



# Somatosensation

## Module 2

# Announcements

- Last labs this week
- Las quiz due Wednesday
- Final exam a week from Wednesday
  - Extra office hours Tuesday before final
  - Study guide posted by by Wed (or sooner)
- Photo contest vote next class

# Discussion

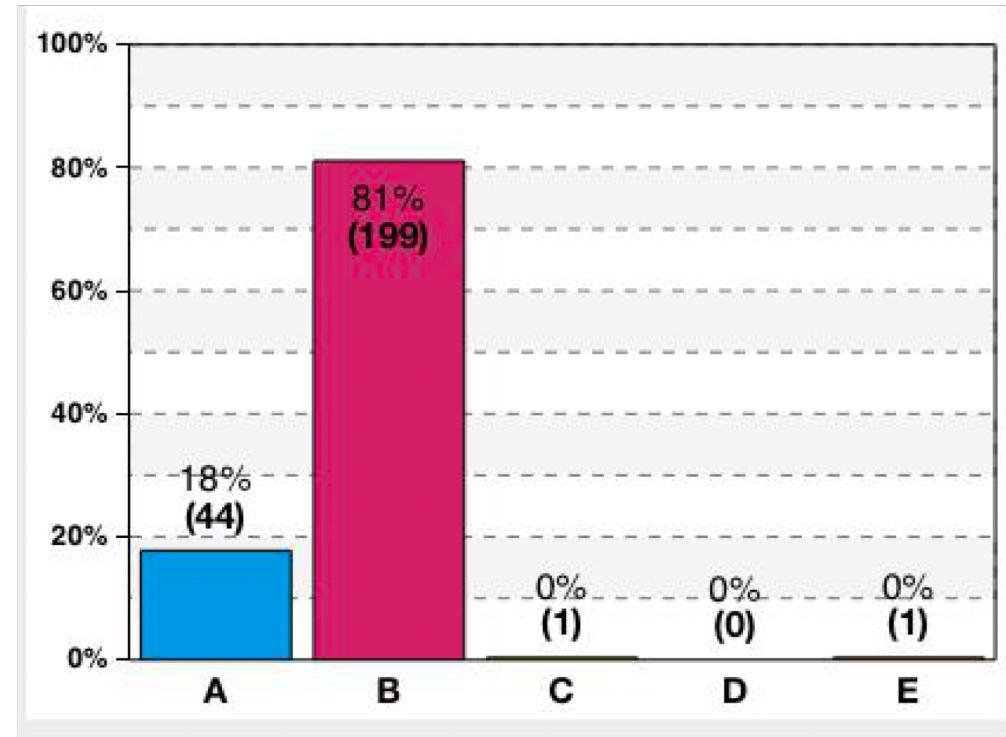
- Ajax is an artificially-mutated villian in Deadpool who he feels no pain
- Do you think this would actually be a useful super power?

A

Yes

B

No



# Pain Perception

Pain is a multimodal phenomenon containing a **sensory** component and an **affective** or emotional/cognitive component

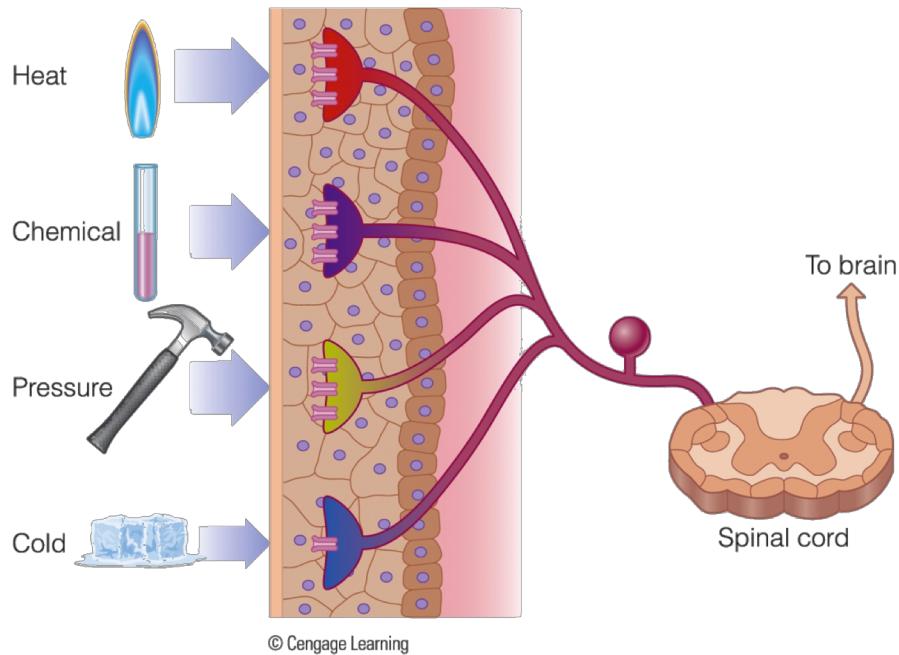
- The skin has pain receptors that can act as a threat detection system
- The threshold of eliciting receptor response must be balanced to warn of damage, but not be affected by normal activity
- People with **Congenital insensitivity to pain (CIP)** don't experience pain and can unintentionally injure themselves while performing normal activities
- **Sensory processing disorder (SPD)** can result when an individual is too sensitive to common sensations



