Emotions, Aggression and Stress (Ch.15) II

- Brain regions mediating emotions
  - Limbic System, Prefrontal Cortex, Amygdala
- Neurobiological basis of stress
  - Hypothalamic-pituitary axis
- Effects of acute vs chronic stress
  - Beneficial and detrimental effects
  - Immune system
  - Learning, Memory, Cognition
  - Testosterone

  - No Q & A during reading break
  - Remaining slides on content for 2nd midterm will be posted during reading break

midterms marked!
↳ avg: 81%
↓
2nd MT will prob be a bit harder

Subcortical = "emotion generator"
cortex = guide & regulate emotions/ emotional response

Neural Circuits of Emotions (3)

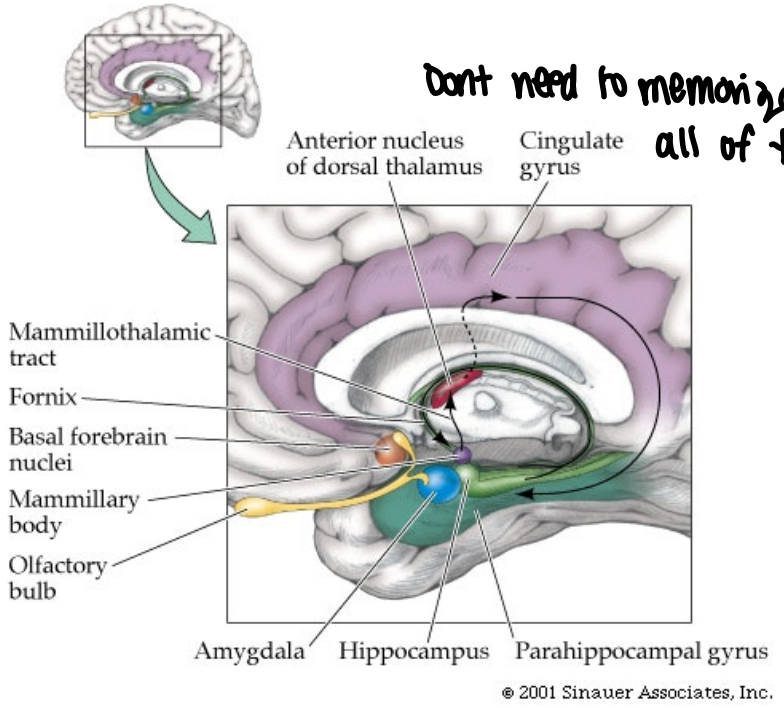
- Papez assessed brains of patients w/ emotional disorders and rabid animals- found consistent patterns of damage in certain areas (**"Papez's circuit"**)
- Collectively termed the **LIMBIC SYSTEM**
- In charge of the "four F's"
  feeding fighting fleeing ....
  - **Three big players**

refers to location, means border/edge
right under the cortex mostly

- **Hippocampus =** major memory center (temporal lobe)
- **Amygdala =** mediates emotional responses (especially fear); both autonomic and behavioural responses (temporal lobe)
- **Prefrontal cortex =** integrates inputs from temporal lobes and other regions to co-ordinate appropriate responses (frontal lobes)

remember emotional memory more
connect 2 Hth → incr. physiological arousal

Dont need to memorize all of these



breaks & steering wheel " = PFC

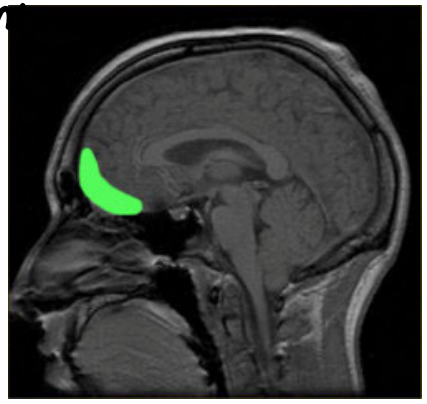
talk abt particular subregions of PFC in this class

areas of PFC relevant to emotion

Prefrontal Cortex (PFC) and Emotion

- **Orbital/medial** PFC damage:
  - Normal emotional responses to intense stimuli (e.g. pain)
  - Language, motor skills, IQ, unaffected
  - Impoverished (not abolished) affect; patients show (often inappropriate) burst of emotions
  - Inappropriate in social situations

still know what they should do – when watch clip of their behavior they know what actions were wrong, just in moment cant regulate



