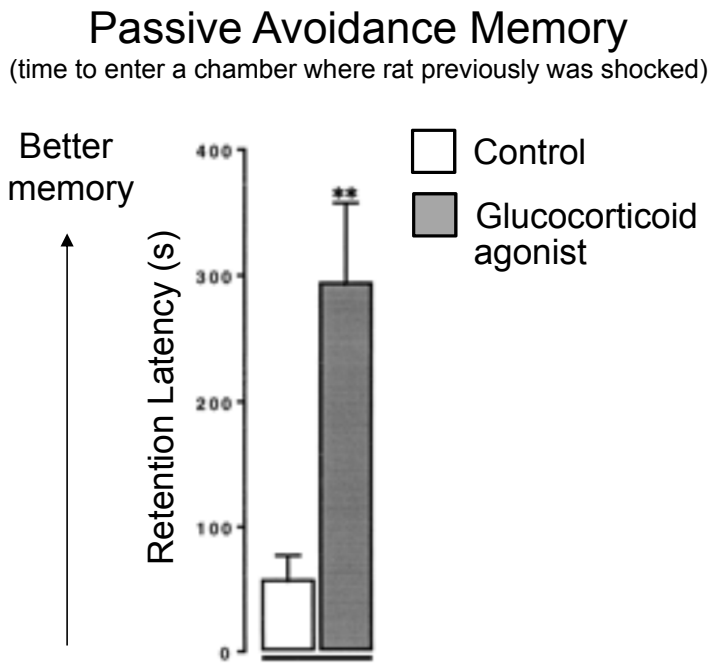
Emotions, Aggression and Stress (Ch.15) II

- Effects of acute vs chronic stress
  - Learning, Memory, Cognition
  - Testosterone
  - Stressors
- Neurobiology of Aggression
  - Testosterone
  - Serotonin and other neurotransmitters

CORT = glucocorticoid

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.



Injection of cort. → increase memory

Experiment:
Injection of cort. → increase memory
- 2 chambers: one w/ flashing lights, one dark
- day 1: rodent shocked when enter dark chamber
- day 2 (no shocks): how long does it take them to go back to dark chamber
- cort injection: increases passive avoidance

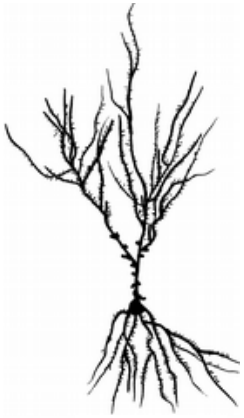
monoamines = dopamine + norep.

monoamines release in PFC enhance cogn. (acute stress = better encoding, retrieval, attn. short-term mem)

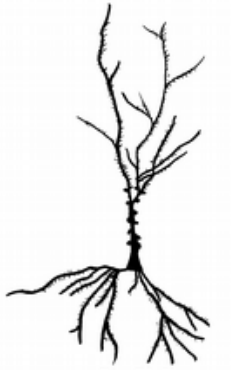
Stress and Cognition (II)

- **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

Atrophy (PFC + hipp.) from chronic stress; impair memory formation + PFC func.

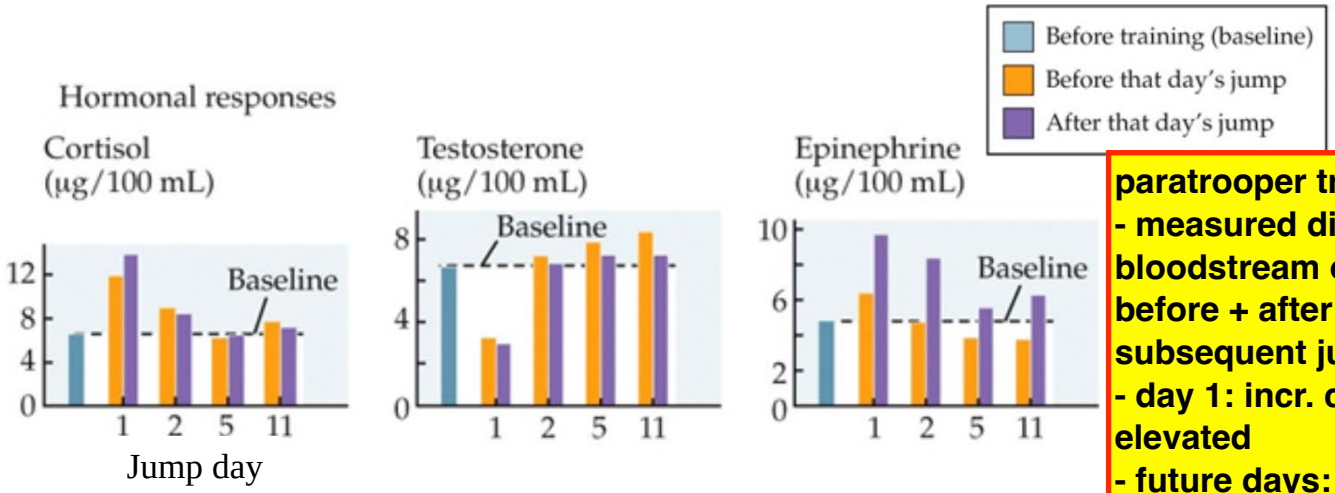
Excessive monoamines = decr. cogn. (shuts down cortex: fight/flight overrides higher lvl cogn.)

