

Sex: Hormonal and Neural Basis (Ch 12) III

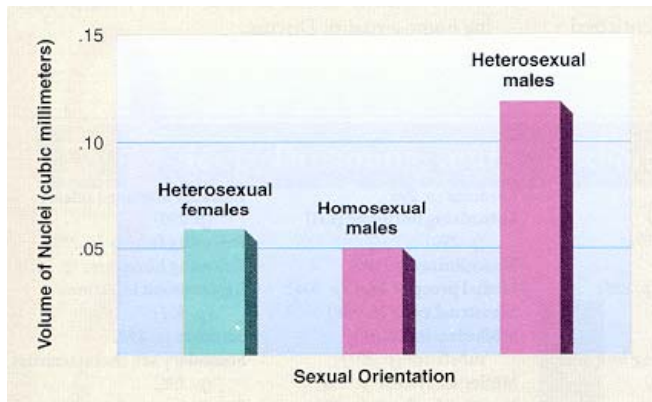
- Sexual Development and Differentiation
 - Sexual preference
- Neural and Hormonal Regulation of Sexual Behaviour in Adults
 - Activational effects of hormones
 - Neural circuits
 - Animal and human studies
- Other studies on the neurobiology of sex
- For next class, start reading Ch. 13, feeding section (pgs 396-412)

Sexual Orientation (1)

- The vast majority of researchers on the topic agree that sexual orientation (hetero/homosexuality) is determined early in development, and is due to biological factors
 - It is near impossible to rule out social factors, but there is no real evidence to suggest this plays a role
- Prevalence of homosexuality difficult to determine, but in Western countries, typically range 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)

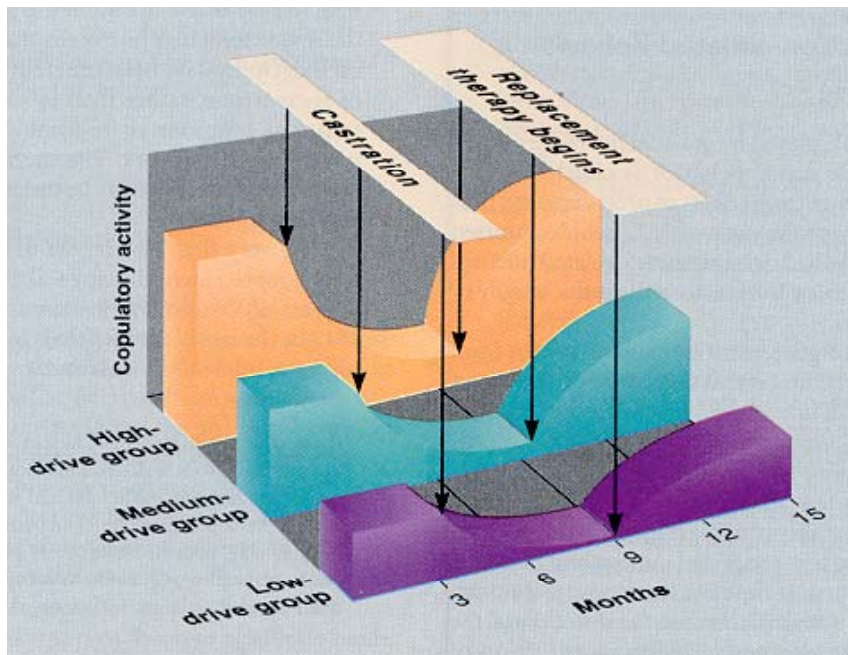
- **Hormones:** Homo and heterosexuals do not differ in hormone levels. Adult castration reduces sexual behavior, does not redirect it.
- *In animals*, Neonatal castration or perinatal T can cause same sex preference in many species
- *In humans*, evidence is much weaker
 - Lesbians tend to show markers indicative of fetal androgen exposure (eg; finger length patterns)
 - 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)



Brain: 3rd interstitial nucleus of the anterior hypothalamus is larger in heterosexual males.
- problems with samples (many were from AIDS victims).
- These findings should be interpreted cautiously. Not replicated