"smth that makes everyone in the room uncomfortable"

emotion regulation main effect ↓ dont get consequences of actions & dont regulate emotional response

- **Core deficit: impaired emotional regulation**

➢ insensitive to emotional consequences of actions *at the time*- inability to view situations from someone else's perspective

  - Primate studies: PFC lesions disrupt social behaviour: ↓ social interaction and dominance, altered social preference, ↓ motor, facial, vocal expressions
  - Psychopaths display reduced PFC activation, may explain lack of guilt/empathy
  - More subtle types of deficits as well (sarcasm, humor)

Phineas Gage changed – grumpy after

exp w/ 2 jokes
- joke w/ punchline → no dmg = laugh
- weird punchline that makes no sense → w/ PFC laugh – dont know

humor = detect errors for way should be

w/ PFC dmg – dont know what it "should be"

prone to develop seizures, doesn't respond well 2° treatment → remove amygdala

(temporal lobe

Amygdala and Emotion

- How to lose your amygdala:
  - Surgical removal to treat epilepsy
  - Urback-Wiethe Disease: genetic abnormality causing selective calcification of amygdala

"basically have little rocks where amygdala should be"

- Deficits include:
  - Blunted affect and emotional responses (especially FEAR)
  - Inability to distinguish "fear" faces
  - Disruption in generation of emotional responses to conditioned stimuli