# Types of Pain

There are three classic types of pain

1. **Nociceptive:** caused by activation of receptors in the skin called nociceptors, which are specialized to respond to tissue damage and potential tissue damage
2. **Inflammatory pain:** caused by damage or irritation within tissues and joints.
3. **Neuropathic pain:** caused by lesions or other damage to the central nervous system (not from receptors, but from nervous system activity) including
  - Brain damage caused by stroke
  - Repetitive movements which cause conditions like carpal tunnel syndrome



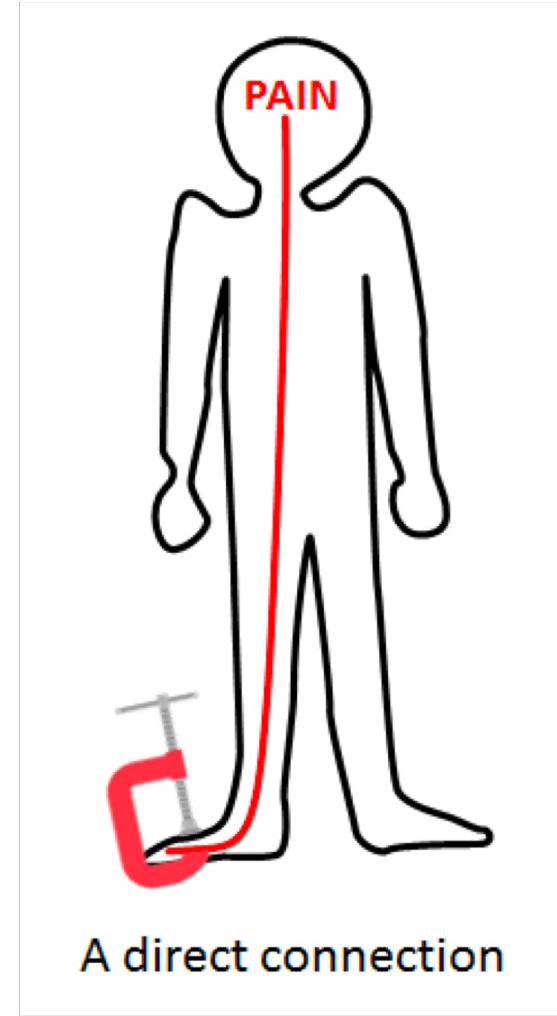
# Types of Pain

- Fourth type of pain??
- Some researchers have argued that **social isolation** or **rejection** is a form of **pain** is the experience of pain result from interactions (or lack thereof) with other people
- Cases often involve depression and social rejection
- Can be associated with interpersonal rejection or loss
- No tissue damage, but very strong affective element (aversive)