Hormonal Regulation of Male Sex Behaviour

- In animals and humans, 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)
- However, removal of T effects (castration, drugs) will eventually reduce sex drive
- Replacement of T will bring sex drive back to normal levels



Guinea Pig Experiment:

- Rated "sexual activity" of males.
- Low, Medium and High Groups.
- Castrated all males, then monitored sexual activity.
- All males THEN receive same large Testosterone injections.
- Restored all males to **PREVIOUS** level of sex drive.
- **OTHER FACTORS** control individual differences in sex drive

Neural Regulation of Male Sex Behaviour

- T is converted to an estrogen in brain, and stimulates mPOA, medial amygdala

- Olfactory signals go through medial amygdala, then to mPOA

- mPOA sends signals to ventral midbrain and from there, signals go to motor centers and spinal cord

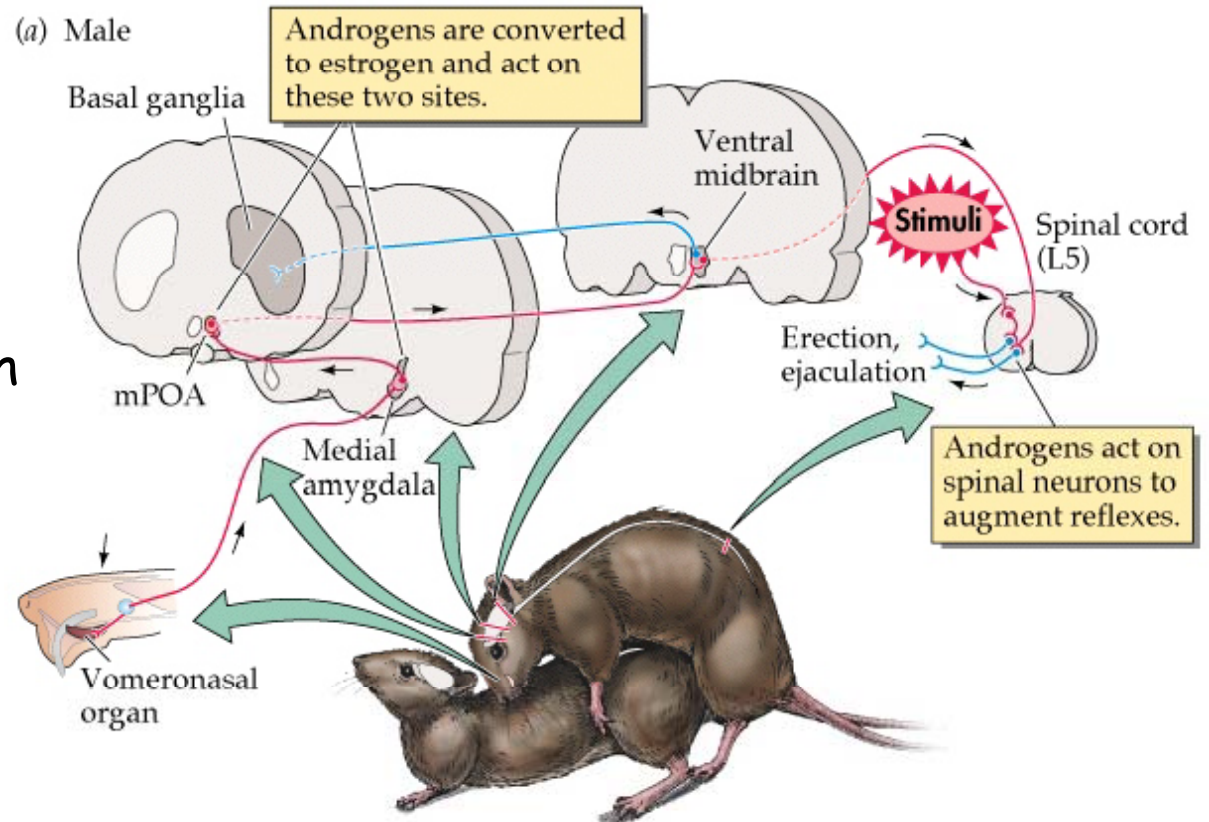
- We know all this because

- 1) lesions of these regions disrupt sexual behaviour

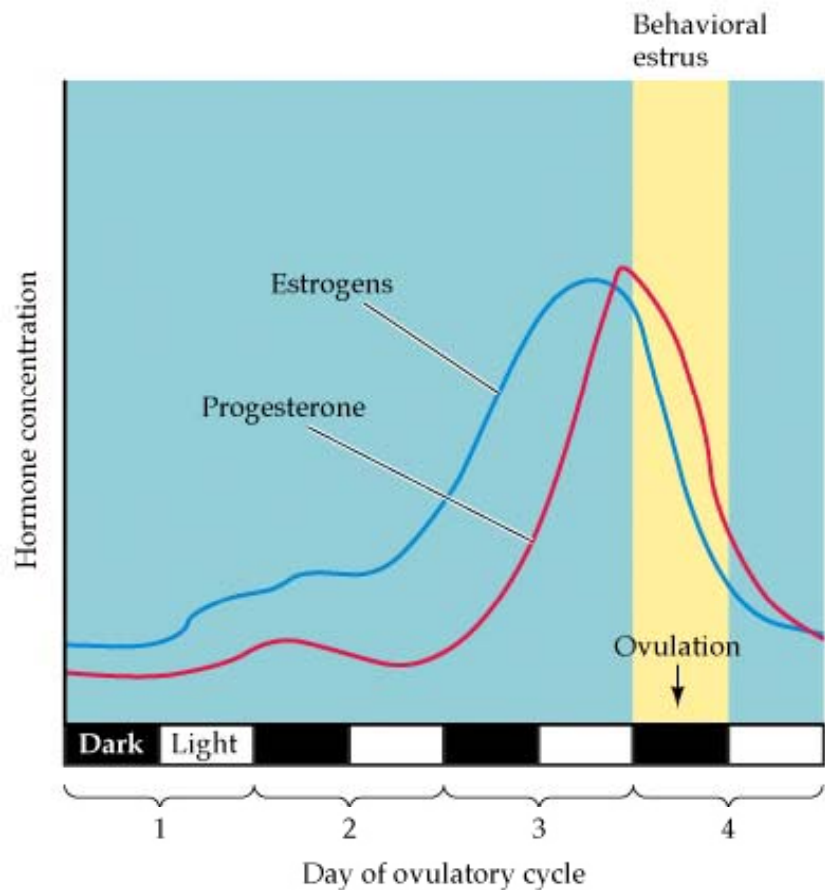
- 2) stimulation of mPOA initiates sexual behaviour

- 3) implantation of T **only** into mPOA reinstates sexual behaviour in castrated males

- Androgens get these brain regions ready to act in response to sexual stimuli. Do not cause behaviour, but are necessary for it (activational effect).



