"...seeing a dog, a horse and a man yawn makes me feel how much all animals are built on one structure..."

From the notebooks of Charles Darwin (1838)

...and President George Bush proves the point !



















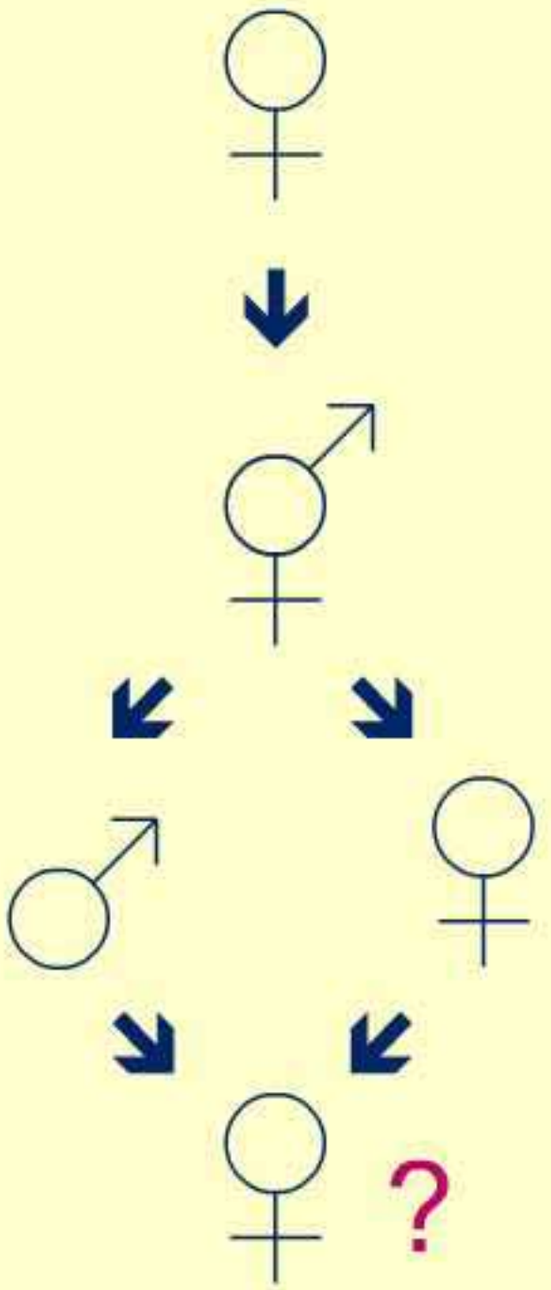


Hormones, sex and animal passion: making pleasure out of necessity ?

Why do we need to have sex to reproduce ?

Why do we need to have sex to reproduce ?

Having separate individuals to produce sperm (male) and eggs (female) is a 50% reduction of fitness in any species



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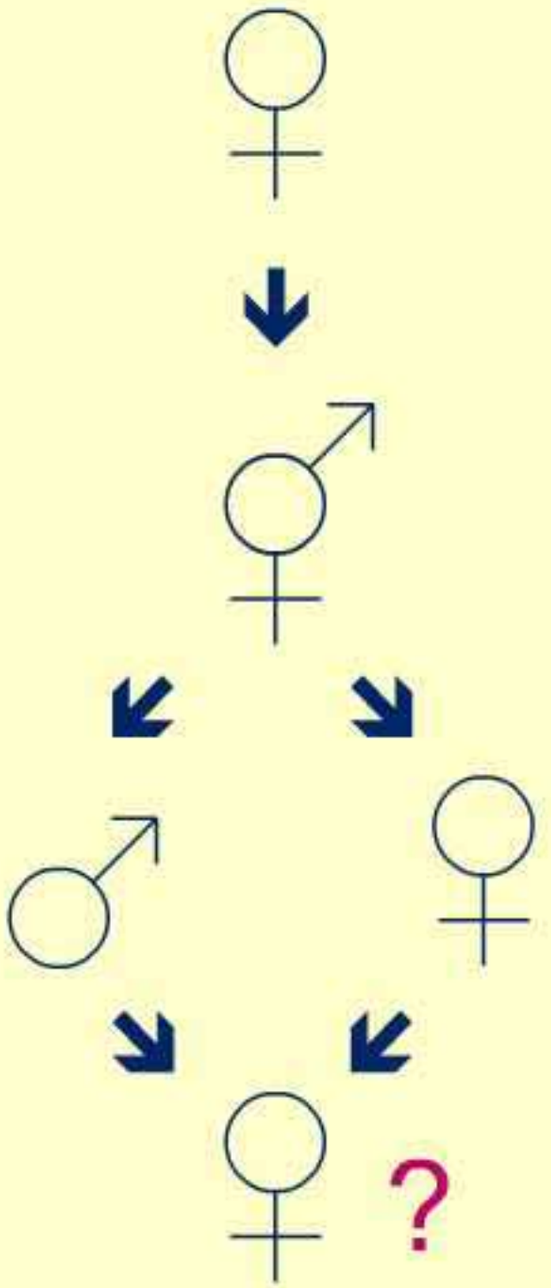