Acute stress; good for encoding, cogn.
Chronic stress; bad for encoding, cogn.

chronic cort. release = decr. T

Stress and Testosterone

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



paratrooper training:
- measured diff hormones in bloodstream over course of training, before + after jump & over subsequent jumps
- day 1: incr. cort before, remains elevated
- future days: less stressed, learned, cort. stops incr., T stops decr.

- ↓ 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)

adaptive value: T takes energy to produce + use

effect on T decr. over time, predictable stress less detrimental

Social Stress and Testosterone

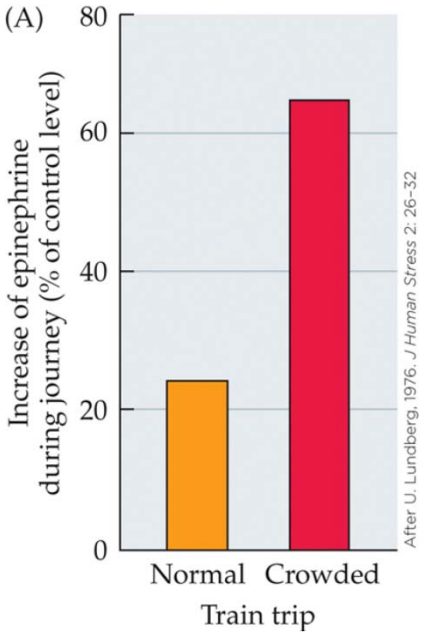
- Social stress: chronic stressor common in primates
  - Subordinate males typically have higher CORT levels, lower testosterone (T) levels, shorter lifespans
  - Dominant males do not necessarily have higher (T) levels, but do show faster recovery of (T) levels after stressor (vs subordinates)
  - Repeated 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 stress
- sub males: higher cort., lower T, shorter life
- dom males: faster T *recovery* after stress (altho not higher T overall)
- repeated fights/social stress → long term T incr (winner) /decr (loser)

- stress also activated by being chased, screamed at

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



Relatively low stakes social stress (ie. public speaking) still raises cort, adr.

Experiment: Measured adr. lvls on crowded vs not crowded train

adaptive value: social groups crucial to survival – strong bodily reactions motivate us to remain in good social standing

Stan's HR on lecture day: up to 160bpm just lecturing!

Types of Aggression

- **Aggression** defined empirically: behaviours whose primary function is to inflict harm
  - **Predatory:** may be viewed as feeding behaviour
  - **Defensive:** response to attack by conspecifics or other species
  - **Social:** unprovoked attack at conspecific for establishing/maintaining social hierarchy: in mammals, mostly in males

- Most "aggressive" interactions can be viewed as a continuum between aggressive vs defensive behaviours
  - e.g.: cat's "playing" with mice are actually defensive behaviours; give antianxiety drug, less play time, more efficient killing

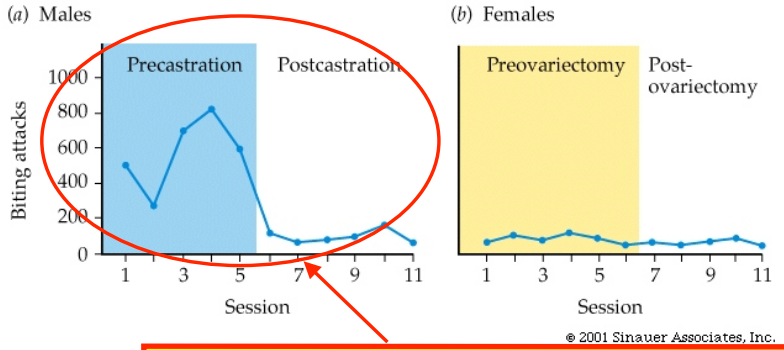
predatory = feeding behavior
defensive = response to attack
social = same species, unprovoked attack, est.&maint. social hierarchy

aggressive + defense = gradiation

antianxiety drug = cat playing w mice shortens

Testosterone and Aggression (I)

- **Animal studies**: Castration in males decreases social aggression
- Testosterone replacement reinstates aggressive behaviour



