Sex: Hormonal and Neural Basis (Ch 12) III

- Sexual Development and Differentiation
- Neural and Hormonal Regulation of Sexual Behaviour in Adults
  - **Activational effects** of hormones
  - Neural circuits in males and females
  - Human studies of the neurobiology of sexual behaviour

- For next class: Start reading Ch 13- Food and energy regulation (sec 13.4)

Sexual Orientation (1)

- Sexual ***orientation*** is not the same as sexual ***identity***
  - Developmental/neural basis of sexual identity even less well understood than sexual orientation
- Vast majority of researchers agree that sexual ***orientation*** (hetro/ homosexuality) is determined early in development, and is due to biological factors
  - Near impossible to rule out social factors, but no firm evidence suggests this plays a major role
- Prevalence difficult to determine, but in Western countries, typically ranges between 2-10%
- **Genetics**: Males= 52% of monozygotic, 22% of dizygotic twins both homosexual.
  - There may be a gene near the end of the X-chromosome (Xq28) that influences male sexual orientation.
- Females = 46% monozygotic, 16% dizygotic are homosexual.

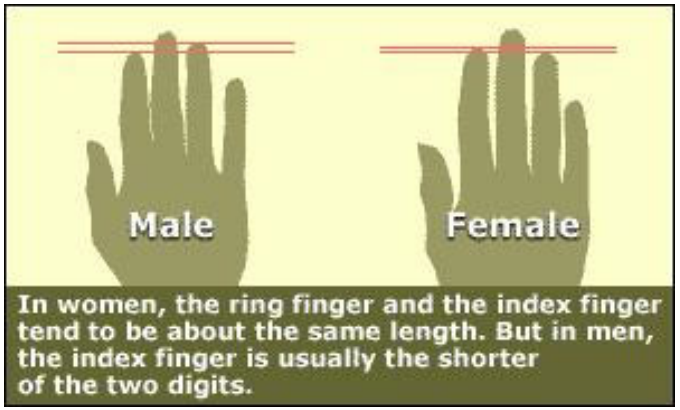
Sexual Orientation (2)

- **Hormones:** Homo- and heterosexuals do not differ in hormone levels.
- *In animals,* certain hormone manipulations made during development (neonatal castration or perinatal T) can cause same sex preference in many species

  -Homosexual tendencies have been observed in many species

Sexual Orientation (3)

- *In **humans***, evidence is much weaker
  - Lesbians ***tend*** to show markers indicative of fetal androgen exposure (eg; longer ring fingers)
    - Early exposure to synthetic estrogens may lead to women being more amenable to same-sex encounters