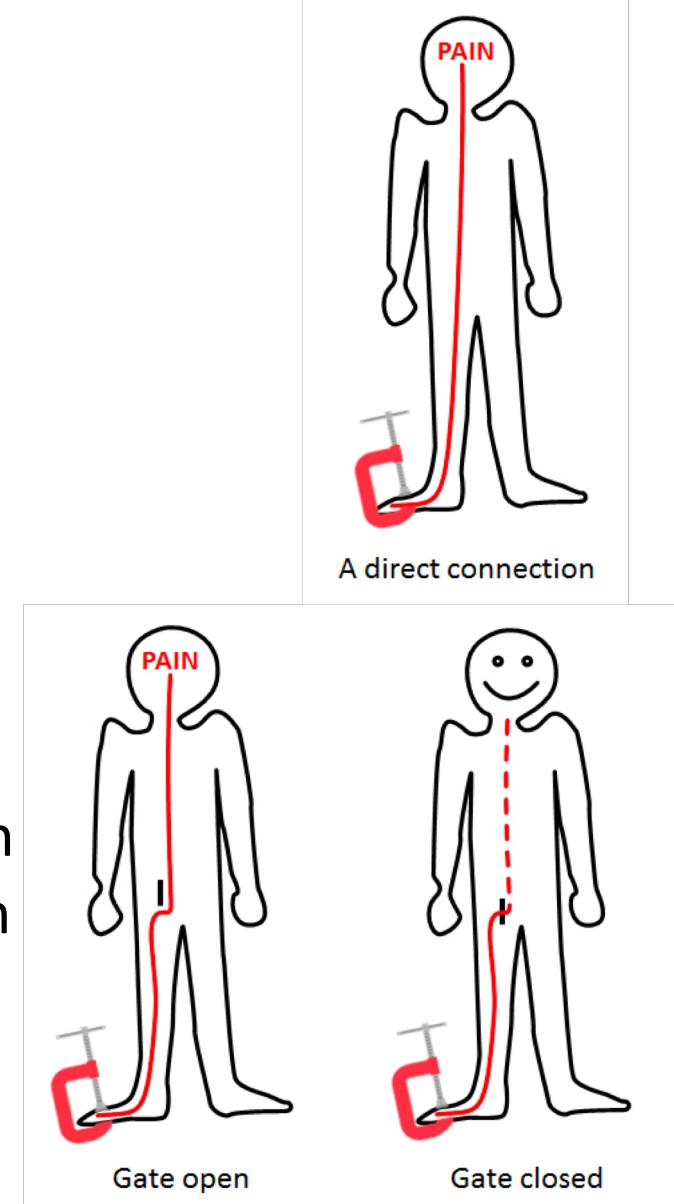
# Model of Pain

- **direct pathway model** proposed that nociceptors are stimulated by the appropriate stimuli and these signals are immediately sent to the brain
- Problems:
  - Can occur in absence of skin stimulation (e.g. phantom limbs)
  - Can be affected by what the person is attending to (e.g. if they don't realize they are injured)
  - Pain affected by mental state (e.g. less pain when happy)



# Model of Pain

- **direct pathway model** proposed that nociceptors are stimulated by the appropriate stimuli and these signals are immediately sent to the brain
- **gate control theory of pain:** non-painful input (mechanoreceptors) as well as top-down influences (central control: affect, mood) can close the nerve "gates" to painful input, which prevents **pain** sensation from traveling to the central nervous system



# Pain & Central Control

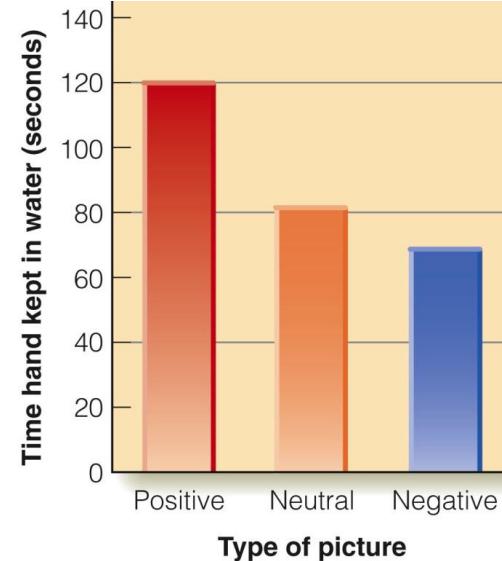
- **Expectation** can change the experience of pain (Bingel et al, 2011)
  - **Placebo** causes a *decrease* in pain even though there is no active ingredients
  - **Nocebo** causes an *increase* in pain even though there is no active ingredients

