Other Perceptual Modalities

Lesson II: Perception module 12

University of Idaho
Ranking of the different senses by their research relevance in cognitive psychology

1. Vision and auditory processing
2. Touch and haptic processing
3. Nociperception (pain)
   - Proprioception
   - Chemical senses: smell and taste
4. Others (e.g., thermal)
Functions of auditory perception
- Perception of sounds
- Perception of spoken language
- Localization of sounds in environment

Physical stimulus
- Mechanical sound pressure changes
- Frequency, amplitude, and phase

Processing path
- Cochlea (inner ear)
- Medial geniculate nucleus (thalamus)
- Auditory cortex (temporal lobe)
  (tonotopic organization by frequency)
Auditory perception

- **Ability to differentiate frequencies ...**
  - Humans can hear sound in the 20 - 20,000 Hz range
  - Best hearing in the frequency range of spoken language (400 - 4,000 Hz)

- **Object perception and audition**
  - Recognizing a spoken word is the analogous problem to recognizing a visual object
  - Expectations (top-down processing) drive much of our speech perception
    (we will encounter this again in lesson 7: language)
  - Geons are conceptually similar to phonemes in language comprehension
Cochlear implants
- Are surgically placed in the inner ear of deaf patients
- Supply the auditory nerve with electrical simulation
- Are limited to a very small number (i.e., 16) different frequencies (stimulation sites)

Auditory performance with a cochlear implant
- Improved language understanding when lip-reading
- Phone conversations are possible
- Music perception

Role of top-down processing
- Expectations and the use of context play a much greater role with degraded auditory input than in regular auditory speech perception
Sound can transmit relevant object information

- Perception of distance by frequency spectrum (higher frequencies diminish faster with increasing distance than lower frequencies)
- Perception of movement (Doppler-effect: Sound from a moving object changes its pitch depending on the direction of movement - towards or away from the listener)

Echolocation

- Some species (e.g., bat, dolphin) use self-generated sound to locate, identify, and track objects via echolocation
Synaesthesia is present when sensory processing of one modality automatically activates mental representations belonging to another modality

- Number-color
- Shape-taste
- Sound-color

Potential explanations

- Synaptic “cross-talk” between neighboring brain areas
- Chemical “cross-talk” between neighboring (and more remote) brain areas
- Genetic basis
Number-Color synaesthesia
- Visual processing of color occurs in V4 in the temporal lobe
- Graphemic representations of numbers are processed in a nearby area in the fusiform gyrus
Other evidence for synaesthesia

- **Behavioral evidence**
  - Pop-out of otherwise “invisible” patterns
  - Increased threshold to detect a tinted number if the color matches synaesthesia (otherwise not impaired)
  - Increased ability to identify numbers in attentionally demanding tasks
  - Synaesthesia is grapheme specific - when presented with roman numerals (e.g., V for 5), no color is perceived

- **Neuropsychological evidence**
  - fMRI reveals activation in color area when looking at black/white numbers