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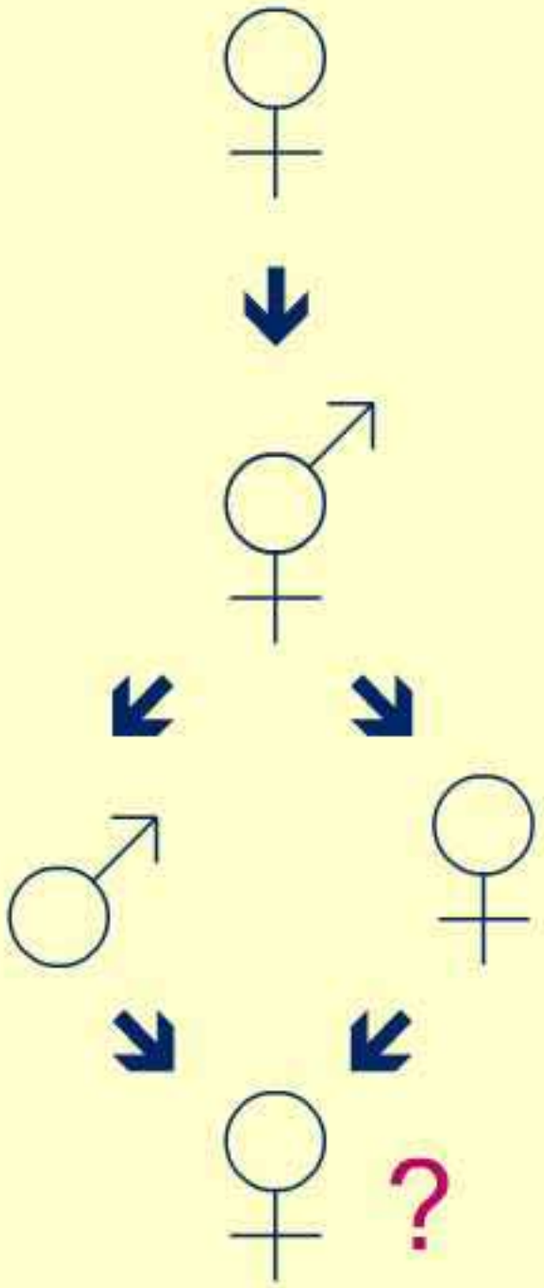

Why do we need to have sex to reproduce ?

Having separate individuals to produce sperm (male) and eggs (female) is a 50% reduction of fitness in any species

So why do it ?

Increased advantages for beneficial gene mutations

Increased inter and intra-sexual competition

Why do we need to have sex to reproduce ?

So sexual reproduction is the best way to allow us to adapt to changing environments

How do male and female mammals have sex ?

Males produce a lot of sperm, females only a few eggs

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Males tend to spread their seed indiscriminately

How do male and female mammals have sex ?

Males produce a lot of sperm, females only a few eggs

Males tend to spread their seed indiscriminately

Females are much more choosy

What do male mammals do ?

Courtship?

Eye contact, sniffing the female's genitals, flaunting erections, vocalising, tongue-protrusion and invasion of 'personal space'

What do male mammals do ?

Courtship?

Eye contact, sniffing the female's genitals, flaunting erections, vocalising, tongue-protrusion and invasion of 'personal space'

Males normally mount females from the rear

What do male mammals do ?

Courtship?

Eye contact, sniffing the female's genitals, flaunting erections, vocalising, tongue-protrusion and invasion of 'personal space'

Males normally mount females from the rear

Typically it's all over in between 2 seconds and a few minutes

male mammals

What do male mammals do ?

Bonobos, orangutans and lowland Gorillas can use the 'missionary' position

What do male mammals do ?

The only other species reported to do this is the Stitchbird - a songbird from Tiritiri Matangi island off the coast of New Zealand

What do male mammals do ?

Post-ejaculation impotence

What do male mammals do ?

Post-ejaculation impotence

Further sexual arousal depends on:

Age
Level of female attraction and encouragement
Novelty of female (Coolidge effect)
Level of fitness/stress
Whether other males are in competition

- so the next ejaculation may be anything from a few minutes to many hours later

What do male mammals do ?

Even for the human male the sex act lasts as little as 2 minutes (Kinsey, 1948)

However, for species that use a copulatory lock sex can last several hours

Why are males of most species so quick ?