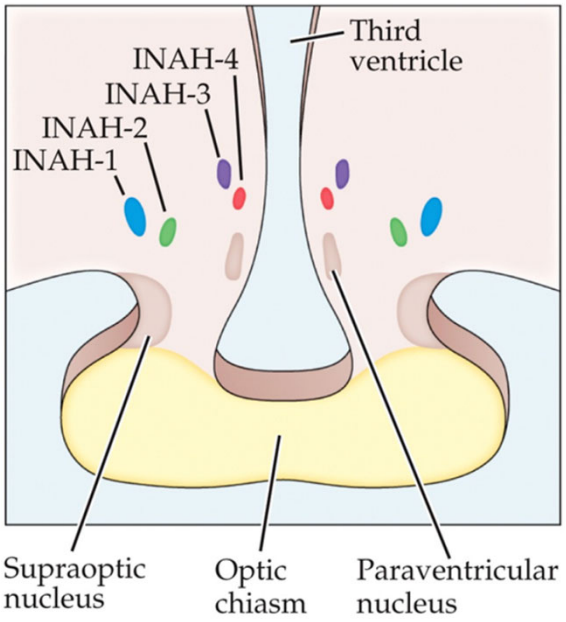


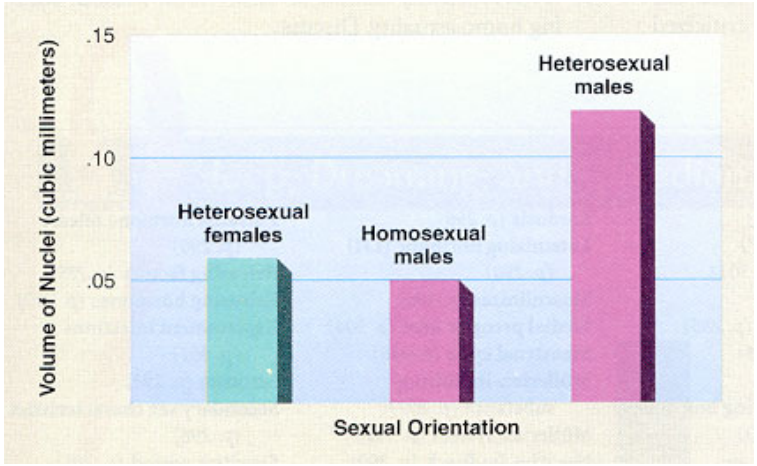
  - For gay men, fetal androgen exposure (or lack thereof) data inconclusive
  - Other indicators not necessarily correlated with early hormones also linked to homosexuality (birth order, handedness)

Sexual Orientation (4)

Brain Differences: A study by Simon LeVay showed region of the anterior hypothalamus (3rd interstitial nucleus) is larger in hetero- vs homosexual males.

- Problems with samples (many were from AIDS victims); should be interpreted cautiously.

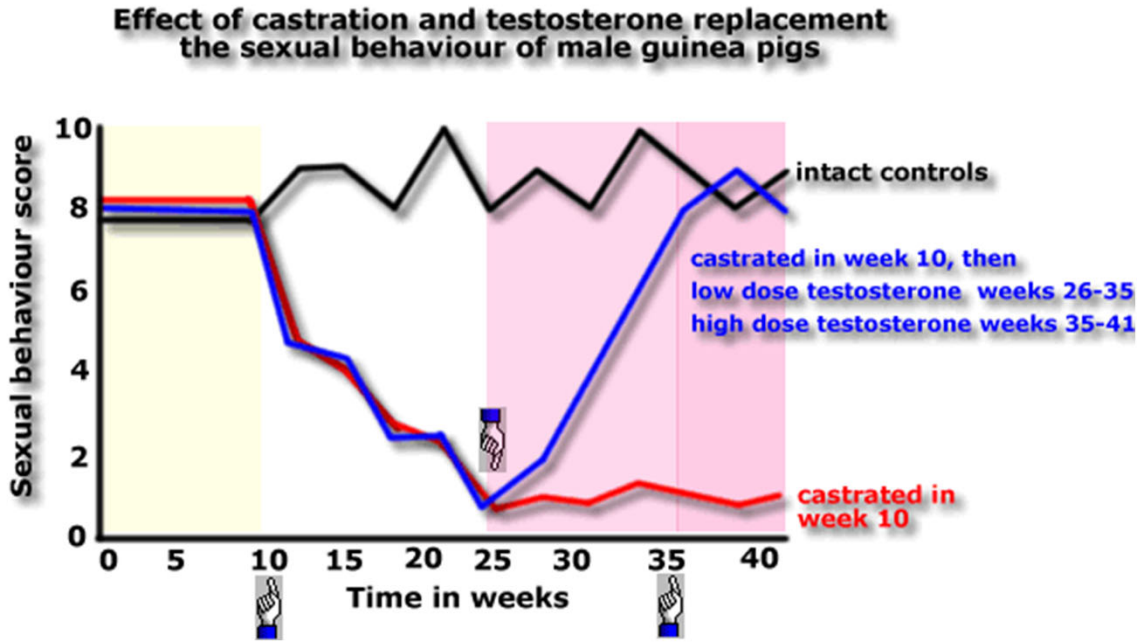




- More recent imaging studies suggest some anatomical differences in brain structures in hetro- vs homosexual men and women
- Other studies have shown differences in brain connectivity between homosexual vs transgender individuals

Activational Effects of Hormones- Male Sex Behaviour (1)

- Removing T effects (castration, drugs) eventually reduces sex drive (you need SOME T)
  - Replacement T brings sex drive back to normal levels



- However, **relative** sex drive and T levels are uncorrelated in normal males. T injections do not increase sex drives
  - (males have more than 10 times what they need)