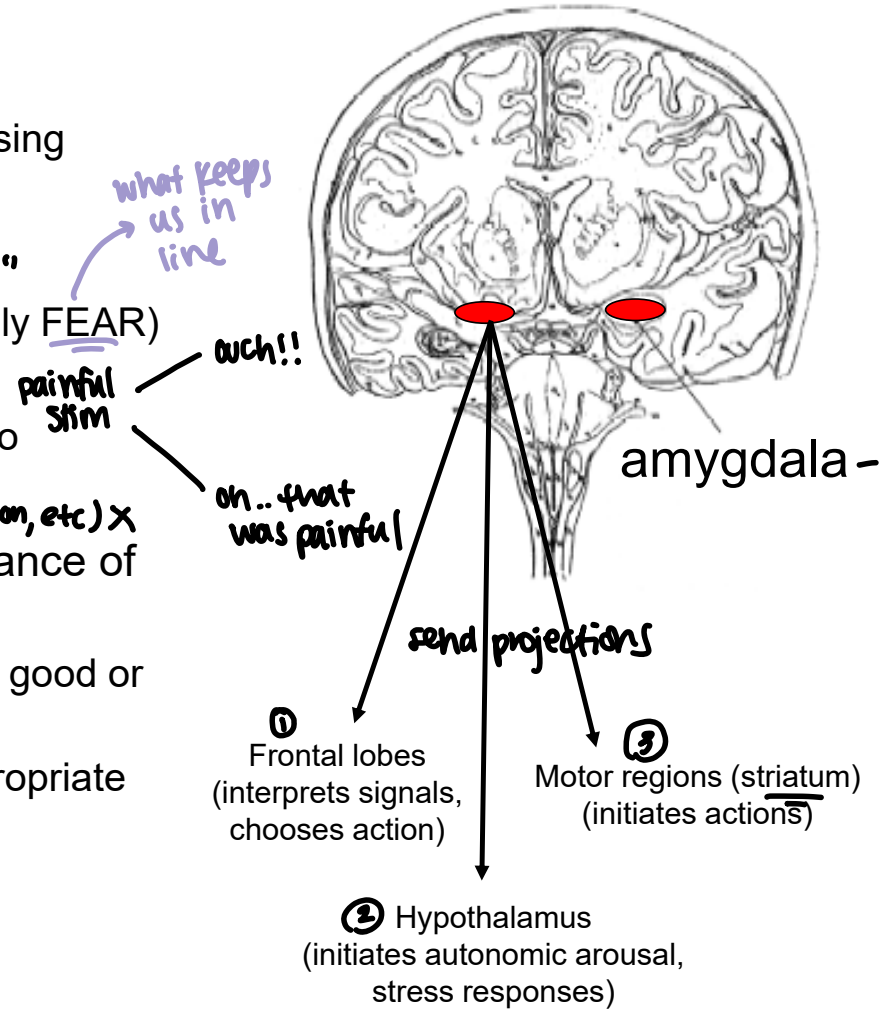
can identify some, but ↗

physiological response blunted as well (↑heart rate, pupil dilation, etc) X

- **Core deficit;** inability to learn emotional significance of external events

∴ respond to them

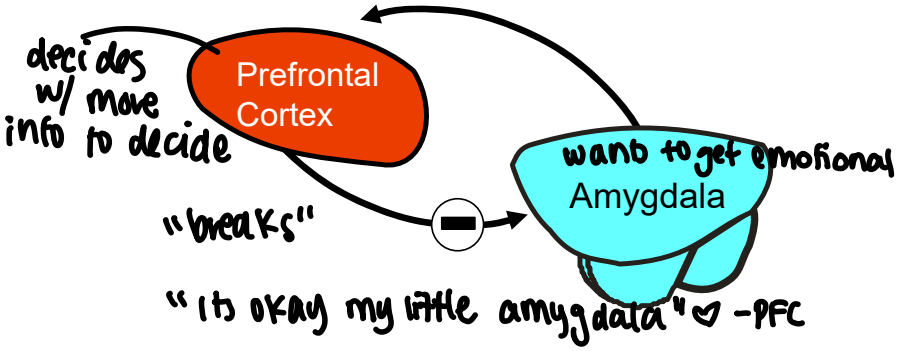
  - Amygdala = learns about stimuli related to what's good or bad in environment
  - PFC = interprets these signals and chooses appropriate course of action/ inaction

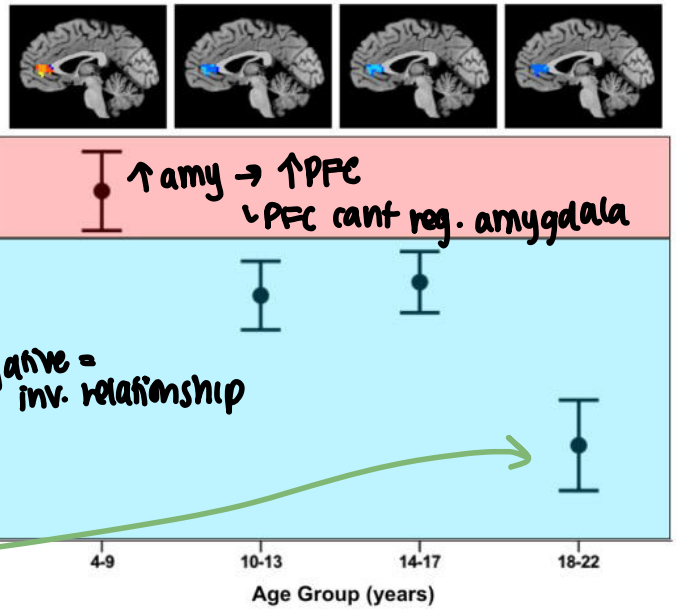


Amygdala-Prefrontal Interactions

- Amygdala and PFC are reciprocally connected:
  - PFC can exert inhibitory influence over amygdala
  - May refine/suppress emotional responses (e.g.; fear, anger) generated by amygdala
- PFC–amygdala interactions in emotional situations change over development
  - Childhood/adolescence = increased amygdala **and** PFC activation
  - Adulthood = PFC shows greater activation, associated with ***reduced*** amygdala activation

➢ As we become adults, PFC gains greater control over subcortical emotion generators





functional imaging study → show them emotionally provoking stimuli but unsure of what should feel (ambiguous)

