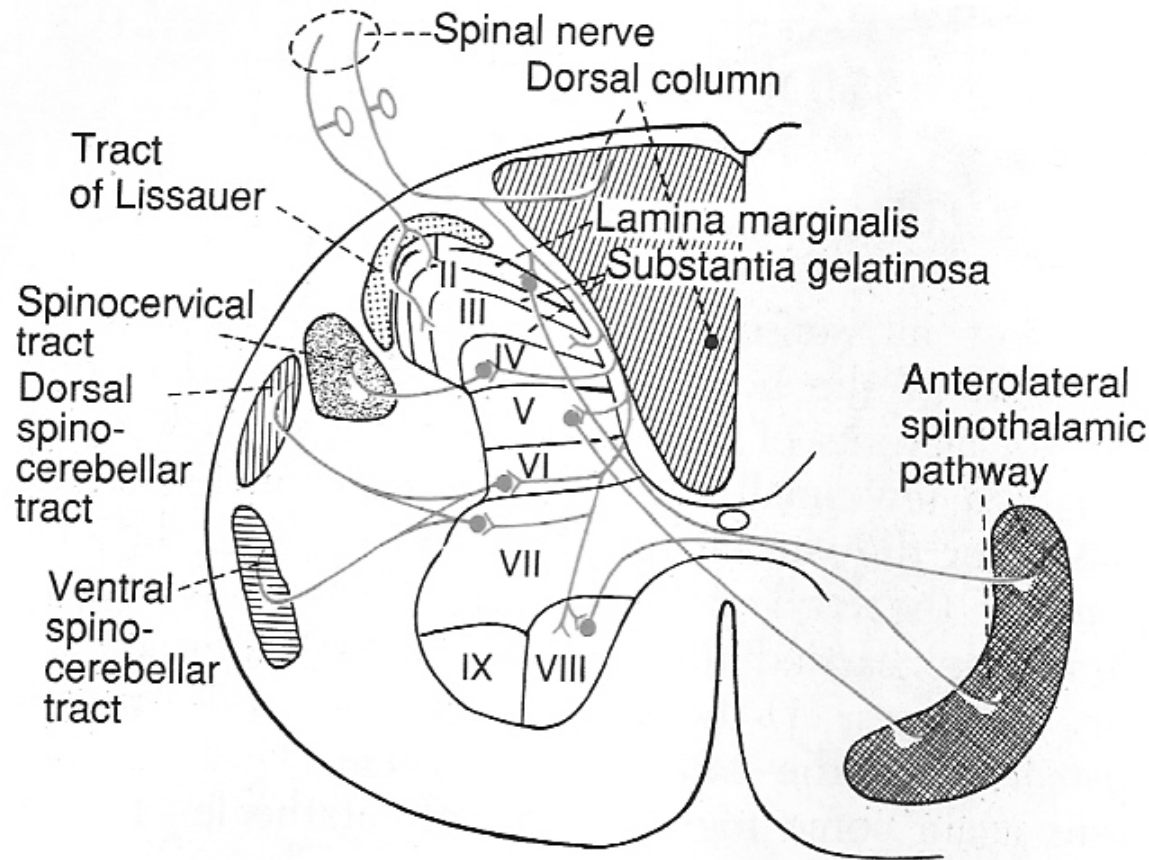


Figure 47-2. Cross section of the spinal cord, showing the anatomical laminae I through IX of the cord gray matter and the ascending sensory tracts (in red) in the white columns of the spinal cord.