Sex is a risky business

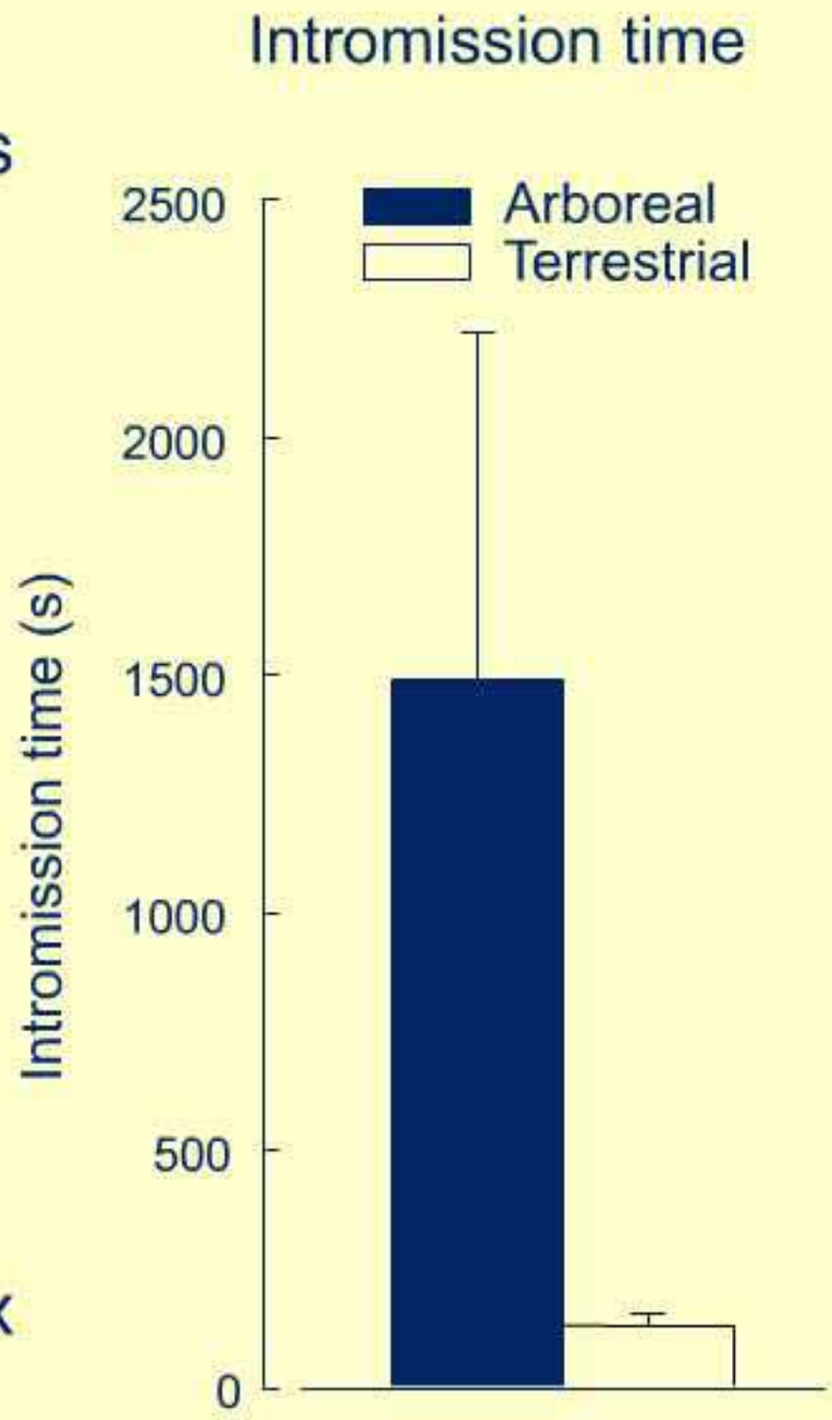
The male can get pleasure from sex very quickly

The male can move on rapidly to another female

Why are males of some species slower ?

Because they have less risk of predation

- so males from species that live in trees often take more time



Because while they are engaged in sex no other male can get access

male mammals

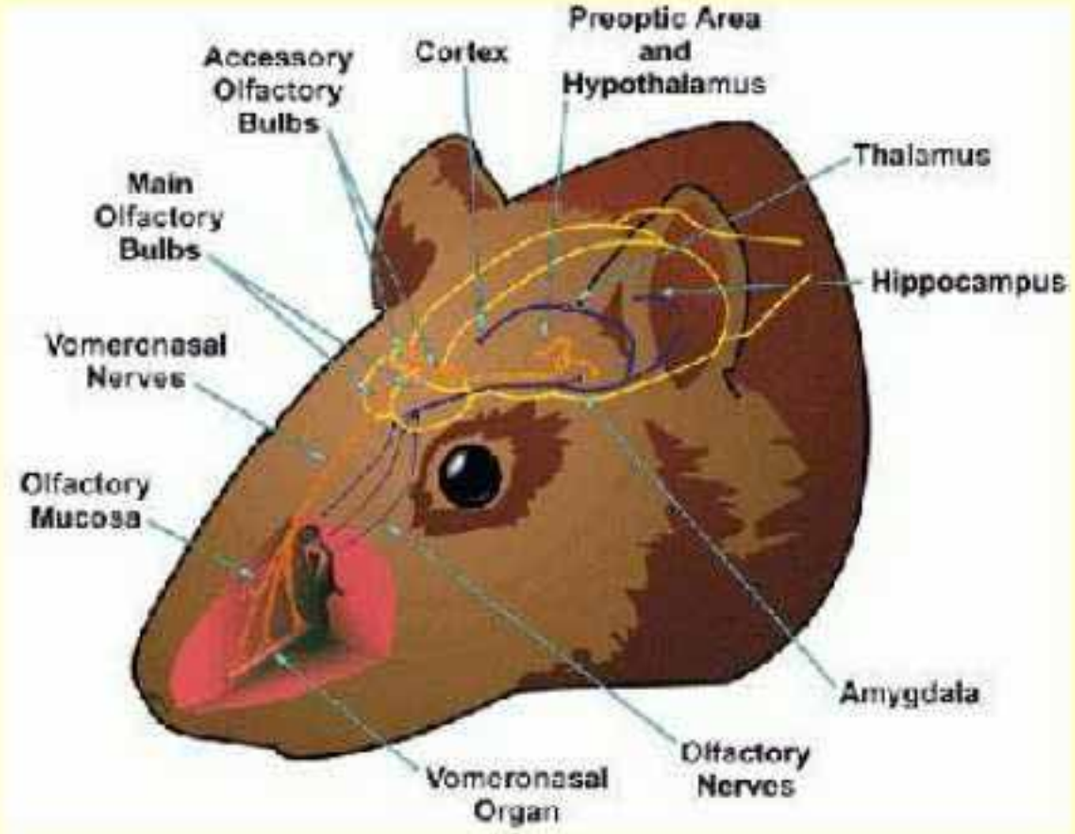
Which parts of the brain are involved ?

The brain regions controlling the male sexual response are phylogenetically old and remarkably conserved across species.