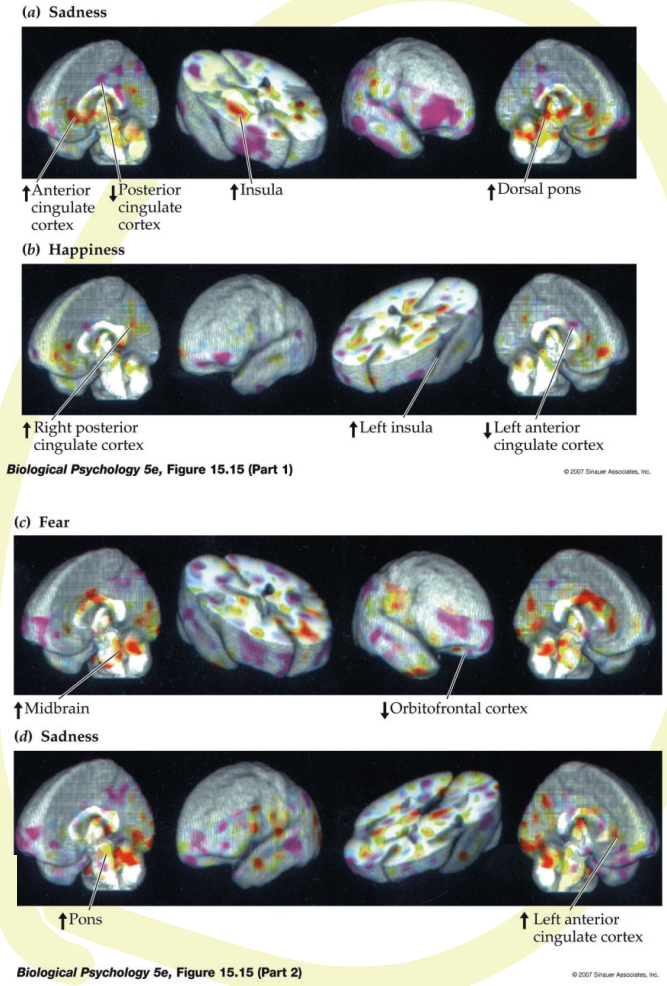
Imaging the Emotional Brain

Don't memorize

- **Study:** subjects told to recall intense emotional episodes (anger, happiness, fear etc).
  - Measured physiological arousal – sweat on palms
  - Imaged brain activation during different emotions
  - ➢ **Results**: Physiological responses *came before* reporting an emotional response
  - Same brain regions can be involved in different emotions
  - Different patterns of activation/ inactivation in multiple brain regions for different emotions

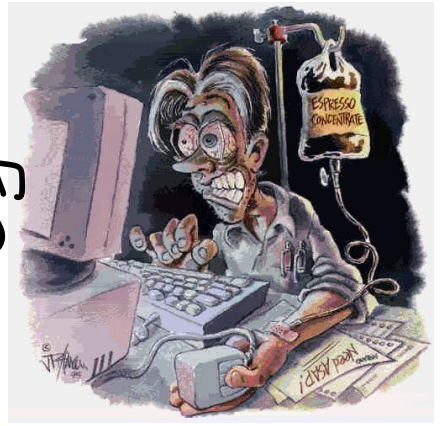
- Different emotional states appear to be mediated by distinct patterns of activity in distributed brain regions

•There is not **one** emotional center; multiple brain regions interact in different ways to process different emotions



Stress

get brain & body ready to handle events (esp emergency)



- Ultimately defined as any change in homeostasis
- Typically broken down into three components
  - Stressful stimulus → processing/assessment of stimulus →
  - **Stress Response (the body's response to emotionally-charged events)**

