Touch Physiology

• Touch sensations are represented somatotopically (analogous to retinotopy found in vision/tonotopy in audition)
  – Adjacent areas on skin: Connected to adjacent areas in brain, called homunculus
  – Brain contains several sensory maps of body, different subareas of S1, secondary areas as well

Primary Somatosensory Receiving Areas in the Brain
The Sensory Homunculus

Relative distribution of body parts
Olfaction
Olfaction

- Olfactory Physiology
- From Chemicals to Smells
- Olfactory Psychophysics, Identification, and Adaptation
- Olfactory Hedonics
- Olfaction, Memory, and Emotion

Olfactory Physiology

- Odors: Olfactory sensations
  - Chemical compounds
  - But not every chemical is odorant
  - In order to be smelled: Molecule must be volatile, small, and hydrophobic
Olfactory Physiology (cont’d)

- The human olfactory apparatus:
  - Nose: Small ridges, olfactory cleft, olfactory epithelium
  - Primary purpose of nose is to filter, warm, humidify air we breathe
Olfactory Physiology (cont’d)

• The olfactory epithelium: the “retina” of the nose:

  – Three types of cells:
    • 1. Supporting cells
    • 2. Basal cells
    • 3. Olfactory sensory neurons (OSNs)—cilia protruding into mucus covering olfactory epithelium

  – Olfactory receptors (ORs): Interaction between these and odorant stimulates cascade of biochemical events
Olfactory Perception Pathway

(a) Olfactory bulb
   To primary olfactory cortex and other brain structures
   Mitral cell
   Glomerulus
   Cribriform plate
   Olfactory nerve
   Olfactory sensory neuron
   Olfactory cilia

(b) Olfactory bulb
   Primary olfactory cortex
   Amygdala-hippocampal complex
   Entorhinal cortex

11/18/2008
Olfactory Physiology (cont’d)

• Olfactory loss can cause great suffering:
  – Sense of taste
  – Danger warning

Olfactory Physiology (cont’d)

• Olfactory receptor cells are different from all other sensory receptor cells
  – They are not mediated by any protective barrier, make direct contact with brain (visual receptors are protected by cornea, receptors for hearing are protected by eardrum, taste buds are buried in papillae)
    • Therefore many drugs can be inhaled
    • OSN axons are among thinnest and slowest in body…so it takes a long time to perceive odors compared to other perceptions
Olfactory Physiology (cont’d)

• Subtle differences between sensation and perception:
  – Sensation occurs when scent is neurally registered
  – Perception occurs when becoming aware of detecting it

Olfactory Physiology (cont’d)

• The genetic basis of olfactory receptors:
  – In 1991 Buck and Axel showed that genome contains about 1000 different olfactory receptor genes, each codes for single type of OR
  – All mammals have roughly this set (though many become nonfunctional—or pseudogenes)
    • Genes are in chromosomes, but proteins coded for by the genes never get produced
  – Trade-off between vision and olfaction
Olfactory Physiology (cont’d)

• The feel of scent:
  – Odorants can stimulate somatosensory system through polymodal nociceptors (touch, pain, temperature receptors)
    • Cranial nerve I = olfactory receptors
    • Cranial nerve V (trigeminal nerve) = somatosensory receptors
  – Often impossible to distinguish between sensations from cranial nerve I from and those traveling up cranial nerve V

From Chemicals to Smells

• Theories of olfactory perception:
  – Shape-pattern theory
    • Match between shapes of odorants and odor receptors
From Chemicals to Smells

• Theories of olfactory perception:
  – More recent molecular research
    • Scents are detected by means of combinatorial codes
  – Vibration theory
    • There is a different vibrational frequency for every perceived smell
    • Molecules that produce same vibrational frequencies will produce same smell