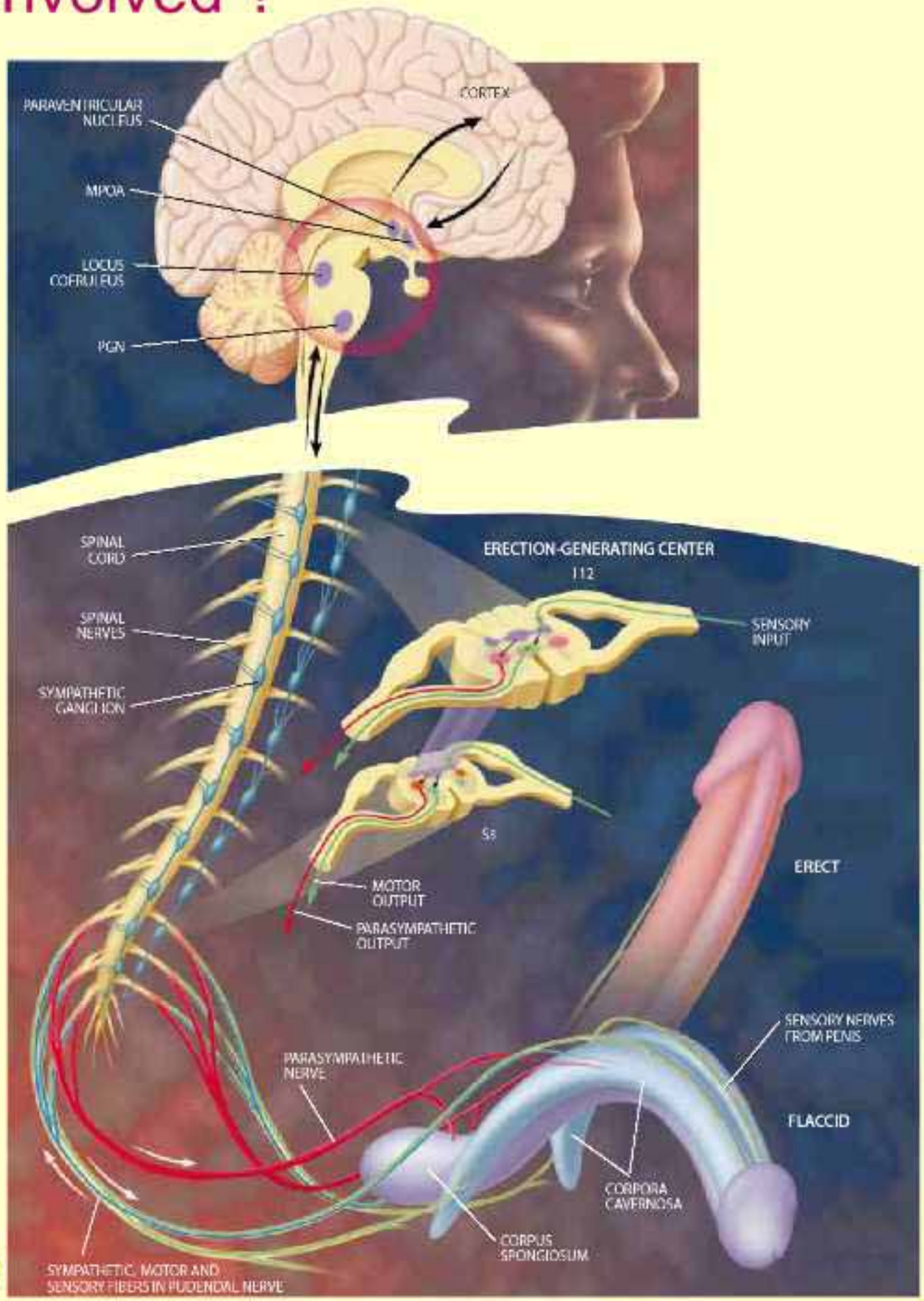
Male sexual behaviour is controlled by a region called the hypothalamus

This region also receives inputs from parts of the brain dealing with emotion

Which parts of the brain are involved ?