CONDITION	DRUG?	PAIN RATING
Baseline	No	66
No expectation	Yes	55
Positive expectation	Yes	39
Negative expectation	Yes	64



# Pain & Central Control

- Pain perception can be influenced by a persons **emotional state** (deWied & Verbaten, 2001)



- Roy at al (2008)
  - Pleasant music can decrease pain

CONDITION	INTENSITY RATING	UNPLEASANTNESS RATING
Silence	69.7	60.0
Unpleasant music	68.6	60.1
Pleasant music	<b>57.7</b>	<b>47.8</b>

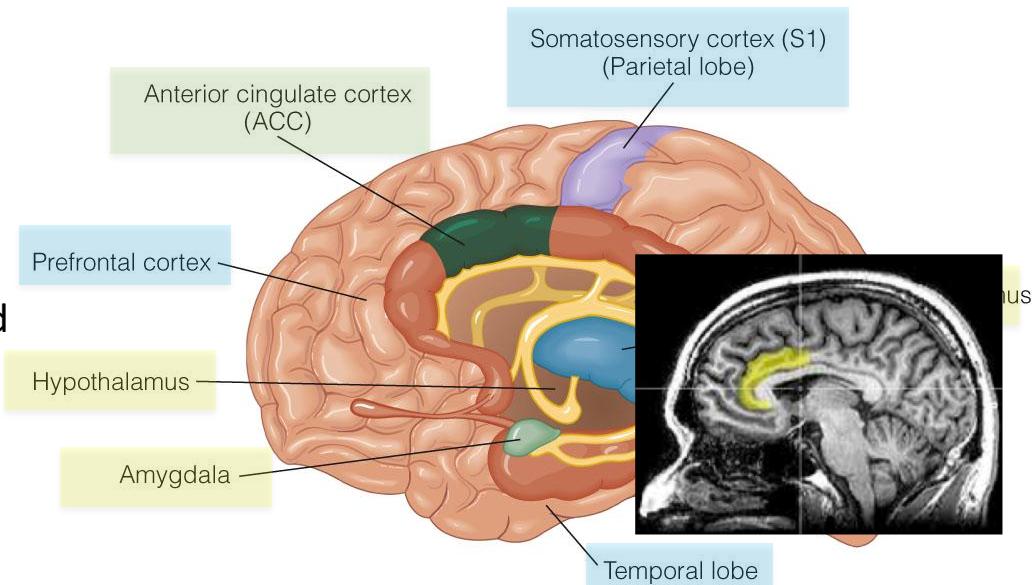
# Clicker Question

According to the gate control theory of pain  
\_\_\_\_\_ can contribute to “closing the gate” and decrease the intensity of pain.

- A. Mechanoreceptors
- B. Affect/mood
- C. Nociceptors
- D. Both A and D

# Pain in the Brain

- The **pain matrix**: pain representation is widely distributed
  - Subcortical areas include: the hypothalamus, limbic system, and the thalamus
  - Cortical areas include: the somatosensory cortex, the insula, prefrontal cortices, and anterior cingulate
- **Anterior cingulate** seems to be involved in the affective (emotional component)
  - Hofbauer et al (2001) Used hypnosis to manipulate subjective pain intensity and affective component (unpleasantness). Found unpleasantness associated with activity of anterior cingulate in fMRI.