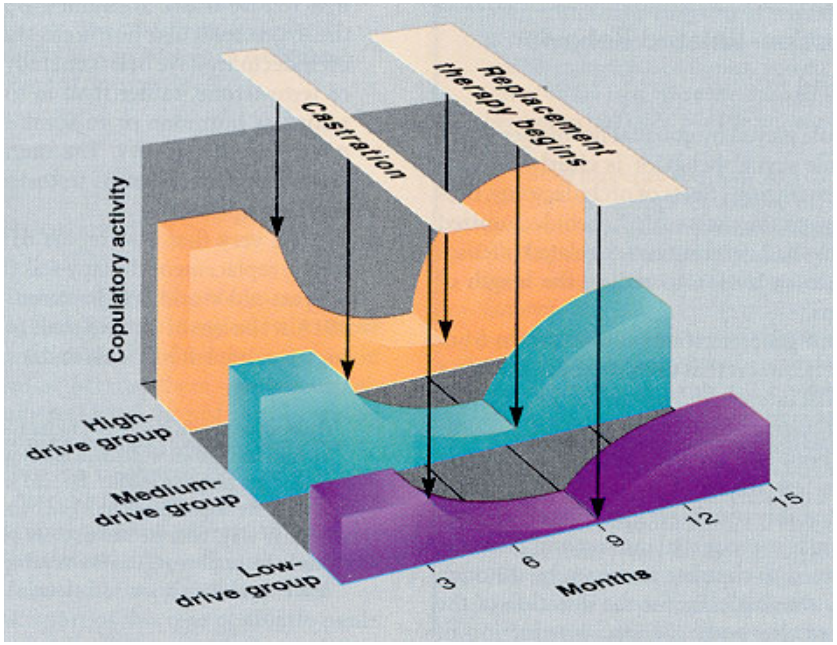
Activational Effects of Hormones- Male Sex Behaviour (2)

•**Guinea Pig Experiment:**

•Rated "sexual activity" of males (ranked as Low, Medium and High Groups).

•Castrated all males, then monitored sexual activity.

•All males THEN receive same large dose of testosterone injections.



•The (large) test dose of T restored all males to **PREVIOUS** level of sex drive.

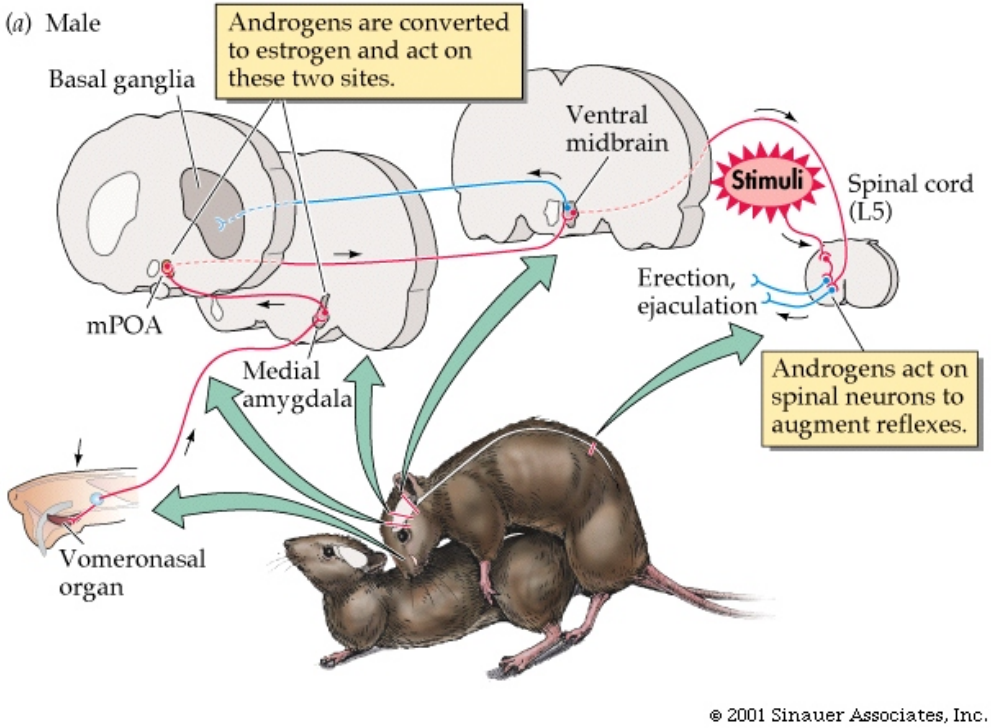
•**Conclusion: OTHER FACTORS control individual differences in sex drive**

