260-2017-03-27-sensation

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Prelude

Today's Topics

- Sensory systems

Sensation/Cognition/Action

From sensation to action

Systems/information processing view

- Input
- Processing
- Memory
- Output

Your turn:

- What information do you need to know?
- Why do you need to know it? In what context, for what purpose?
- What do you need to know about it?
- What types of information do you need to gather, through which channels?

You vs. Your Smartphone

Multisensory processing in a smartphone

- Accelerometer
- Gyroscope
- Magnetometer
- Proximity sensor
- Ambient light sensor
- Barometer

http://www.phonearena.com/news/Did-you-know-how-many-different-kinds-of-sensors-go-inside-a-smartphone_id57885

Multisensory processing in a smartphone

- Thermometer
- Mic
- Camera
- Radios (Bluetooth, wifi, cellular, GPS)

http://www.phonearena.com/news/Did-you-know-how-many-different-kinds-of-sensors-go-inside-a-smartphone_id57885

Dimensions of sensory processing

- *Interoceptive*
  - How am I?
- *Exteroceptive*
  - What's in the world, where is it?

Questions for interoception

- Tired or rested?
- Well or ill?
- Hungry or thirsty or sated?
- Stressed vs. coping?
- Emotional state?

Questions for exteroception

- Who/What is out there?
- Where is it?

Who/what

- Animate/inanimate?
- Conspecific (same species)/non?
- Threat/non?
- Familiar/un?
- Mate/non? or Friend/not?
- Food source/non?

Where

- Distance
- Elevation, azimuth
- Coordinate frames
  - Self/ego (left of me)
  - Object (top of object)
  - Allo/world (North of College Ave)
- Where moving?

How

- What kind of response?
  - External
  - Internal
- Approach/avoid/freeze
- Signal/remain silent
- Manipulate

More than 5 senses

From world to brain

- How do events/entitities generate patterns that sensors can detect?
  - Chemical
  - Photic/electromagnetic
  - Mechanical/acoustic

How sensory channels differ

- What is the energy/chemical source
- How does the channel inform
  - What is out there
  - Where it's located

Features of sensory signals

- Tonic (sustained) vs. phasic (transient) responses
- Adaptation
  - Decline in sensitivity with sustained stimulation
  - Most sensory systems attuned to change
- Information propagates at different speeds

Common principles

- Sensors detect repeating signals
  - In space (textures)
  - In time

Spatial frequency/contrast sensitivity

http://fourier.eng.hmc.edu/e180/lectures/figures/csf_image.gif

Frequencies in sound

http://hearinghealthmatters.org/waynesworld/files/2012/06/Fourier-Analysis.gif

Common principles

- Compare (>1) sensor for each channel
  - Eyes
  - Ears
  - Nostrils
  - Skin surface

Why is the snake's tongue forked?

http://indianapublicmedia.org/amomentofscience/files/2010/06/tongue_111.jpg

Common principles

- Sensory neurons have “receptive fields”
  - Area on sensory surface that when stimulated changes neuron’s firing

Tactile receptive field

Visual receptive field

https://classconnection.s3.amazonaws.com/594/flashcards/1450594/png/untitled_picture51356035996428.png

Common Principles

- Topographic maps

Tonotopic (frequency) maps in auditory cortex

http://www.his.kanazawa-it.ac.jp/~tomi/public/MEGLab/Auditory/tonotopy.gif

Retinotopic maps in visual cortex

http://jov.arvojournals.org/data/Journals/JOV/933499/jov-3-10-1-fig001.jpeg

Common principles

- Non-uniform sensitivity

Two-point touch thresholds

http://jov.arvojournals.org/data/Journals/JOV/933499/jov-3-10-1-fig001.jpeg

Acuity variations across visual field

https://upload.wikimedia.org/wikipedia/commons/thumb/2/27/AcuityHumanEye.svg/270px-AcuityHumanEye.svg.png

Hearing threshold varies across frequency

http://www.hearforever.org/userfiles/image/tools_to_learn/SS4_Hearing_Sensitivity.jpg

Hierarchical processing

Parallel processing

Parallel processing

Next time...

- Somatosensation