Dorsal Column Transmission

- Large myelinated nerve fibres 30 – 110 m/sec
- High spatial organization of nerve fibres
- Touch sensations requiring high localization or with fine gradations of intensity
- Vibratory (phasic) sensations
- Movement against skin
- Position sensations
- Pressure sensations with high degree of pressure differentiation

Anterolateral System

- Small myelinated fibres to 4 μm with several to 40 m/sec
- Pain
- Thermal sensation
- Crude touch and pressure
- Tickle and itch
- Sexual sensations

Transmission to Brain

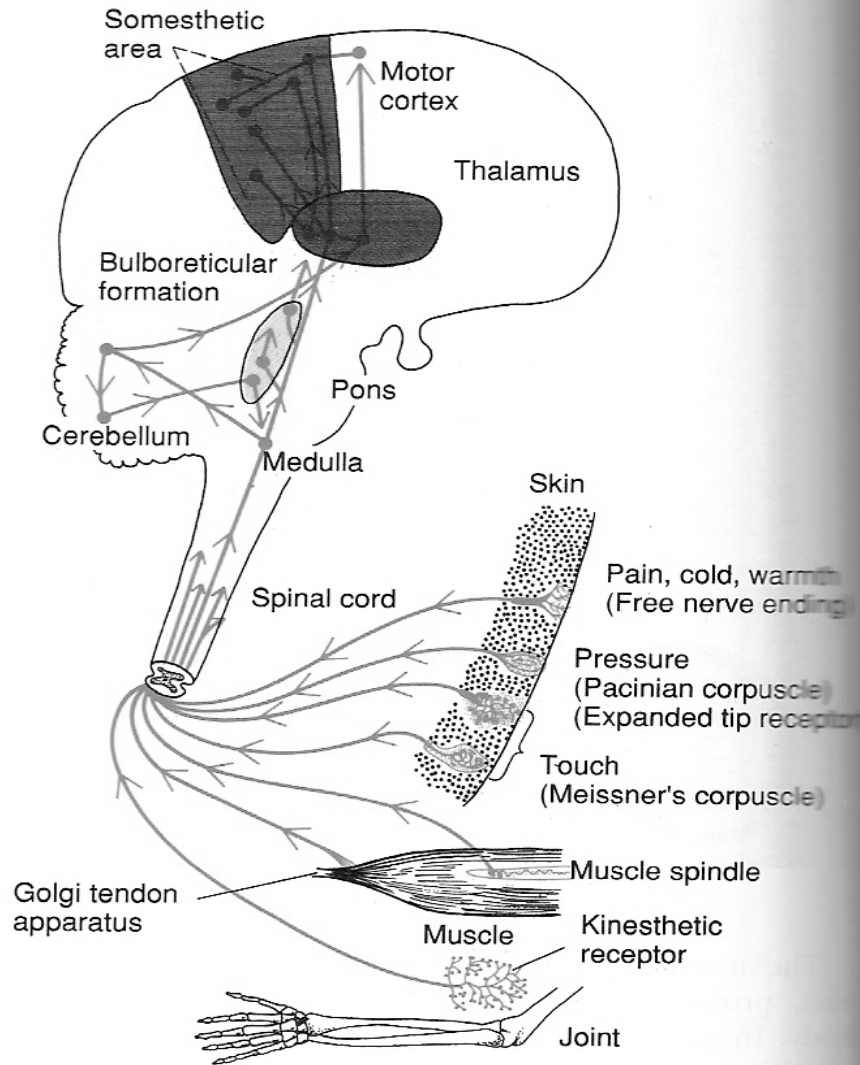


Figure 45-2. Somatic sensory axis of the nervous system.