- The "stress response" refers to physiological changes (hormonal, neural, behavioural) designed to deal with short-term problems

or emotionally charged event

- Acute stress can have beneficial effects
  - Designed to enhance the "flight or fight" response
  - Increased energy, metabolism
  - Enhanced attention, vigilance
- Chronic stress can have detrimental effects on the body & brain "chew away brain/body"
  - **The most damaging type of stress is unpredictable and/or uncontrollable stress**

can't do anything about it

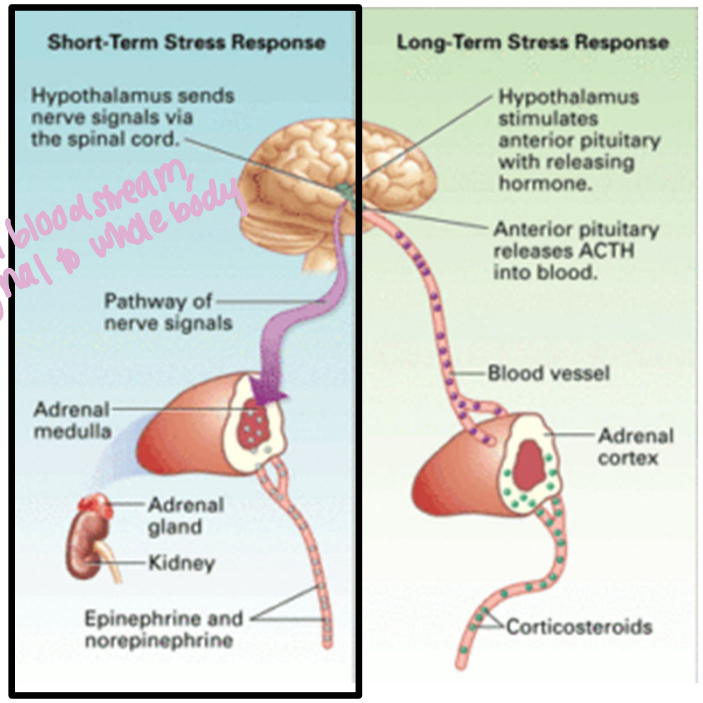
world used to be way more scary - life threatening → stress = ✓ ☺ , but all the time

The Stress Response (I)

Two main pathways out of brain trigger bodily responses to stress

1) Sympathetic Nervous System

- Direct projections from brain (via spinal cord) stimulate ***adrenal medulla***, to release adrenaline
- This rapid response (seconds) increases heart rate, respiration, vasoconstriction, pupillary dilation.
- Increased blood flow gets more oxygen/glucose to muscles to prepare for activity.



The Stress Response (II)

recieve sensory signals, determine if threat or not

2) Hypothalamic-pituitary axis (HPA)

Limbic regions (amygdala, hippocampus, frontal lobes) sends signals to hypothalamus that trigger another aspect of the stress response

Hypothalamus releases CRH into pituitary, which release ACTH in blood, hits ***adrenal cortex*** → glucocorticoid release (**CORT**) that:

↳ i call it this

1) ↑ glucose metabolism and ↓ inflammation (get body ready for action and/or damage)

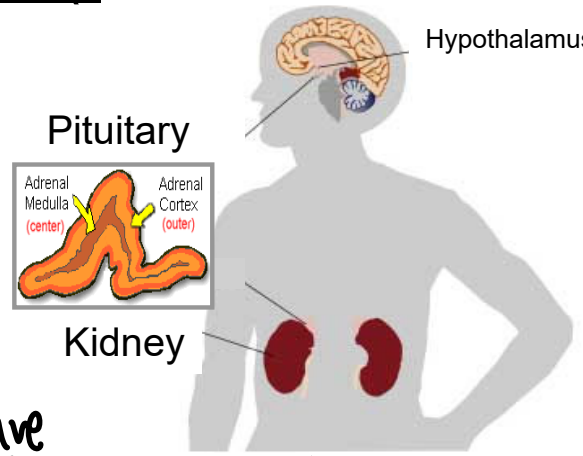
2) Reorganizes energy usage
- some systems shut down

