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 (tough, temp, pain)
Proprioceptive – from stimulation internal to body, position of body,
   No conscious awareness; feedback from muscles, joints, ligaments, 
   and from organs of balance
Interceptive – 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):                Hairy skin:
   Pacinian corpuscle                  Pacinian corpuscle (deep, rapid)
   Meisner’s corpuscle                Hair cell (shallow, rapid adaptor)
   Ruffini endings                    Ruffini endings (deep, slow adapt)
   Merkel’s discs                     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?