Dorsal Column Transmission

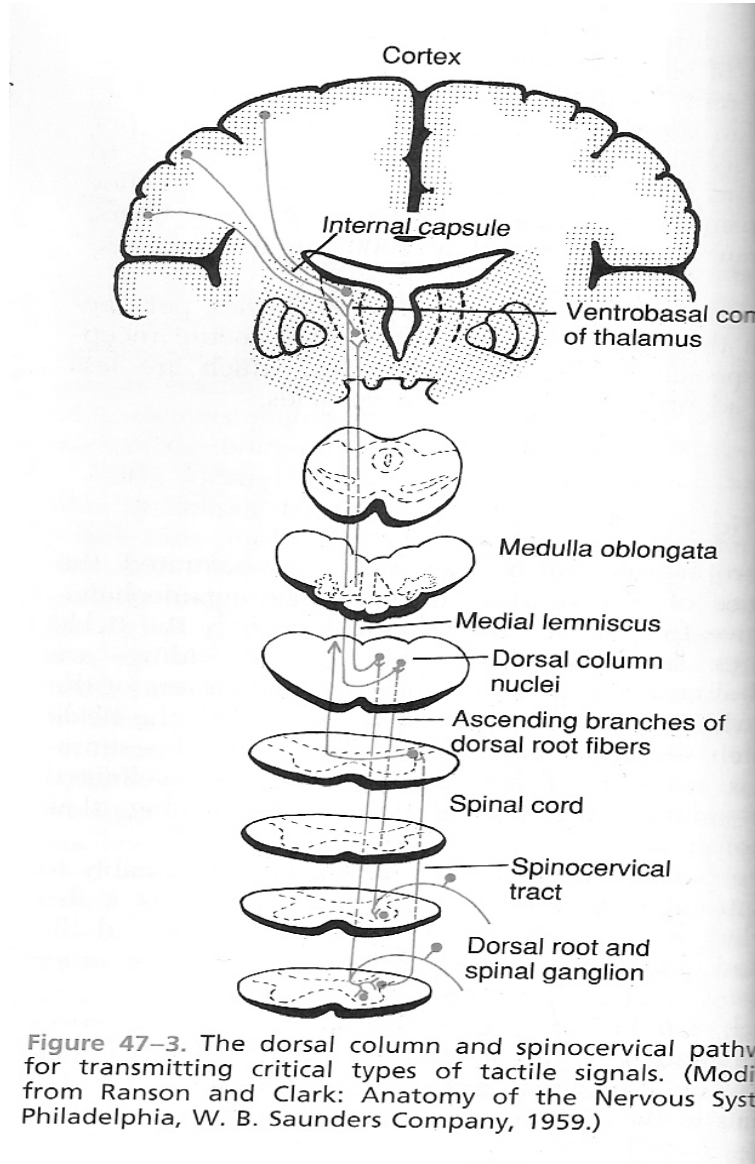


Figure 47-3. The dorsal column and spinocervical pathways for transmitting critical types of tactile signals. (Modified from Ranson and Clark: *Anatomy of the Nervous System*, Philadelphia, W. B. Saunders Company, 1959.)