Hormonal Regulation of Female Sex Behaviour

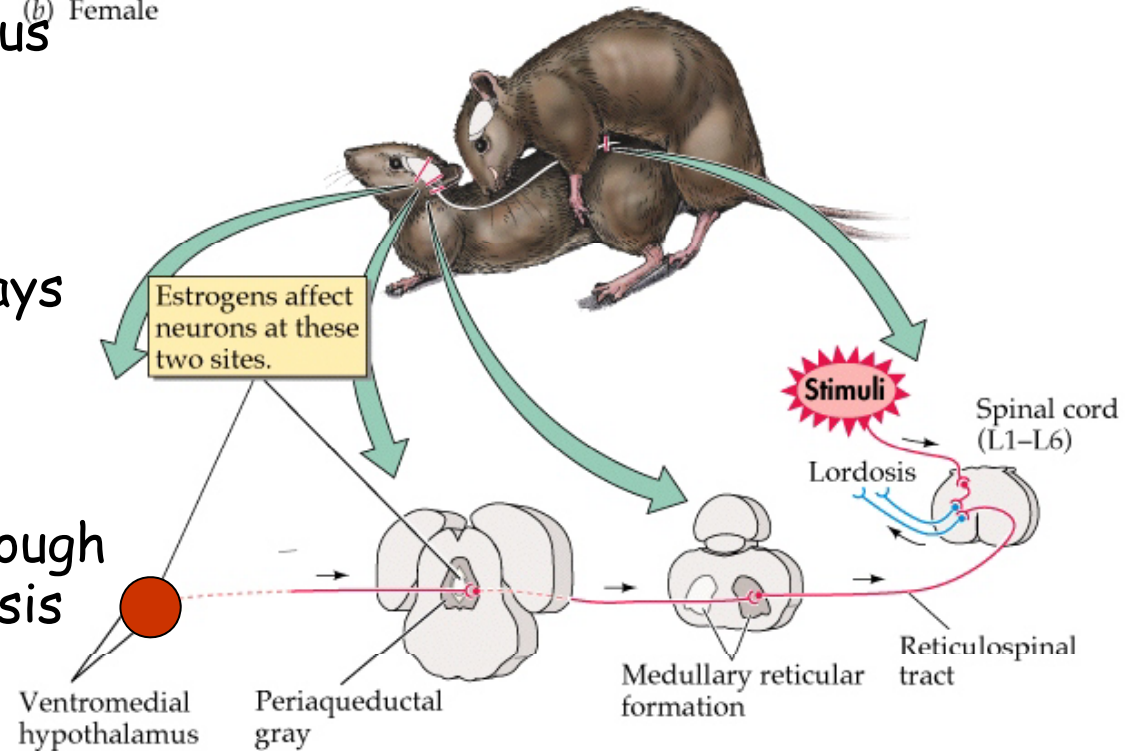


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- In female rats, estrogen starts to increase about 2 days before ovulation
 - One effect of estrogens is they cause the brain to make progesterone receptors
- A bit later, progesterone starts to increase
- When both of them hit a peak, ovulation occurs:
 - at this point when the female is ready to be impregnated, and will show sexually stereotyped female behaviours
- Both estrogens and progesterone increasing in this order is required for these events to occur.

Neural Regulation of Female Sex Behaviour

- The ventromedial hypothalamus^{(b) Female} monitors changes in hormonal levels
- When hormones hit peak, activates multisynaptic pathways via periaqueductal gray and medullary reticular formation (motor areas).
- Eventually, signals output through spinal cord, and promote lordosis in response to stimulation.



