Somatic Sensory System

(1) <u>Exteroception</u>:

- (a) Mechanoreception: Non-Painful Mechanical Stimuli (Touch)
- (b) Nociception: Pain (Sharp, Dull)
- (c) <u>Thermoreception</u>: Temperature (Warm, Cold)

(2) Proprioception:

Position of the Body and Extremities in Space

Direction and Speed of Movements

(3) Interoception:

Information from Internal Organs (Partly Conscious, Partly Unconscious)

Modality Segregation:

Different Modalities Reach the CNS via Anatomically Segregated Pathways

Somatotopy:

Spatially Ordered Representation of the Body Periphery in the CNS





Pacinian corpuscles



Variations of Skin Receptors in <u>Receptive Field Size</u> and <u>Adaptation Rate</u>



Merkel's Disk



Meissner's Corpuscle



Meissner's Corpuscle

Pacinian Corpuscle

Pacinian Corpuscle

Nociception

Free Nerve Endings ! <u>First Pain</u>: Fast, Sharp, Mediated by Myelinated Aδ Fibers <u>Second Pain</u>: Longer-Lasting, Dull, Mediated by Unmyelinated C Fibers

Thermoreception

Free Nerve Endings !

<u>Cold Receptors</u>: Respond to Temperatures < 35°C and > 45°C

<u>Warm Receptors</u>: Respond to Temperatures $\approx 40^{\circ}$ C

Proprioception = Kinaesthesia

Position of the Body and Extremities in Space Direction and Speed of Movements

Muscle Spindle

Muscle Spindle

Function of Gamma Motor Neurons

Muscle Spindle

Golgi Tendon Organ

Interoception

Carotid Body (Glomus Caroticum)

Primary Afferent Axons

Structure of a Segment of the Spinal Cord

Segmental Organization of the Spinal Cord

Dermatomes

Dermatome:

C5

Skin Area Innervated by the Right and Left Dorsal Roots of a Single Spinal Segment

Modality Segregation

Afferents from the Trunk and Extremities: Spinal System (SS)

- <u>Mechanoreception</u>: Dorsal Column Pathway
- Nociception, Thermoreception: Anterolateral Pathway
- Proprioception: Lateral Pathway

Afferents from the Face: Trigeminal System (TS)

- Mechanoreception: Principal Sensory Nucleus
- Nociception, Thermoreception: Spinal Nucleus
- <u>Proprioception</u>: Mesencephalic Nucleus

SS: Mechanoreception (Dorsal Column Pathway)

SS: Mechanoreception (Dorsal Column Pathway)

SS: Nociception & Thermoreception (Anterolateral Pathway)

<u>SS</u>: Nociception & Thermoreception (Anterolateral Pathway)

SS: Proprioception (Lateral Pathway)

SS: Proprioception (Lateral Pathway)

Trigeminal System (TS)

Thalamus – Ventrobasal Complex

Somatosensory Areas of the Cortex

Primary Somatosensory Cortex (S1) Areas 3a, 3b, 1, 2

Secondary Somatosensory Cortex (S2)

Posterior Parietal Cortex Areas 5, 7

Primary Somatosensory Cortex – Somatotopic Map

Primary Somatosensory Cortex – Somatotopic Map

Area 3b – Columnar Organization and Plasticity

Area 3b – Columnar Organization and Plasticity

(b) Normal hand, palmar surface

Details of cortical map

(c) Reorganization of cortical map after surgical removal of third finger (D3)

(d) Reorganization of cortical map after discrimination training of two fingertips

After reorganization of somatosensory cortex

Areas 3a, 3b, 1, 2 – Somatosensory Integration

Parallel ($\uparrow \uparrow$) and Serial ($\rightarrow \rightarrow$) Processing

Areas 3a, 3b, 1, 2 – Somatosensory Integration

Posterior Parietal Cortex – Neglect Syndrome

Posterior Parietal Cortex – Neglect Syndrome

Paintings by the Artist Anton Räderscheidt After he had a Stroke in his Right Posterior Parietal Lobe

Posterior Parietal Cortex – Neglect Syndrome

Posterior Parietal Cortex – Neglect Syndrome