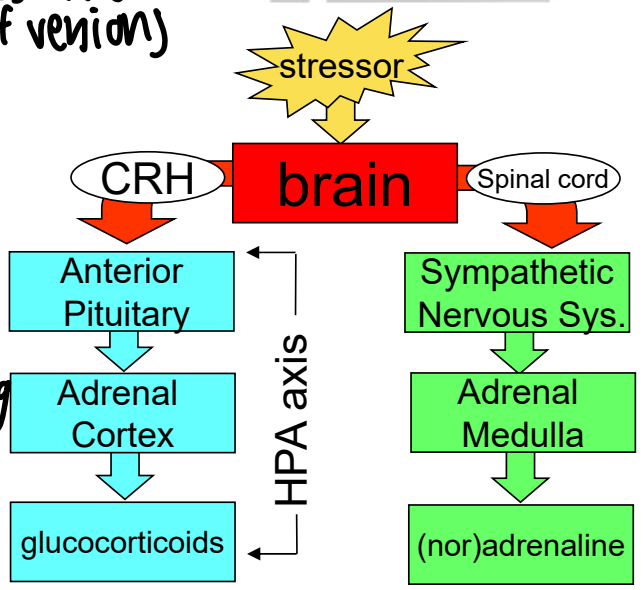
enhance how cells ute glucose

- dont feel it as bad in acute situation

swelling protects dmg joint & sensitizes pain receptors ↓ not good if this is life threatening circumstances

-diff species have diff version)





The Stress Response and Consequences of Prolonged Stress

Principal components of the stress response	Common pathological consequences of prolonged stress
Mobilization of energy at the cost of energy storage	Fatigue, muscle wasting, steroid diabetes
Increased cardiovascular and cardiopulmonary tone	Hypertension (high blood pressure)
Suppression of digestion	Exacerbation of ulcers
Suppression of growth	Psychogenic dwarfism, bone decalcification
Suppression of reproduction	Suppression of ovulation, impotency, loss of libido
Suppression of immunity and of inflammatory response	Impaired disease resistance
Analgesia	Apathy
Neural responses, including altered cognition and sensory thresholds	Accelerated neural degeneration during aging

inability to process glucose efficiently

- Acute stress can be beneficial
- Chronic stress has detrimental effects
  - (our bodies were not designed to deal with this type of stress)

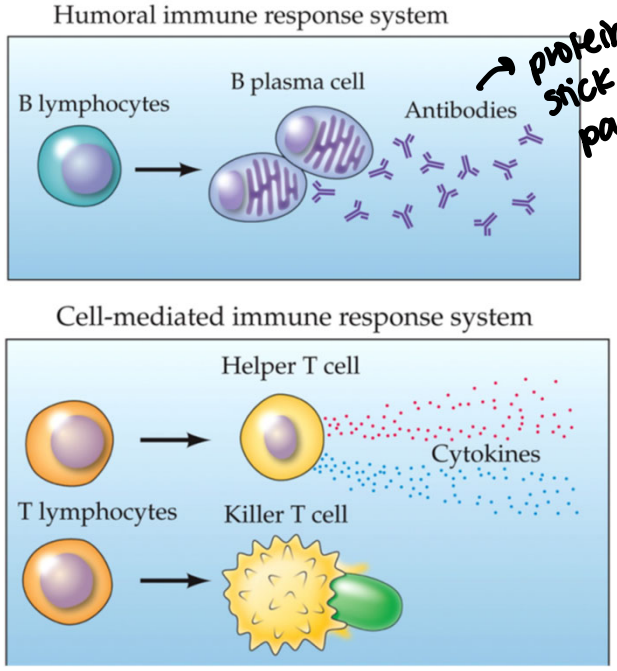
exercise can help reduce long term consequences

Stress and Immunity (I)

- Immune response releases certain hormones and stimulates different cells to fight infection
- The CNS influences immune responses and vice versa
  - Hypothalamus monitors levels of immunity proteins in blood
  - Autonomic nervous system provides inputs to immune organs
  - Activation of B lymphocytes (B cells) = produces antibodies that neutralize pathogens
  - T lymphocytes (T cells)=act as killer cells

detects infection → signal to sleep centers

engulf it & break it down



Stress and Immunity (II)

