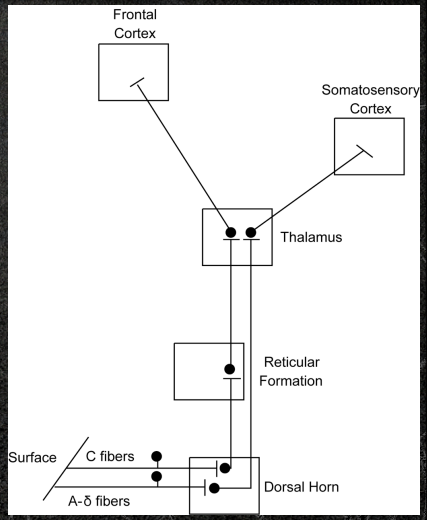
Consciousness II: Pain

Philosophical Accounts

- Eliminativist: pain doesn't exist (Paul Churchland, Dennett)
- Behaviorism (Wittgenstein): pain is a form of behavior, not an inner experience
- Pains are located in the affected tissue (Armstrong, Newton)
  - Asked what hurts, we name the affected part of our body
  - Makes pain appear as a type of perceptual process--just as we report on objects we see, we report on pain
- Pains are purely subjective and inherently conscious (Grahek, McGinn)
  - People report pains without damage in tissues
  - Pain is "an unpleasant sensory and emotional *experience* associated with actual or potential tissue damage, or described in terms of such damage" (International Association for the Study of Pain)
  - People cannot be mistaken about their pains

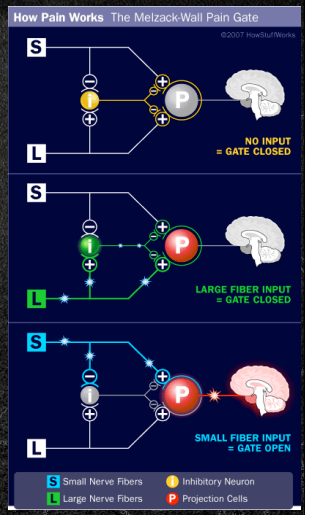
Classical Two Pain Pathways

- A-δ fibers project via the thalamus to somatosensory cortex, providing information about the location of the pain stimulus on the body, its intensity, duration, and nature
  - Myelinated fibers that send information quickly
- C fibers project via different layers in the thalamus directly to motor control areas, providing information about the unpleasantness of the stimulus
  - Unmyelinated fibers that respond slowly



Melzack and Wall

- In the 1950s Melzack and Wall advanced a gate-control theory of pain
  - Small (C) fibers and Large (A δ) both project onto inhibitory interneurons (I) projection cells (P) which go up to cortex
    - When large fibers fire without small fibers, the Inhibitory neuron blocks activation of the projection fiber
    - When small fibers fire, they inhibit the Inhibitory neuron, and the gate is open for transmission to the brain
  - If, after a pain stimulus, you rub the spot, the large fibers can close the gate

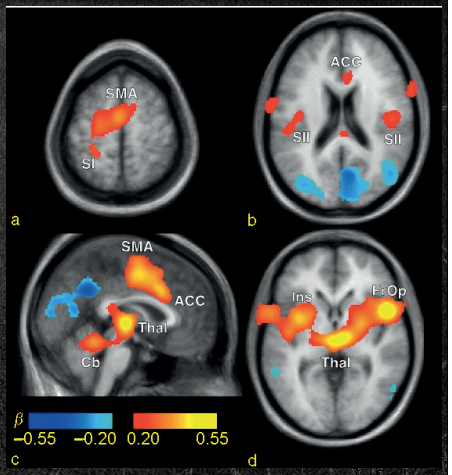


Cortex and Pain

- Traditional puzzle
  - Most cortical lesions do not seem to affect the ability to experience pain
  - Most stimulations administered to cortex do not seem to produce pain experience
  - But single-cell recording in animals has identified areas that seem to be involved in pain processing
- Is cortex involved in pain experience?

Neuroimaging Reveals Distributed Cortical Pain

- Somatosenory cortex (SI, SII)
  - While it is difficult to find individual SI cells that respond to pain stimuli, SI shows increased activity, as does SII
- Anterior cingulate shows activity both in response to pain stimuli and analgesia
- Anterior insula and prefrontal cortex also show pain responses
- Reduced activation in the default network (posterior cingulate, precuneus, and ventromedial prefrontal cortex)



Lateral versus Medial Cortical Pain Systems

- Lateral pain system projects from lateral thalamus to somatosensory areas
  - And seems quickly to engage motor areas
- Medial pain system projects from medial thalamus to prefrontal cortex and anterior cingulate
  - More concerned with affective response than motor response
- Note parallels with the ventral and dorsal visual streams

Dissociation of Pain

- Dissociation of the two pathways
  - Morphine or frontal lesions leave awareness of damage but removed the "hurtfulness" of pain
    - "The pain no longer bothers me"
  - Fentanyl leaves the hurtfulness in place but inhibits the ability to discriminate what tissue is damaged
- Dissociation of peripheral and central processes
  - Brain processes involved in pain experience can be activated without damage to bodily tissue
  - Tissue can be damaged but brain processes suppressed

What is Pain?

- Recall the philosophical alternatives:
  - Pain is a state of the damaged tissue
  - Pain is a subjective response
- Why are so many brain areas involved in pain responses?
  - Is pain itself a complex phenomenon?
    - It typically does involve damage to a tissue
      - This requires both input from tissue and a representation of where the tissue is in the body
    - It typically does involve subjective, including emotional response
      - This requires coordination with other neural processes
- Can the consciousness experience of pain be further decomposed?
  - Are there other brain processes that contribute to the conscious experience of pain?

Phantom Pain

- Pain attributed to a part of the body that has been amputated or is no longer sending signals
  - Widespread in amputees: 82% with arm amputation, 54% with leg
- Drawing upon the fact that phantom pain was more common if the patient had experienced paralysis prior to amputation, Ramachandran developed the mirror box treatment
- What, if anything, do phantom pains tell us about pain experience?
  - Perhaps they serve to highlight the engagement between sensory processing and motor activity
    - Experience depends in part on what we do