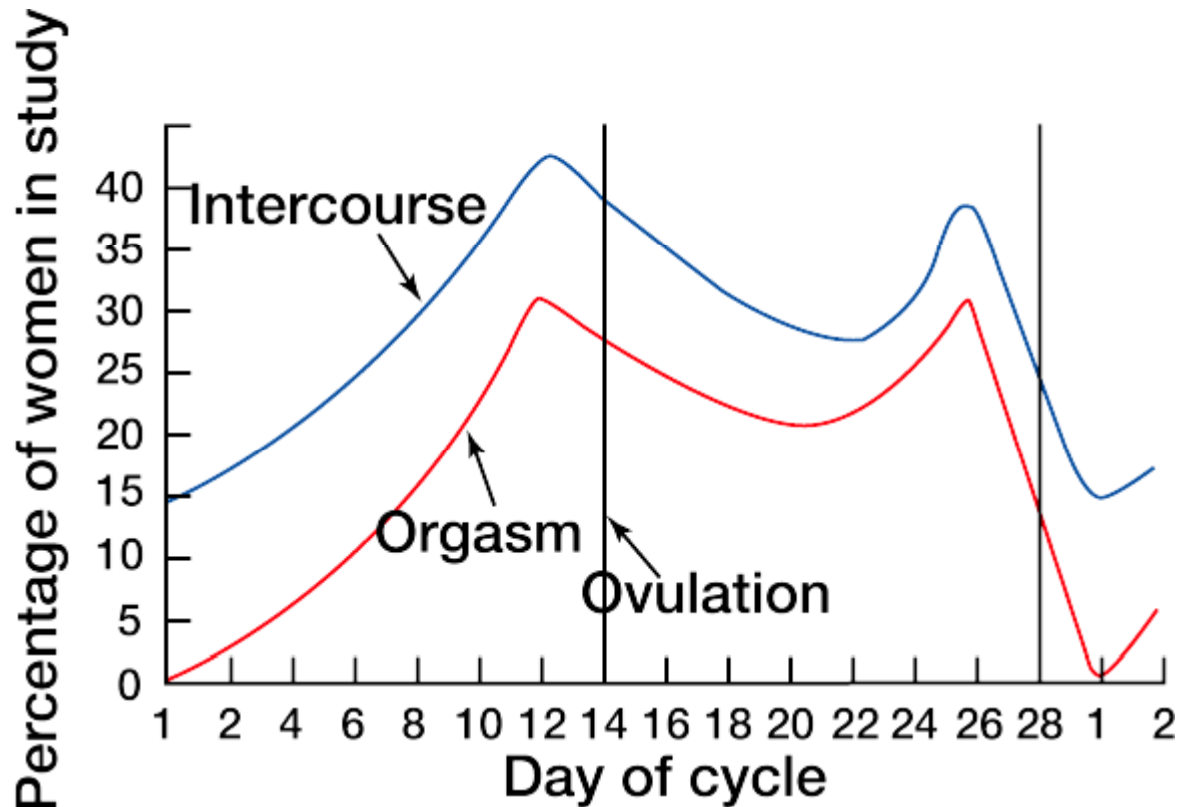
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- We know all this because
 - 1) lesions of these regions disrupt lordosis
 - 2) implantation of estrogens into VMH reinstates lordosis in ovariectomized females
- This pathway is for lordosis, a motor program. Other sexual behaviours are mediated 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 and sexual behavior may or may not be as tightly linked to estrogens released during menstrual cycle.
- Ovariectomy does not have reliable effects on either sexual motivation or sexual behavior.
 - (Only major sexual pitfall may be reduced vaginal lubrication.)
- Androgens:
- In healthy women, testosterone levels have been correlated with various measures of sexual motivation.
- Following ovariectomy, replacement injections of testosterone, but not estradiol, rekindle sexual motivation.
- **HUMAN** female are different from most other mammalian species in this respect

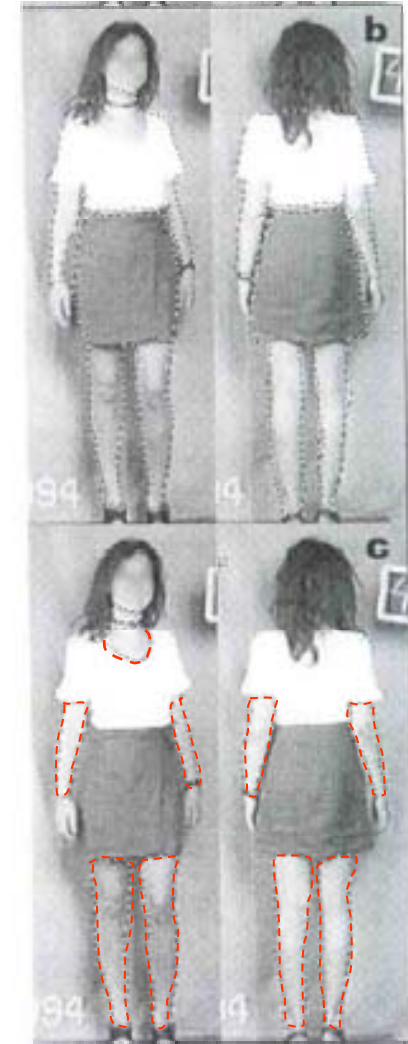
Menstrual Cycle and Female Sexual Behaviour (I)



- **However...**
- Women DO SHOW some changes in sexual behavioural patterns during menstrual cycle
- Greater probability of having intercourse and achieving orgasm as ovulation approaches
- Female orgasm may play a role in assisting fertilization
- Other, more subtle changes in behaviour also occur during ovulation....