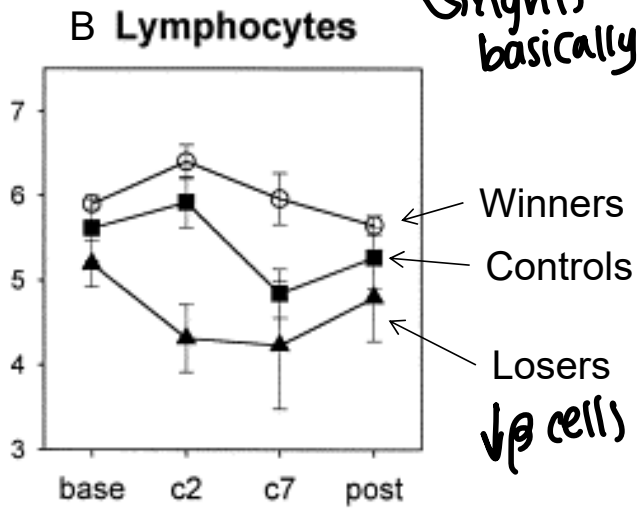
takes a lot of energy, no time/E under stress

- HPA system suppresses the immune response
  - **Chronic stress reduces circulating levels of both B and T cells**
  - Can be observed after stressor that are:
    - Severe (maternal separation, electric shock etc.)
    - Moderate (**social stressors**)
    - Somewhat mild (exam stress)
- Ulcers associated with chronic stress are actually due to a bacteria present in most people (*Helicobacter pylori*)
  - Many people have it, but stress reduces immune response, allows it to cause ulcers

just there, but kept @ bay by immune system

Chronic social stress in rats
(aggressive interactions)

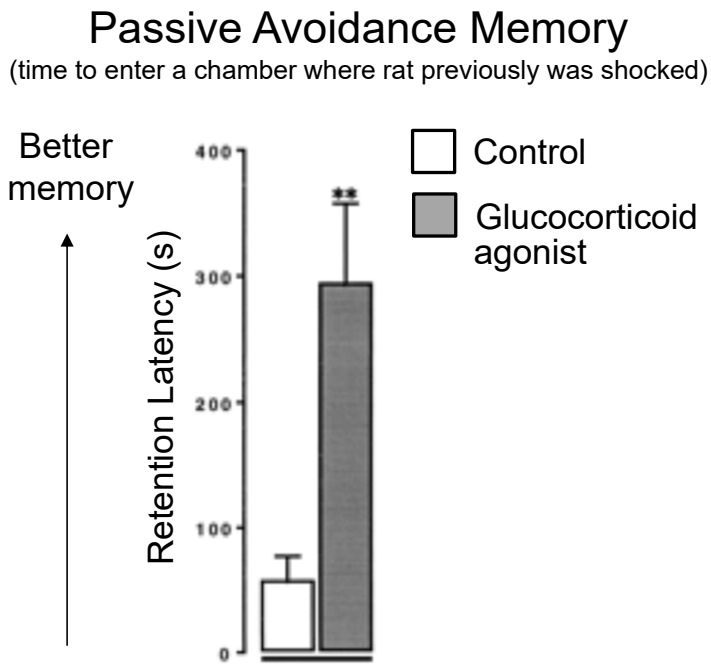
fights basically



↓B cells

Stress and Cognition (I)

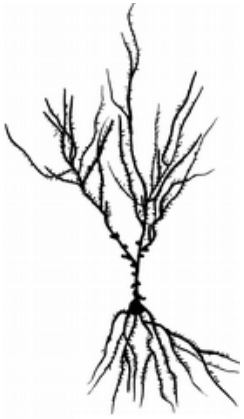
- Acute stress (or just ↑CORT) can enhance function of memory centers like the hippocampus
  - Lots of CORT receptors on hippocampal neurons
  - CORT can increase excitability of these neurons; lead to better memory encoding
  - Acute stressors can enhance many types of cognitive function (memory encoding and retrieval, attention, short term memory etc).
  - Part of the cognitive-enhancing effects of acute stress are due to increased release of monoamines in brain (dopamine, noradrenaline) in regions such as the prefrontal cortex.