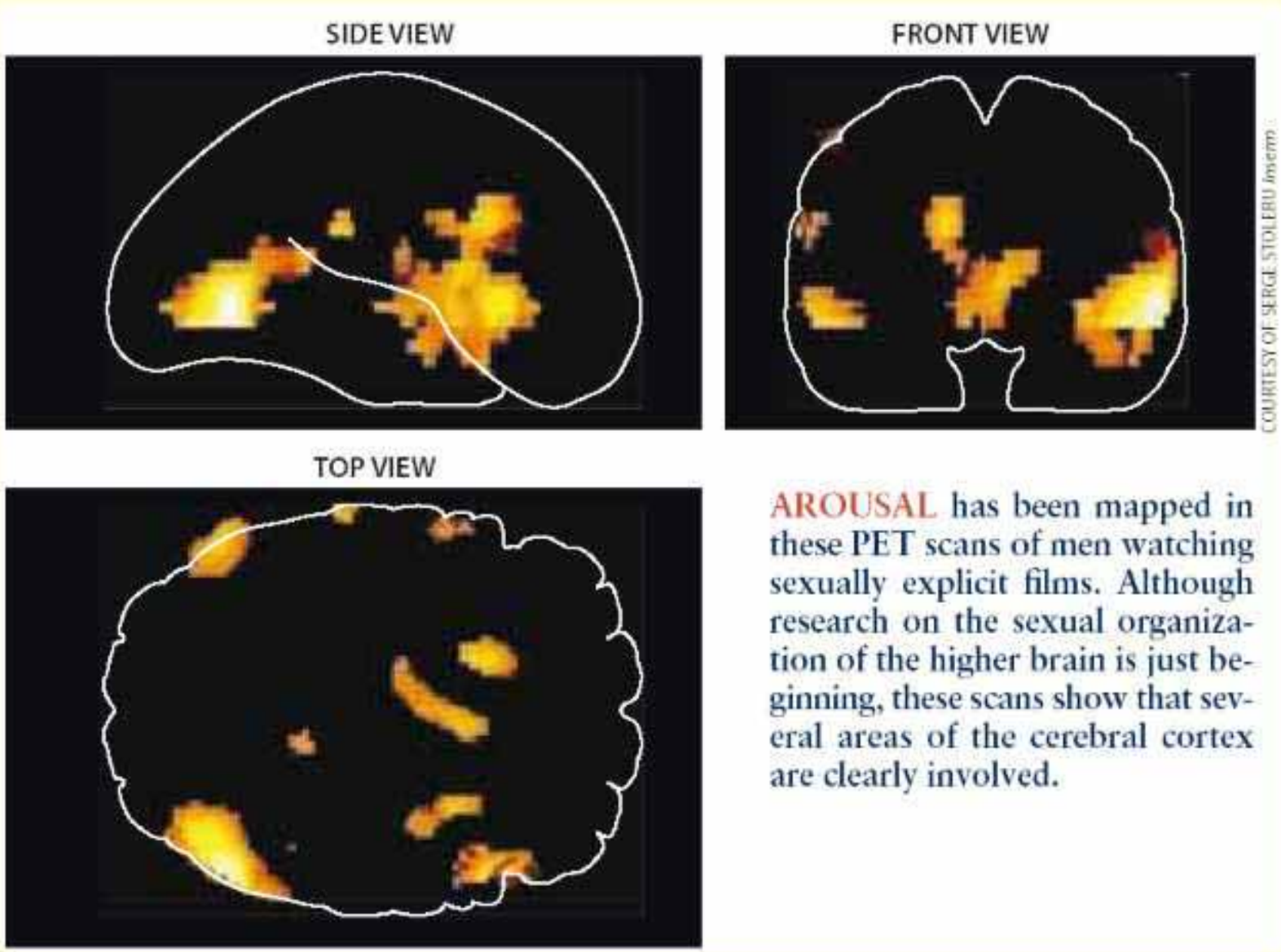
Olfactory systems in the hamster



from Scientific American

male mammals

Which parts of the brain are involved ?



AROUSAL has been mapped in these PET scans of men watching sexually explicit films. Although research on the sexual organization of the higher brain is just beginning, these scans show that several areas of the cerebral cortex are clearly involved.

from Scientific American

What do female mammals do ?

Most female mammals make sure that they are most attractive to males when they ovulate

All non-primate mammals have a period of behavioural oestrus

Some species are 'reflex ovulators'

What do female mammals do ?

Only female primates can have sex at any time but most advertise ovulation

What do female mammals do ?

Like humans, the females of some species don't advertise

i.e. it pays to keep him guessing whether or not he is the Dad !

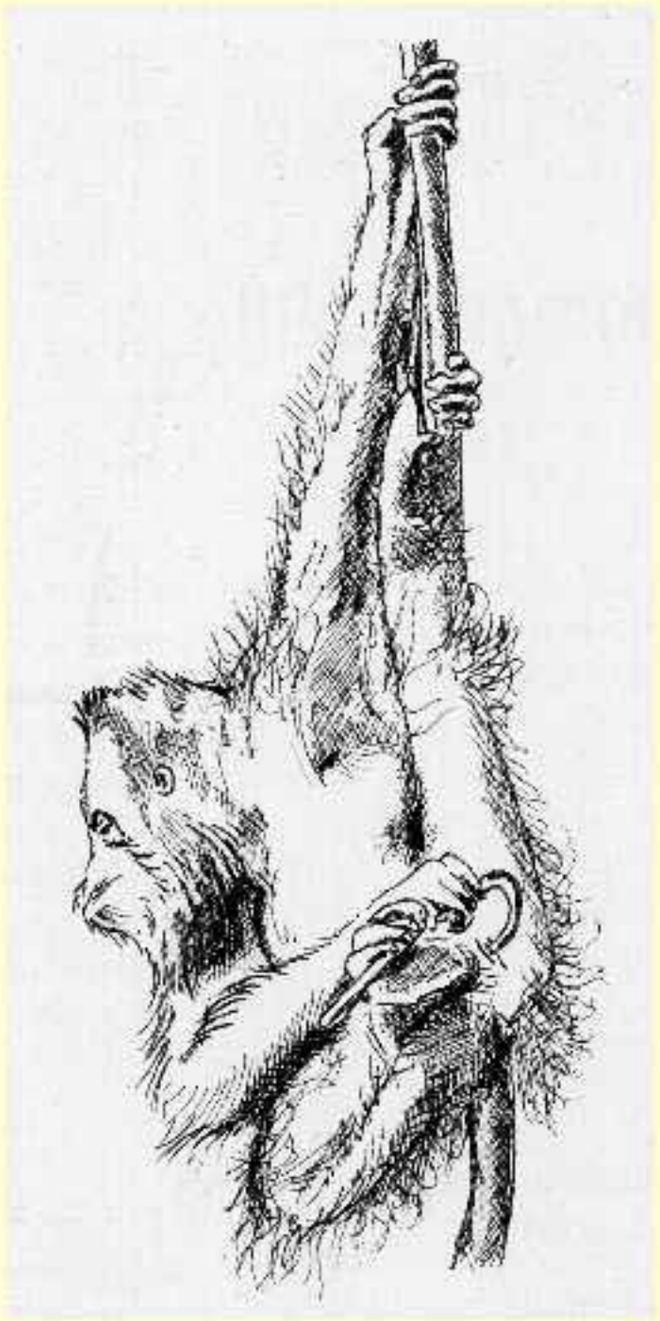
What do female mammals do ?