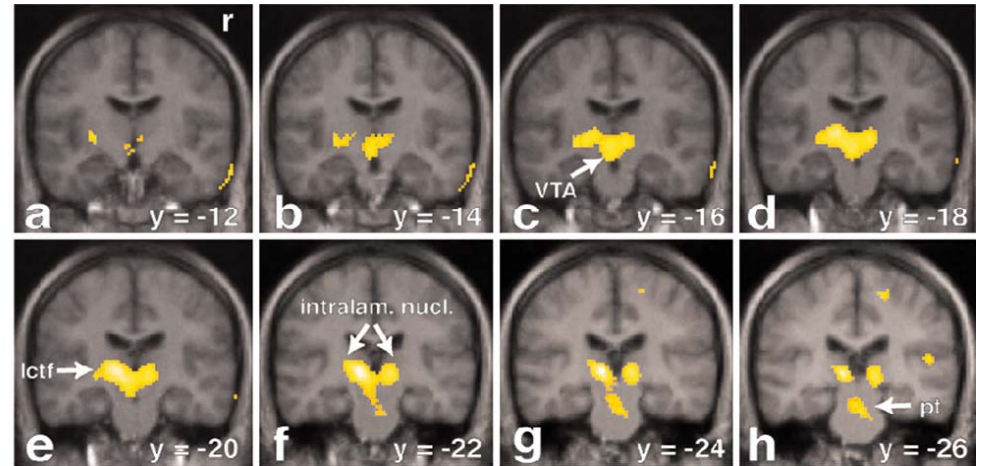
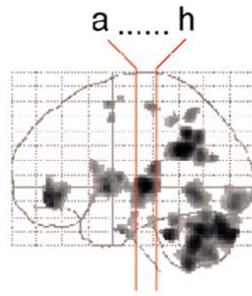
Menstrual Cycle and Female Sexual Behaviour (II)

- Experimenters went to an Austrian discotheques, asked women to
 - 1) give saliva sample to detect what phase of menstrual cycle they were in
 - 2) allow experimenters to take picture of them in the clothes they were wearing
- Afterwards they digitized photos and took measurements of how much skin was exposed by the women (how much/little clothing they were wearing)
- Women ovulating at the time were exposing the most amount of skin (most scantily dressed, wore more sheer clothing etc.)
- Some of these measures correlated with testosterone levels



Neural correlates of orgasm?

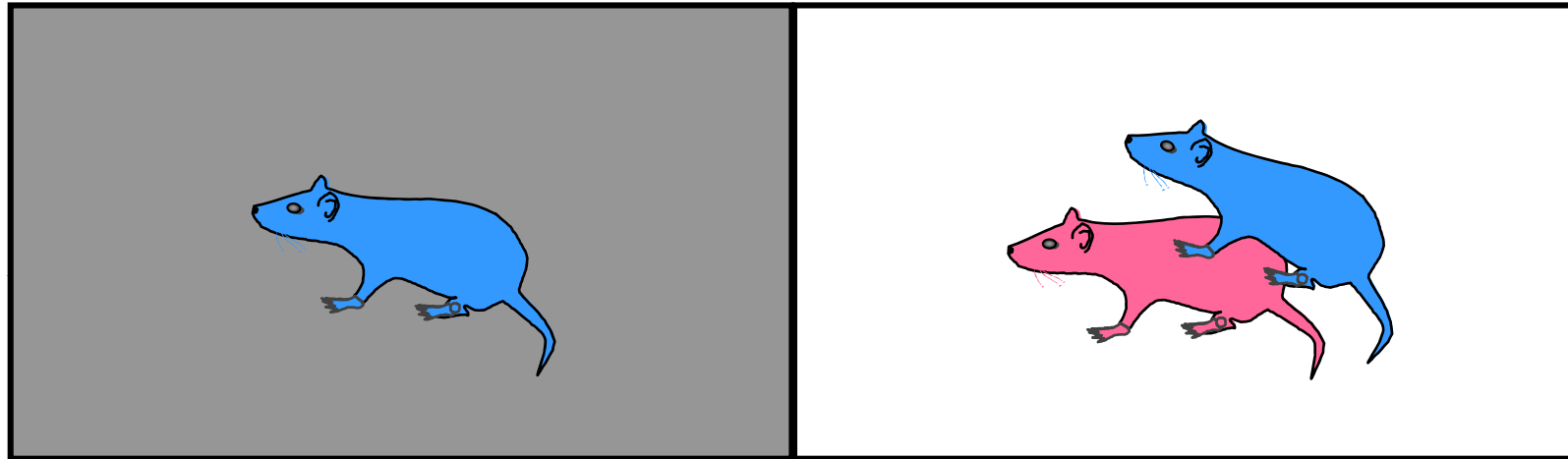
- Dutch study
- Used PET to detect changes in cerebral blood flow during ejaculation.