•**SOME T is necessary, but more T does not mean more sex drive**

Neural Regulation of Male Sex Behaviour (1)

•Sufficient levels of T in bloodstream, "primes" certain brain regions to make them receptive to sexual stimuli

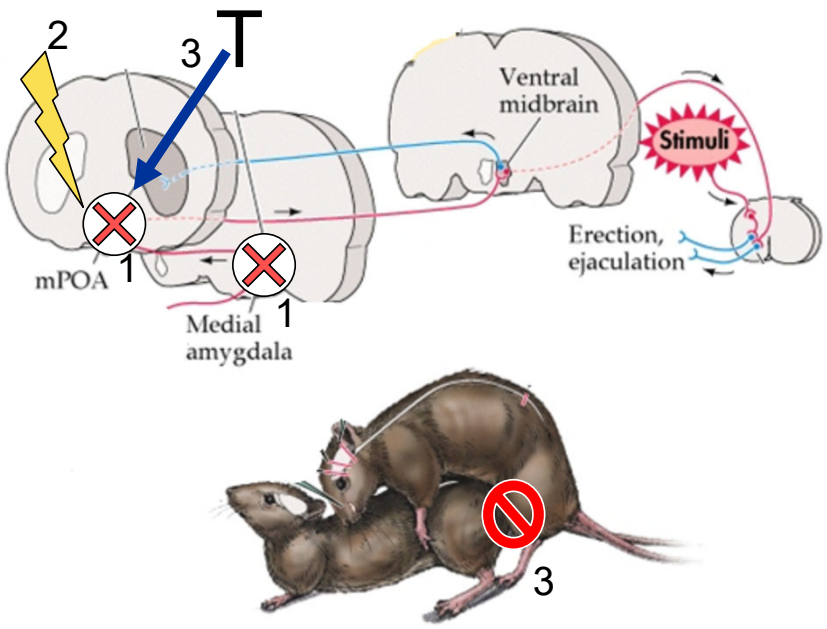
•In males, T is **converted to an estrogen in brain**, and stimulates mPOA, medial amygdala



When estrogens prime these cites, they can response to sexual stimuli

- Olfactory signals go though medial amygdala, then to mPOA
- mPOA signals ventral midbrain → motor centers → spinal cord

Neural Regulation of Male Sex Behaviour (2)



- Evidence for Testosterone/Estradiol regulation of male sexual behavior

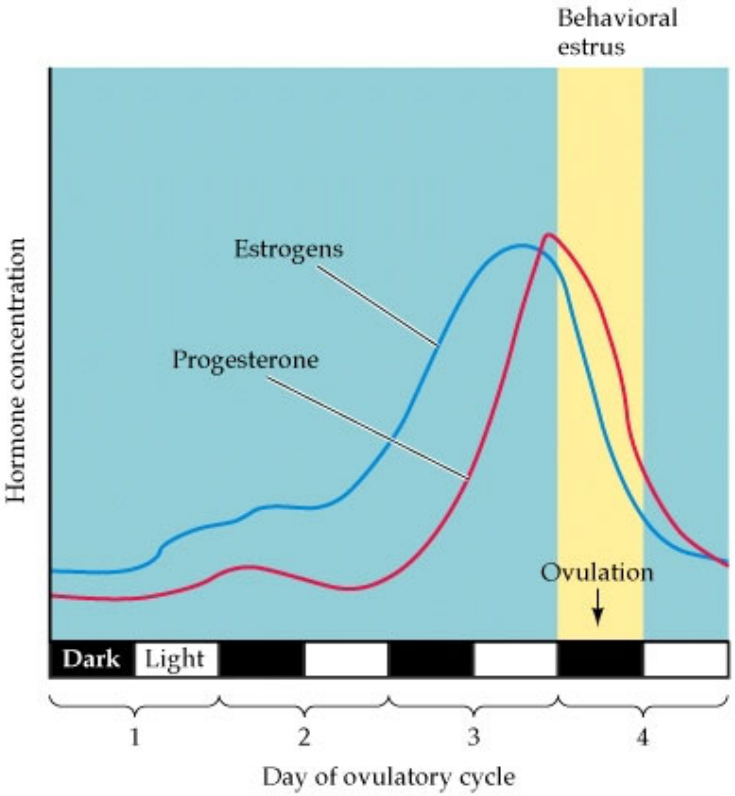
1) mPOA/medial amygdala lesions disrupt sexual behaviour (but NOT sexual motivaton)