T in animals = incr. aggression
Castration = decr. social aggression

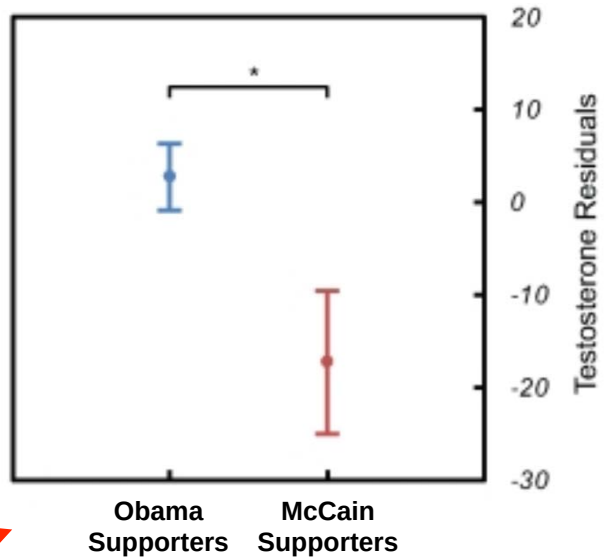
- **Humans**: Not nearly as clean cut a story
  - Correlational studies with T levels and aggression = inconclusive (some show +/ve correlation, some no effect)
  - Not eliminated by castration
  - Aggressive behaviours not reliably increased by testosterone injections (although slight increases in feelings of anger/hostility have been reported)

T in humans: less clear correlation
Castration ≠ decr./elim. aggression
Incr. T ≠ incr. aggression (although some incr. anger, hostility)

Testosterone and Aggression (II)

Confounds with human studies:

- Experience can alter T levels; winners show ↑T, losers show ↓T levels (both animals and humans)
  - Can be occur even if after a loss of the sports team or political candidate you are backing!
- T levels may be related to ***dominance*** more than aggression
- Many aggressive outbursts in humans are overreactions to "threat"; better viewed as defensive aggression
  - In animals, T levels **not correlated** with defense



Confounds w/ humans:

- Experience → alter T lvls, winners incr., losers decr. (even if its politics/sports!)

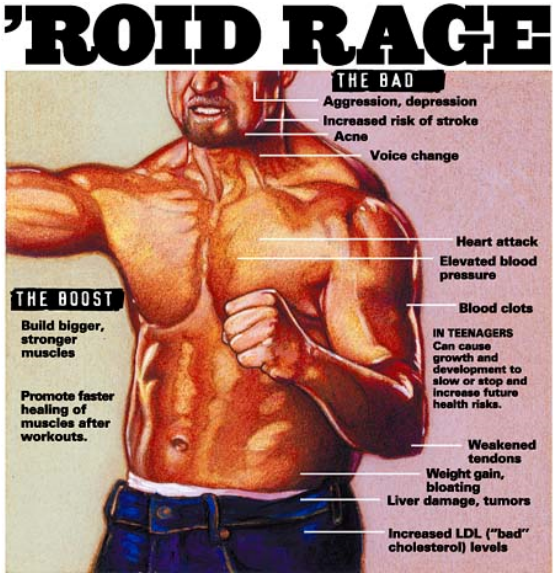
T lvls = dominance, not aggr.

Aggr. in humans = overreaction to "threat", defensive

Animals: T ≠ corr. w defns

Testosterone and Aggression (III)

- **Anabolic steroids??**
- Anecdotal evidence that steroids increase aggression
  - T has been linked to aggression, maybe expectation?
  - Many who use steroids (athletes) may have been aggressive before
  - Indirect consequence of muscularity?
  - Steroids much more potent than T; individual differences (personality types) may play a role



Steroids: incr. aggr. anecdotally

T incr. aggr. = placebo/expectatn?

Chronic steroid use DECR endog. T

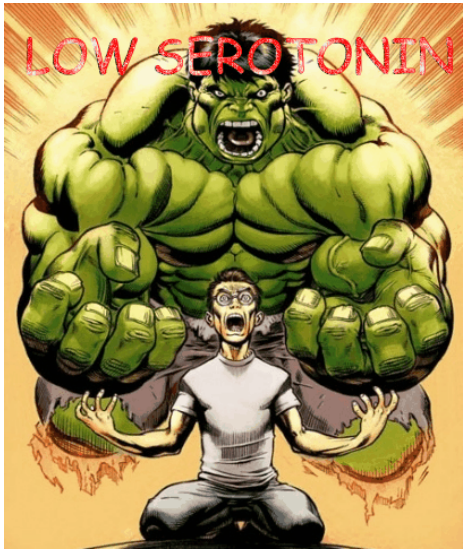
Indir consequence of muscl?

Steroids much more potent than T

Personality plays role, YMMV

Neurochemistry of Aggression

- **Serotonin (5-HT)-** a negative correlation between serotonin and aggression exists:
  - The most aggressive monkeys in a free ranging colony had the lowest levels of serotonin.
  - Mice depleted of 5-HT or lacking certain serotonin receptors or are hyper-aggressive.



Other neurochemicals implicated in various forms of aggression:

- **GABA-** Pharmacological enhancement of GABA transmission reduces aggressive behavior in humans playing a computer game against an "opponent" who was taking money from them.

Incr. GABA = decr. aggr.

Experiment: Playing against "opponent" (computer who takes their money; aggrsve) in video games - 3 button options: compensatory, defensive, aggressive

5-HT, GABA = negative corr. w/ aggr.

Most aggr. monkeys = lowest 5HT

5HT depletion/lack of receptors = hyperaggr. mice