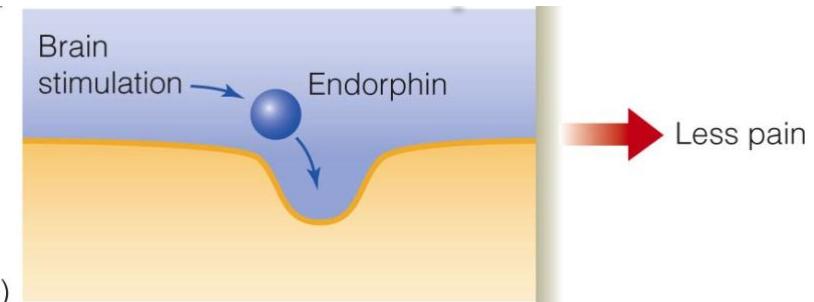
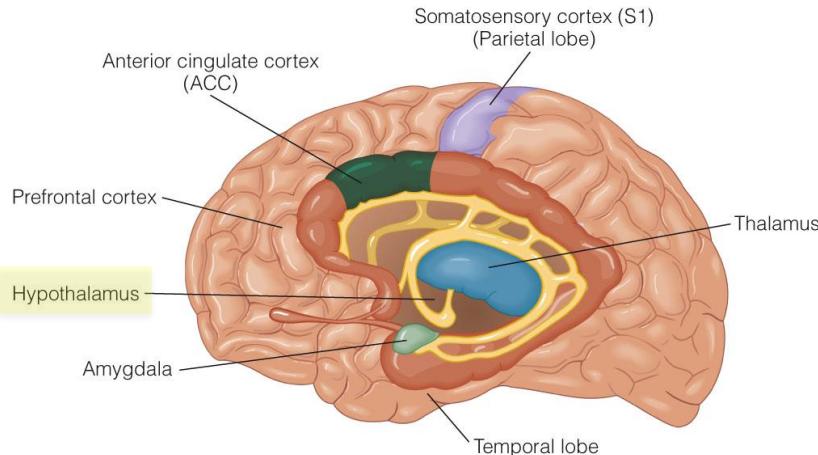
# Clicker Question

Compared to other people, my pain tolerance seems to be:

- A. Low (feel way less pain)
- B. Very low (feel more pain)
- C. Average
- D. High (feel less pain)
- E. Very high (feel way less pain)

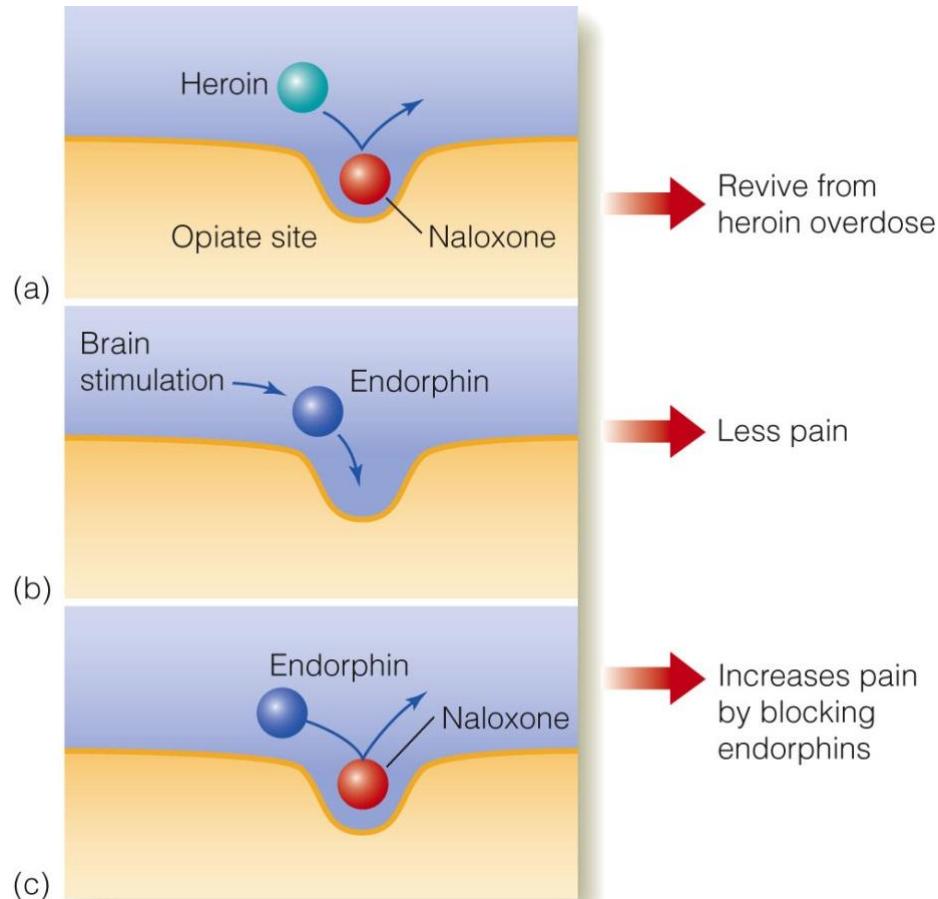
# Pain in the Brain

- The body regulates pain with **endorphins**
- Pituitary gland and hypothalamus release these neurotransmitters
  - People whose brains release more endorphins can withstand higher pain levels