Transmission to Cerebral Cortex

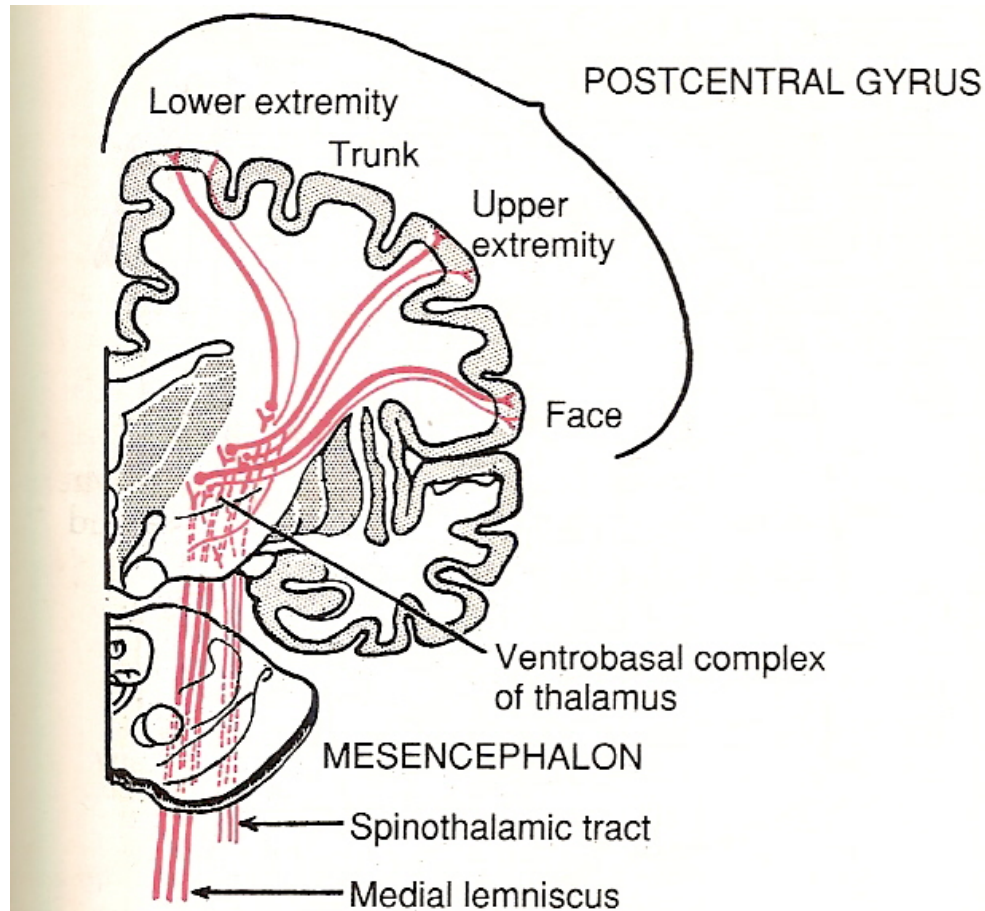


Figure 47-4. Projection of the dorsal column–medial lemniscal system from the thalamus to the somatic sensory cortex. (Modified from Brodal: *Neurological Anatomy in Relation to Clinical Medicine*. New York, Oxford University Press, 1969.)

Distinct Areas of Cerebral Cortex

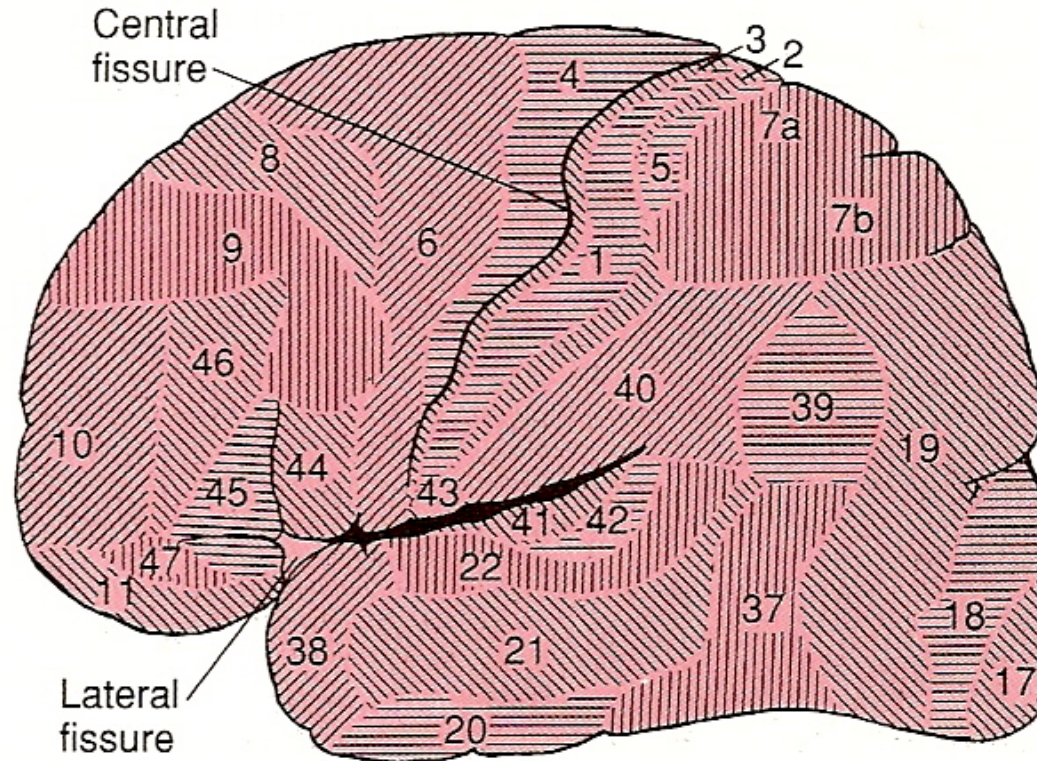


Figure 47-5. Structurally distinct areas, called “Brodman areas,” of the human cerebral cortex. Note specifically areas 1, 2, and 3, which comprise the *primary somatic sensory area I*, and areas 5 and 7, which comprise the *somatic sensory association area*. (From Everett: *Functional Neuroanatomy*. 5th ed. Philadelphia, Lea & Febiger, 1965. Modified from Brodmann.)

