**Somatosensory Perceptions**

Jon D. Howe  
Department of Psychology  
University of Washington

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**Somatosensors**

- Mechanoreceptors (touch & stretch)
- Thermoreceptors
- Nociceptors

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**Mechanoreceptors**

- Merkel (slow adapting)
- Texture/Form
- Meissner (fast adapting)
- Low frequency vibration
- Ruffini (fast adapting)
- High frequency vibration
- Pacinian (slow adapting)
- position and grasp (pressure)

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**Thermoreceptors**

- Temperature-sensitive receptors
- Always somewhat active even in normal range
- Frequency of activations change with changing environmental thermal conditions

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**Thermoreceptors**

- More frequent firing in response to corresponding temperature changes
- Larger changes = more frequent firing

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**Nociception**

- Nociception is not pain.
- Helps us detect possible or actual tissue damage
  - peripherally,
  - internally.
- Nociception does not always produce a perception.
- Nociception is not necessary to produce a perception of pain.
Nociceptors

- Raw nerve endings
- Multimodal
  - chemoreceptors
  - heat-activated receptors
- No adaptation
- Sensitization

Nociceptor Types

- Touch & light vibration
- Polymodal - slow
- Polymodal - fast
- Myelin!
- No myelin

Interneuron
dorsal horn

First & Second Pain

- The touch (pressure)
- The twinge
- The throb
- First pain
  - leg and foot
- Second pain
  - skull and missing
- C fiber (slow)
- Twinge + throb

Wall’s Gate Theory
(Why it works to rub and scratch)

1. Aβ, C (nociceptors)
2. L-fiber (from nociceptors)
3. Gate opens
4. Gate closes
5. T-cell

Ascending Pathways

- Sensory neurons
- dorsal horn
- thalamus
- cerebral cortex
- primary somatosensory cortex
The pain matrix

Where?
How much?
Is it bad?
Is it PAIN?

CNS gateway
Early topographic map

Descending Modulatory Pathway

- Opiate interneurons modulate (excite or inhibit) nociceptors and ascending neurons!
- Gender and hormones may influence the effectiveness of the modulatory systems.

Nociception vs. Pain

An unpleasant sensory AND emotional experience associated with actual or potential tissue damage, or described in terms of such damage.
(International Association for the Study of Pain, 1979)

Neuropathic Pain

- Not all pain has an apparent peripheral or interoceptive nociceptive origin
- Central Sensitization: Pain perception can be learned
  - reduced firing thresholds
  - changes in numbers and types of receptors
  - increased axon thickness for nociceptive transmission neurons
- Neuropathic Pain seems to be associated with anatomic and physiological changes to pain processing areas in the brain.

Phantom Limb Pain

Neuroplasticity

Interoception

- Monitor the state and health of internal organs
- Mostly stretch & raw nerve fibers
- Not as numerous as skin receptors
Pain Referral

dermatomal organization

convergence!