

THE SOMATOSENSES

Unusual (vs. other senses)

- Many somatosenses we have **no conscious awareness** of
- Many somatosenses have a **strong affective component**
- Are **more varied** than other senses

Three kinds of somatosenses:

- Exteroceptive** – from stimulation external to body (touch, temp, pain)
- Proprioceptive** – from stimulation internal to body, position of body,
No conscious awareness; feedback from muscles, joints, ligaments,
and from organs of balance
- Interoceptive** – from stimulation internal to body, no conscious awareness,
e.g. temperature, BP, acidity of stomach, CO₂ levels in bloodstream

Sensory Receptors for Exteroceptive Senses:

Free-Nerve Endings (temp & pain), no “receptor”

Hairless skin (glabrous):

- Pacinian corpuscle
- Meisner’s corpuscle
- Ruffini endings
- Merkel’s discs

Hairy skin:

- Pacinian corpuscle (deep, rapid)
- Hair cell (shallow, rapid adaptor)
- Ruffini endings (deep, slow adapt)
- Merkel’s discs (shallow, slow)

350 touch receptors/square millimeter in human finger tips

Dermatomes

- Skin (derma) zones carried in on given spinal nerves (N=31 pairs)
- Plus input from CN V (trigeminal nerve) for head

Pathway into brain:

- (1) **Dorsal (sensory) column/medial lemniscal pathway**
carries touch and proprioception senses

receptors --- dorsal root nerve into spinal cord --- dorsal (sensory) columns
--- decussate in medulla --- contralateral medial lemniscus --- **ventral**
posterior nucleus of thalamus (joined by CN V) --- **post-central gyrus**

Pathways into brain: (cont.)

2. Anterolateral pathway

carries **pain and temperature** information

Free-nerve endings --- dorsal root nerve into spinal cord --- synapses onto a new nerve cell --- decussates --- ascends in one of 3 tracts:

spinothalamic tract --- ventroposterior nucleus of thalamus

spinoreticular tract --- RF --- parafascicular & intralaminar nuclei of thalamus

spinotectal tract --- colliculi

note: CN V (trigeminal) adds into the mix at medulla

thalamus --- post-central gyrus (SI and SII) & posterior parietal area

Other Interesting Information:

Chronic Pain

= or > 6 months duration, often starts with injury

pain receptors become hypersensitive

opiates help but concerns re. addiction (which may be unjustified)

Melzack's "gate theory" of pain reduction

Noticed that pain awareness is **susceptible to distraction**...why?

Effects of **high emotional states** on pain...fear/anxiety, sexual arousal, anger

Where does pain get blocked? **PAG (periaqueductal gray)** in

midbrain --- **5HT neurons in Raphe nucleus** (medulla) ---

spinal cord interneurons --- inhibit incoming pain signals in dorsal horn of grey matter of spinal cord

Endogenous "opiates" = **endorphins** (neuropeptides)

Do chronic pain patients have too little?

Are suppressed by chronic use of opiates...

Are released in high amounts just prior to giving birth

Are released in high amounts with acute stress

Associated with suppression of immune system, as are opiates

lesion dorsal root ganglia (rhizotomy) --- little relief

lesion ventroposterior or intralaminar+parafascicular nuclei

Chronic Pain (cont.)

Where is pain felt in the brain?...do not know...

If remove SI and SII, no change in pain threshold

Pt. with one hemisphere removed can still feel pain *bilaterally!*

Role of **anterior cingulated gyrus**

If lesion/remove--- *S* shows a reduced emotional reaction to pain

Becomes more active when *S* experiencing pain

S shows less anxiety if lesion ACG, also less OCD

Phantom Limb Pain

Felt in about 50% of all amputees

Lessened if put on an artificial limb...why?

Does not reduce if lesion incoming pain pathways, so must be **central** in origin...similar to phantom vision? Phantom hearing?

Molecular Neurosurgery

Substance P **is a major NT in incoming pain signal**

Glutamate may also be

Capsaicin – causes release of large amount of sub.P, depletes supply

Thus, several hours/days of analgesia

Artificial molecule of **sub.P** + **toxic molecule** (e.g. saporin) created

Inject into ascending pain pathways --- absorbed into neuron ---

kills neuron --- analgesia

S still responds to opiate analgesia (which is good)

Way of the future of treating pain?