Courtship?

Eye contact, nudging, genital presentation, vocalising, tongue protrusion, wiggling ears - even having sex with another female !

Do other female mammals masturbate ?

Yes, many female primates do masturbate



Which parts of the brain are involved ?

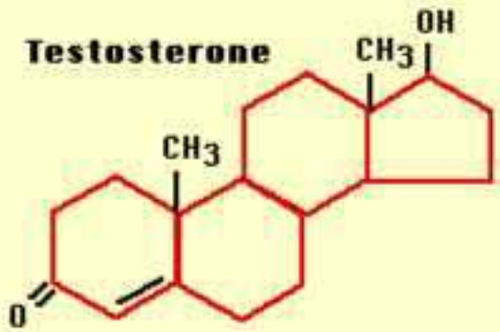
Female sexual behaviour is also controlled by parts of the hypothalamus

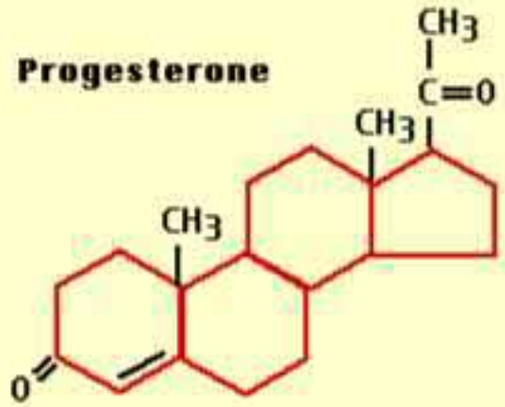
The main centres differ slightly from those controlling male sexual behaviour

Brain mechanisms controlling male and female sexual responses can be mutually opposed

What are hormones and how do they work in the brain ?

Sex hormones





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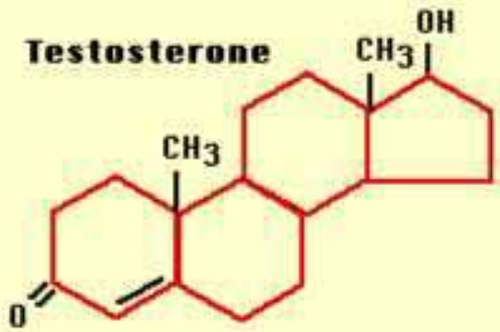
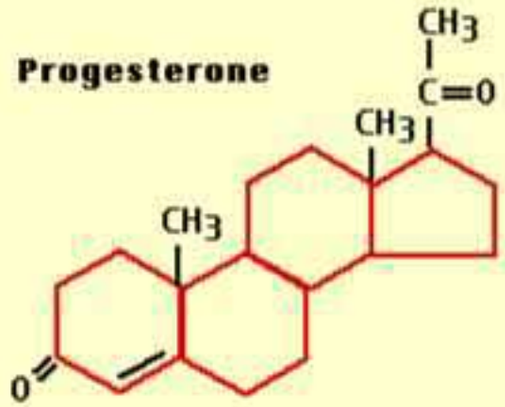