# Pain in the Brain

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- Pituitary gland and hypothalamus release these neurotransmitters
  - People whose brains release more endorphins can withstand higher pain levels
- **Opiates can activate these receptors** and reduce pain.
  - Injecting naloxone (with a similar molecular structure) blocks the receptor sites causing more pain.
  - Naloxone also decreases the effectiveness of placebos!
  - Suggesting placebos might work by releasing endorphins



# Pain in the Brain

- Placebo effect and endorphins (Benedetti et al., 1999)
- Do placebo's cause endorphins to be released widely, or are they more targeted?
  - Injected capsaicin under skin



Effect of Placebo Cream on Different Parts of the Body

CONDITION	PAIN RATINGS AT DIFFERENT BODY LOCATIONS			
	LEFT HAND	RIGHT HAND	LEFT FOOT	RIGHT FOOT
No placebo	6.6	5.5	6.0	5.4
Placebo cream on left hand	<b>3.0</b>	6.4	5.3	6.0
Placebo cream on right hand and left foot	5.4	<b>3.0</b>	<b>3.8</b>	6.3

Source: Benedetti et al. (1999).

# Social Pain??

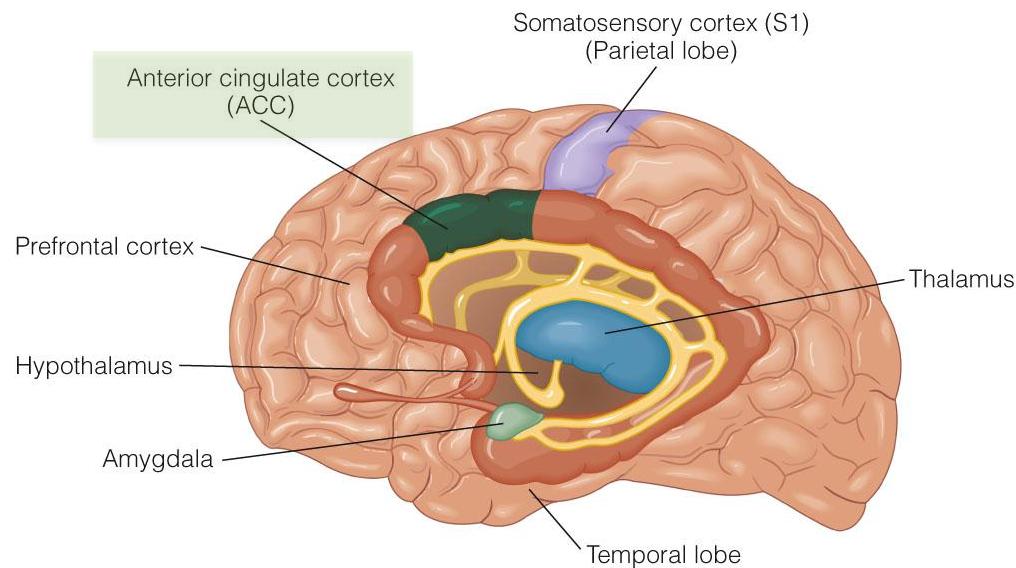
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# Pain in the Brain

If pain has a strong affective (emotional or cognitive) component, can it be experienced without the painful (injuring) stimulus?