Somatic Sensory Cortical Areas

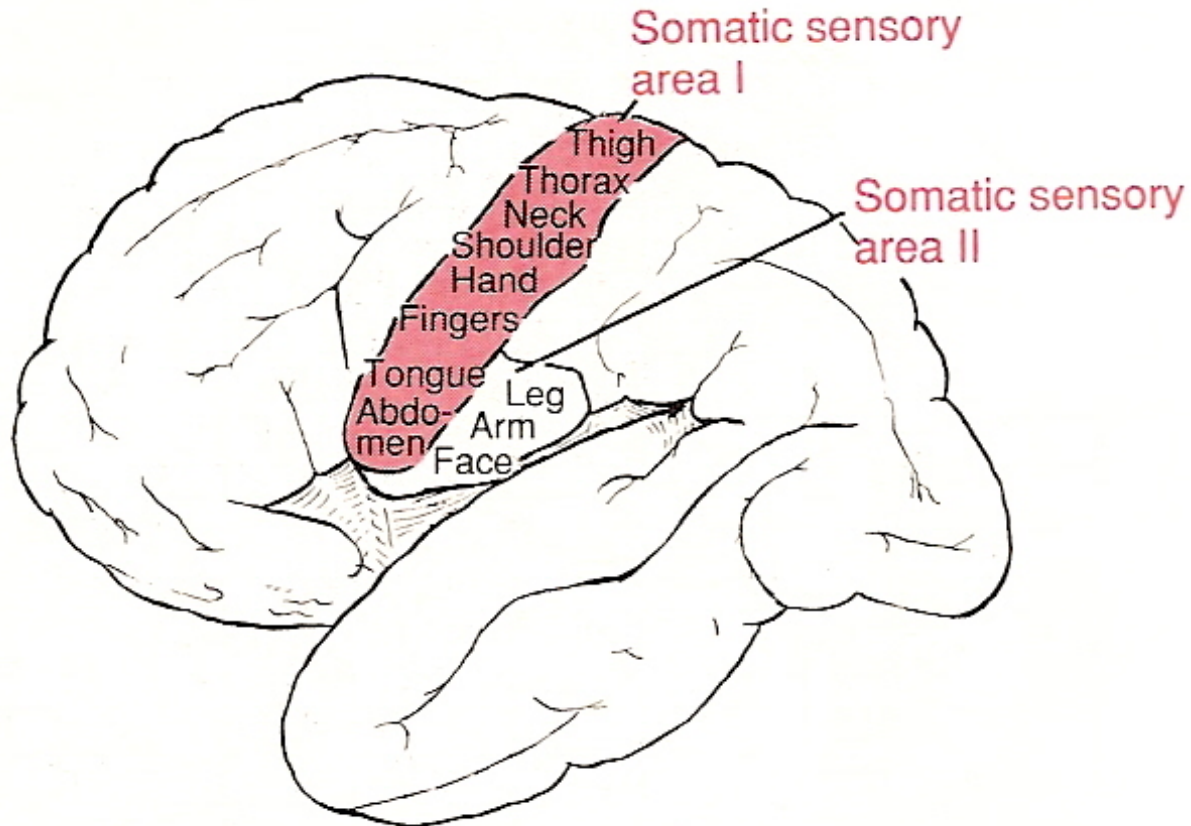


Figure 47–6. Two somatic sensory cortical areas, somatic sensory areas I and II.