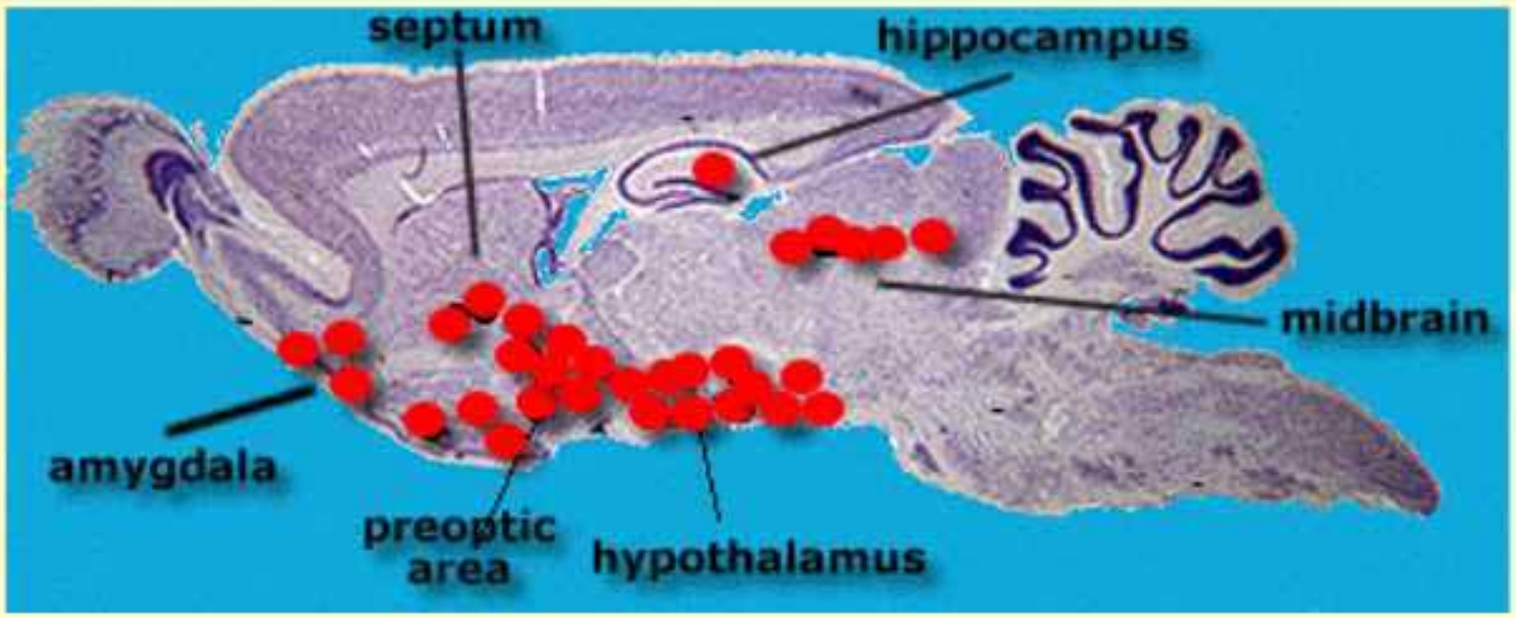


Neurosteroids

These act very quickly (<30 minutes) by modulating neurotransmitter receptors on the cell surface

Where are sex hormones found in the brain ?

They bind to cells in many 'older' areas of the brain controlling sex (hypothalamus), aggression and emotion (limbic system)



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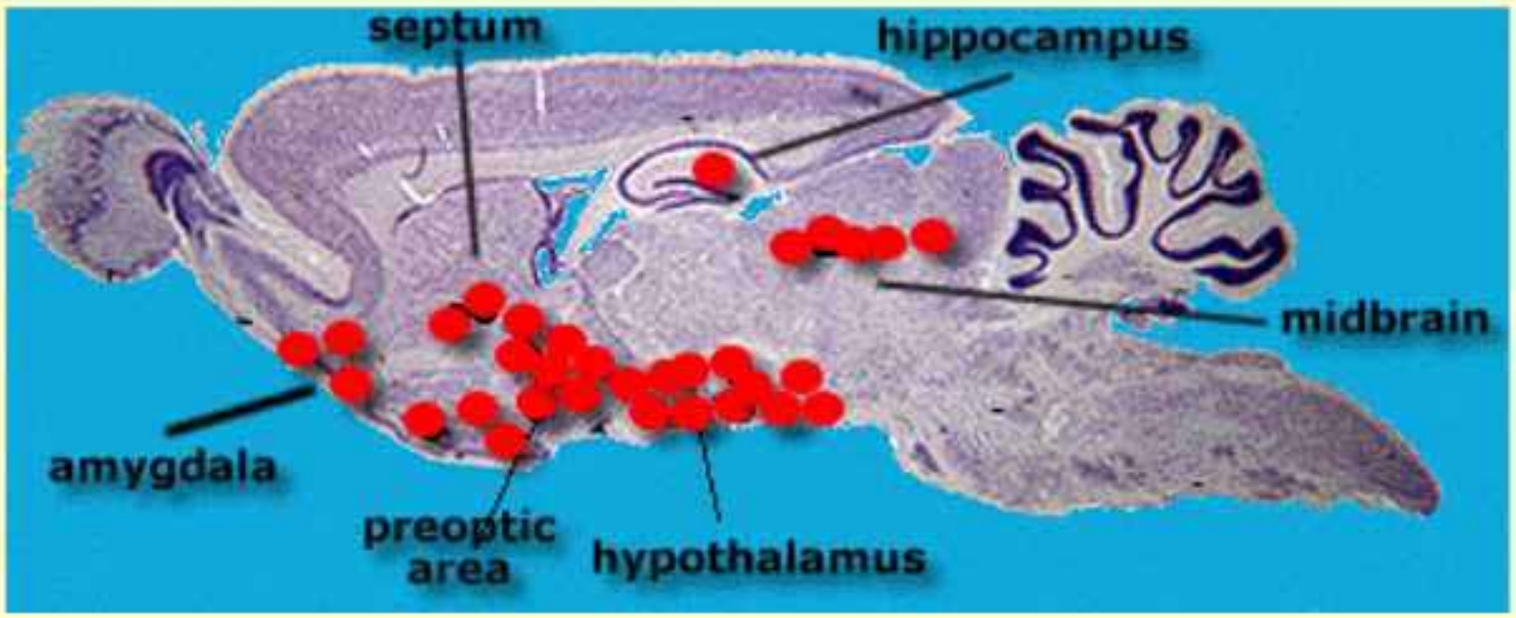


However, neurosteroids can influence the activity of the majority of cells in the brain one way or another