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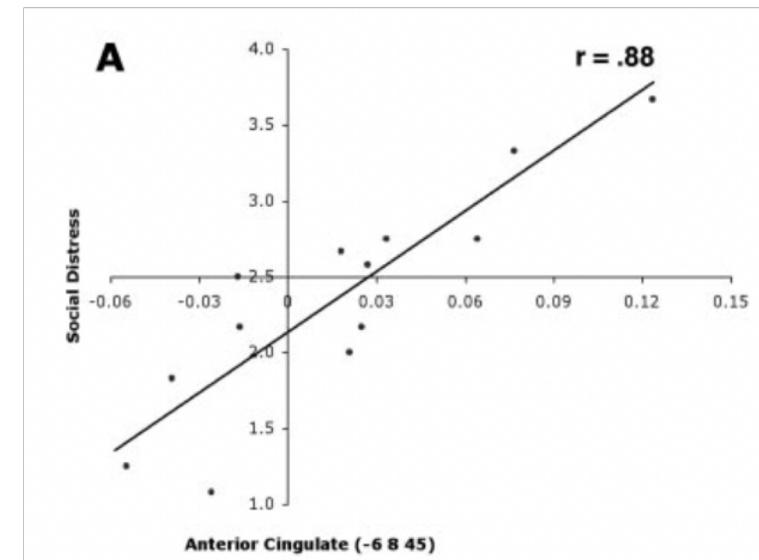
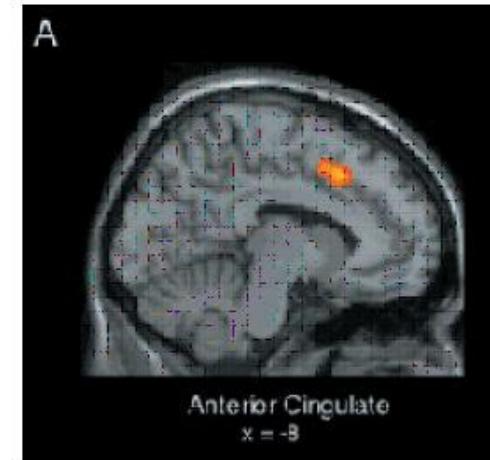
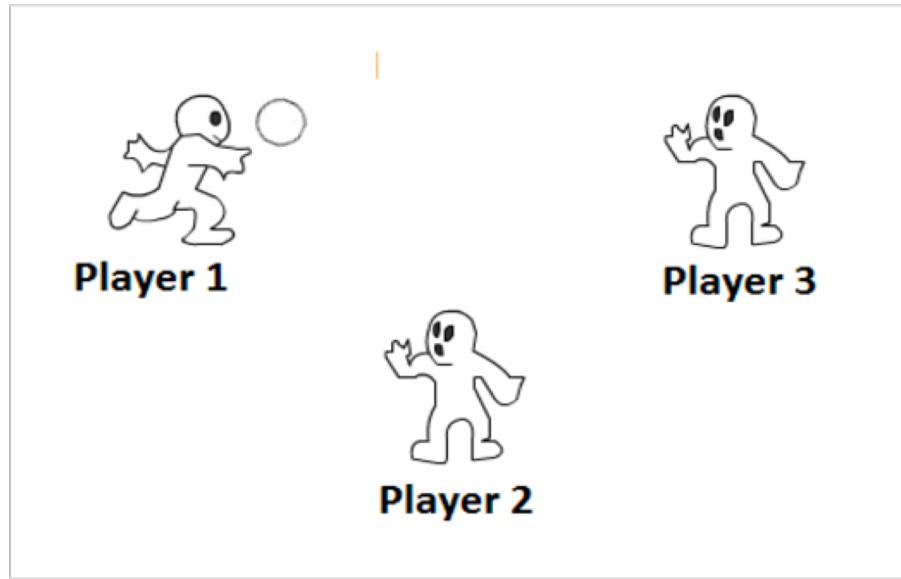
# Social Pain???

- Singer et al. (2004)
- Romantically involved couples: woman's brain activity was measured using fMRI while she either *received shocks* or she *watched her partner receive shocks*.
- Similar brain areas (e.g., insula, anterior cingulate) were active in both conditions. .
- Higher levels of independently reported empathy were associated with more anterior cingulate activation



# Social Pain???

- If pain has a strong affective (emotional or cognitive) component, can it be experienced without the painful (injuring) stimulus?
- Experiment by Eisenberger et al. (2003)
  - “Cyberball”
  - In social psychology long known to cause *emotional* distress



# Discuss

Do you think anterior cingulate activity in response to cyber ball presents a good case against solitary confinement? Is this tantamount to physical torture?

- A. Yes
- B. No