2) mPOA stimulation initiates sexual behaviour

3) in ***castrated males*** – administration of T (or estradiol) into just the mPOA reinstates sexual behaviour

- **Androgens gets these brain regions ready to act in response to sexual stimuli. Do not cause behaviour, but are necessary for it**
- Example of an **activational effect** of hormones on sexual behavior

Hormonal Regulation of Female Sex Behaviour



- In female rats, estradiol increases ~ 2 days before ovulation
  - One effect is that this causes brain to make progesterone receptors
- Progesterone then starts to increase
- When both peak, ovulation occurs:
  - at this point, female is fertile and shows sexually stereotyped behaviours
- Both **estrogens** and **progesterone** increasing in this order is required for these events to occur.

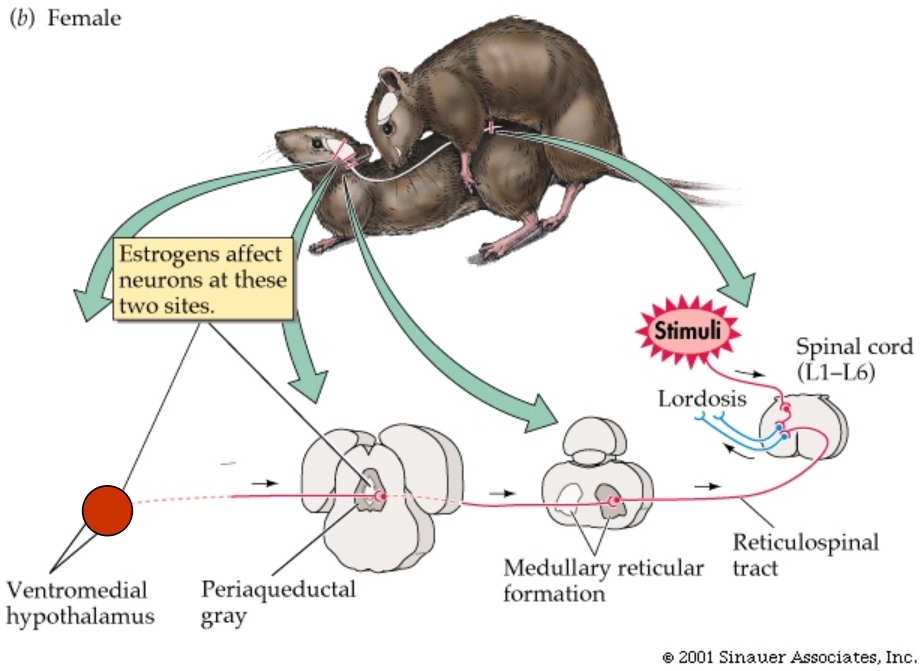
Neural Regulation of Female Sex Behaviour (1)

•The ventromedial hypothalamus (VMH) monitors changes in hormonal levels

- Estradiol causes VMH neurons to alters dendrites and make progesterone receptors
- Stimulation of progesterone receptors causes VMH cells to produce proteins necessary for lordosis

•Hormones hitting their peaks activates multisynaptic pathways that include motor areas.