- “To minimize motor activity by the volunteer during the scan, sexual stimulation was provided by his female partner by means of manual penile stimulation in the tasks stimulation and ejaculation. Manual stimulation was continued throughout ejaculation. The volunteer's head was maintained in position with a head restraining adhesive band, and to minimize visual input, volunteers were asked to keep their eyes closed”
- **No change:** mPOA
- **Minimal changes:** cortex, particularly frontal regions (reasoning)
- **Decrease bloodflow:** amygdala, entorhinal cortex (memory storage)
- **Increased bloodflow:** ventral tegmental area (dopamine, reward)

Sex as a Reward? (Males)

Conditioned "place preference"



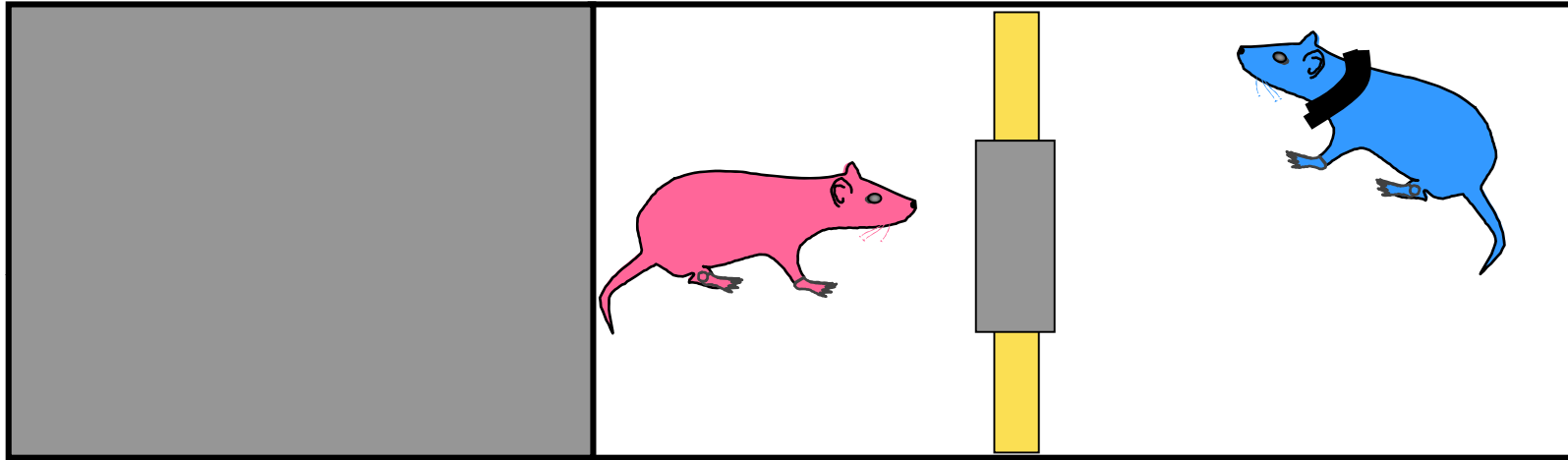
Nothing happens here

Receptive female shows up here
Male rat mounts and ejaculates

- On test day, rat is allowed to choose between both compartments
- Male rats tend to spend much more time in compartment where they had sex.
- This is used as an index of reward

Sex as a Reward? (Females)

Barrier



Nothing happens here

- Female rat moves freely through barrier
- Male rat wears collar that prevents entry

- For females, On test day, female rat chooses to spend much more time in compartment where she DID NOT have sex
- This finding is interpreted as the female finding sex in this fashion aversive
- However, if the female was allowed to control the pace of the sexual interaction, THEN she will find it rewarding and display a place preference