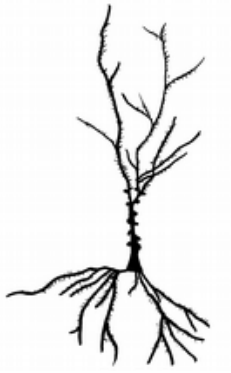
Stress and Cognition (II)

- **Chronic stress** (and chronic increases in CORT) can lead to death of hippocampal and prefrontal cortical neurons
  - Chronic stress can impair memory formation/ prefrontal functioning
  - Chronic injections of CORT alone (without stressor) can also lead to neuronal atrophy/cell death and memory impairments in animals
  - Excessive monoamine release (dopamine, norepinephrine) in brain can also impair cognitive functioning (too much of a good thing).

Hippocampal neurons



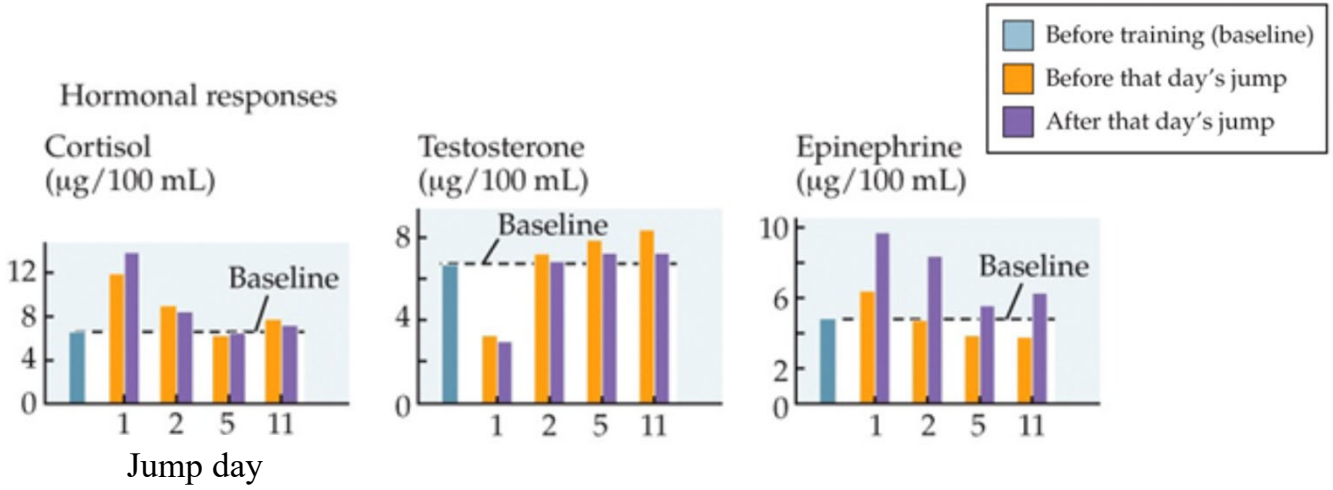
control



Chronically-stressed

Stress and Testosterone

- Another prominent effect of increased CORT release is decrease testosterone levels



  - ↓ testosterone adaptive because it reduces energy usage mediated by testosterone (muscle building, sperm production, libido etc.)
  - Parachute training experiment
  - Effect on testosterone disappears over time (predictable stress not as detrimental)

Social Stress and Testosterone

- Social stress: chronic stressor common in primates
  - Subordinate males typically have higher CORT levels, lower testosterone (T) levels, shorter lifespans
  - Dominant males do not necessarily have higher (T) levels, but do show faster recovery of (T) levels after stressor (vs subordinates)
  - Repeated social stressors (fights) can lead to long term reductions/ increases in (T) in losers/winners
  - Even more subtle social stressors activates these stress systems

Social Stressors in Humans

- Social stress is one of the most common forms of stress humans experience in today's world
  - Fear of embarrassment, close proximity to many people is sufficient to activate stress response
  - **Study:** measures of epinephrine in public train riders- greater epinephrine release when train was crowded
  - Even more subtle social stressors (e.g.; giving a talk) induces large CORT release and activates sympathetic nervous system