- Changes in VMH makes these downstream nuclei more excitable



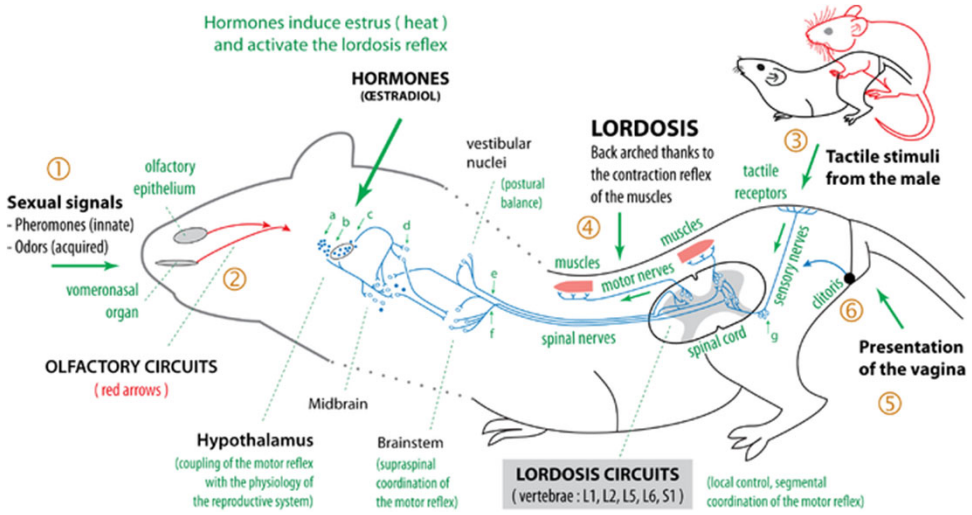
•Eventually, signals output through spinal cord, and promote lordosis in response to stimulation from mounting

Neural Regulation of Female Sex Behaviour (2)

- Evidence for estradiol regulation of female sexual behavior:

1) VMH/PAG lesions disrupt lordosis

2) implantation of estrogens into VMH reinstates lordosis in ovarectomized females

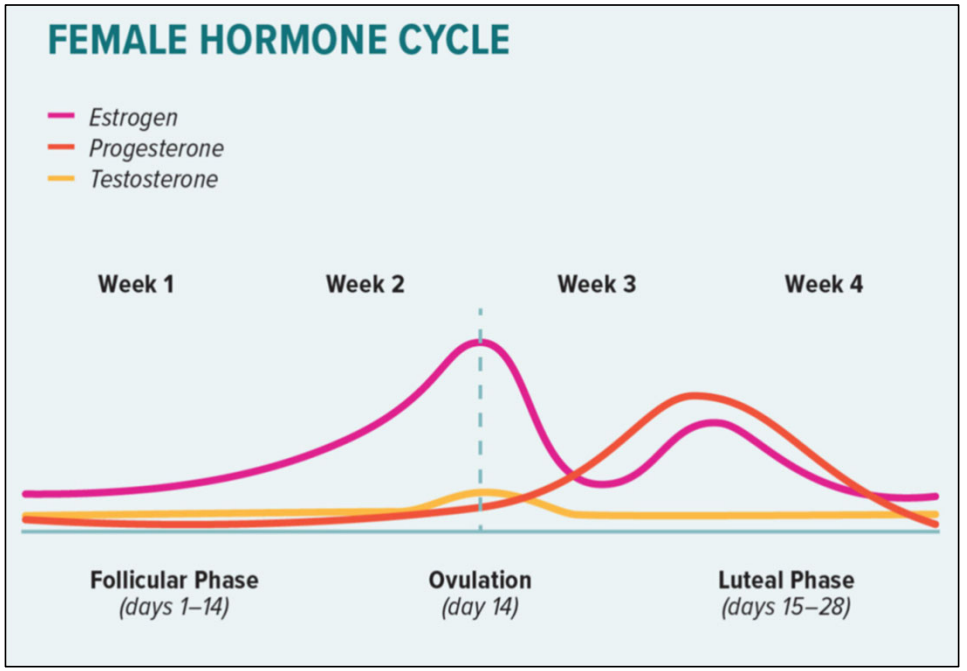


- **This pathway is for particular motor program. Other sexual/maternal behaviours are mediated by other, more complicated brain circuits.**
- **Again, hormones do not cause behaviour, but are necessary for it.**

Hormones and Human Female Sex Behaviour

➢ **Estrogens:**

- Human female sexual motivation/ behavior may or *may not* be as tightly linked to **estrogens** released during menstrual cycle.
  - **HUMAN** females are different from most other mammals in this respect
- Ovariectomy does not have ***reliable*** effects on sexual motivation/behavior.



➢ **Androgens:**

- Testosterone levels can correlate with measures of sexual motivation.
- Following ovariectomy, replacement injections of testosterone (not estradiol), rekindles sexual motivation.

Menstrual Cycle and Female Sexual Behaviour

•**However…**

•Women DO SHOW some changes in sexual behaviour patterns during menstrual cycle

•Greater probability of having intercourse and achieving orgasm as ovulation approaches

•**Other, more subtle changes in behaviour also occur during ovulation**….