Somatic Sensory Area 1

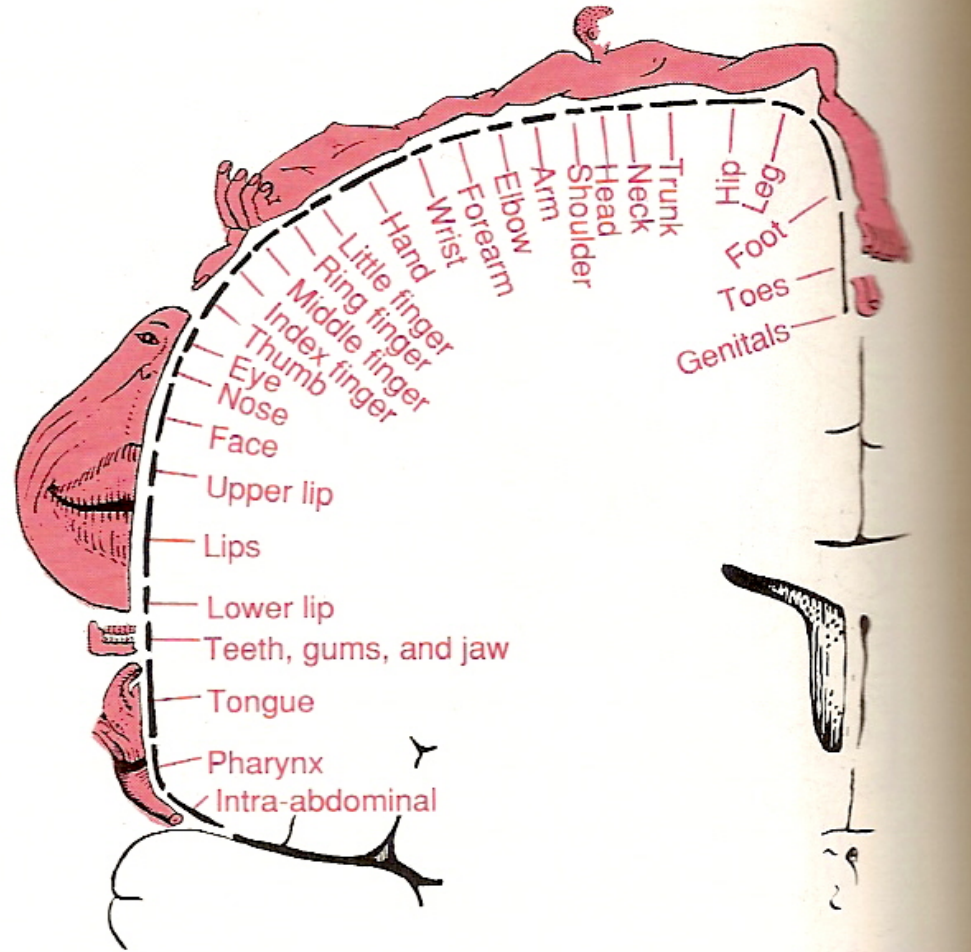


Figure 47-7. Representation of the different areas of the body in the somatic sensory area I of the cortex. (From Penfield and Rasmussen: *Cerebral Cortex of Man: A Clinical Study of Localization of Function*. New York, Macmillan Company, 1968.)

Pinpoint Stimulus to Cortex (divergence)

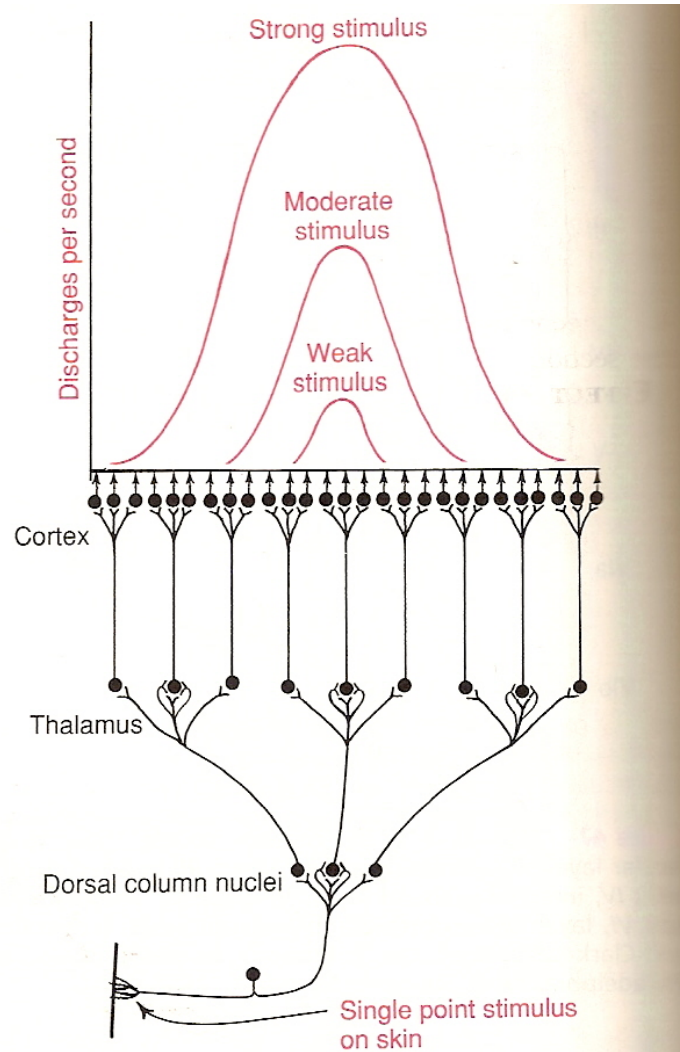


Figure 47-9. Transmission of a pinpoint stimulus signal to the cortex.

Two Point Discrimination

- Two needles pressed lightly against skin at varying distances
- At finger tips discrimination down to 1 -2 mm
- On back discrimination from 30 to 70 mm

Two Point Discrimination

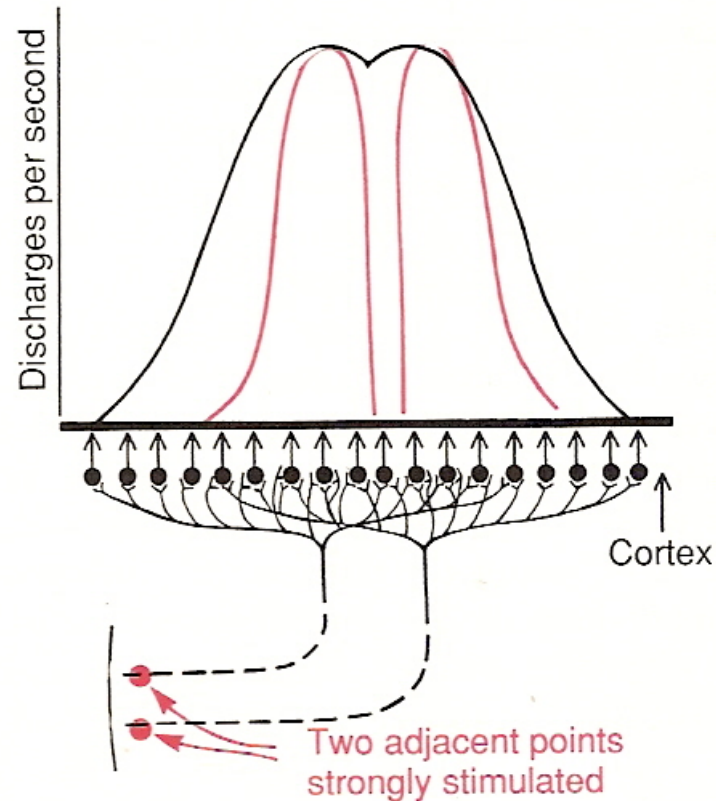


Figure 47-10. Transmission of signals to the cortex from two adjacent pinpoint stimuli. The solid black curve represents the pattern of cortical stimulation without "surround" inhibition, and the two colored curves represent the pattern with "surround" inhibition.