The making of a male brain

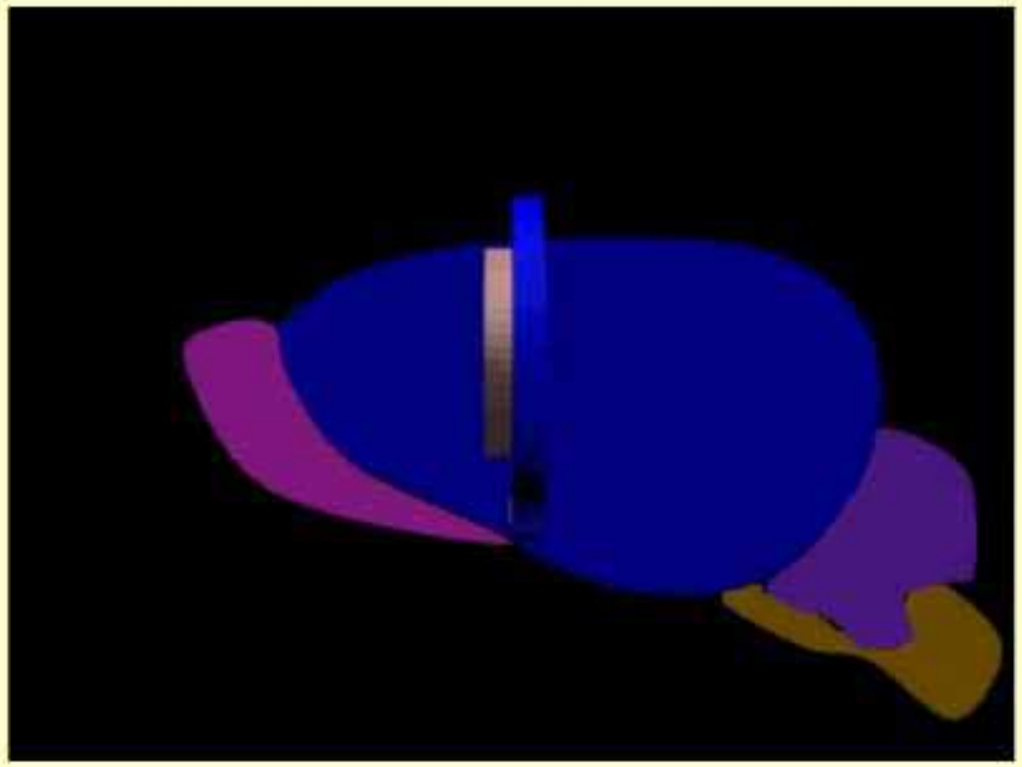
The default sex is female. Indeed, it would have been Adam that was formed from Eve's rib !

Testosterone turns a female brain into a male one.

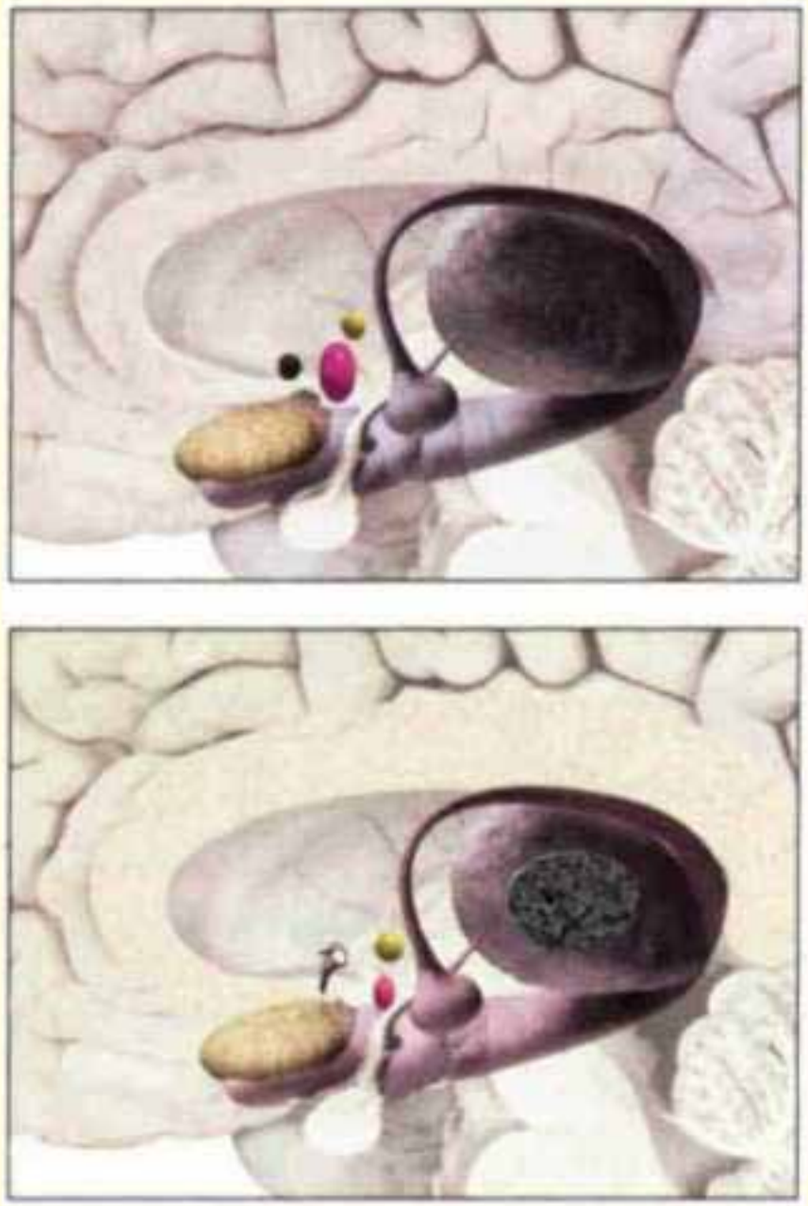
Male and female brains look very similar

There are sexually dimorphic regions in the hypothalamus

The making of a male brain



The sexually dimorphic nucleus of the preoptic area of the rat hypothalamus



INAH3 in the male (upper) and female (lower) human brain

So how do hormones influence adult sexual behaviour ?

Hormones effectively do four main things:

Make it easier for the right signals to elicit a sexual response

Facilitate the making of appropriate motor actions during sex

Heighten awareness of sexually arousing sensory cues

Help you remember who you have had sex with !

So how do hormones influence adult sexual behaviour ?

What they don't do is stimulate sex directly

So how do hormones influence adult sexual behaviour ?

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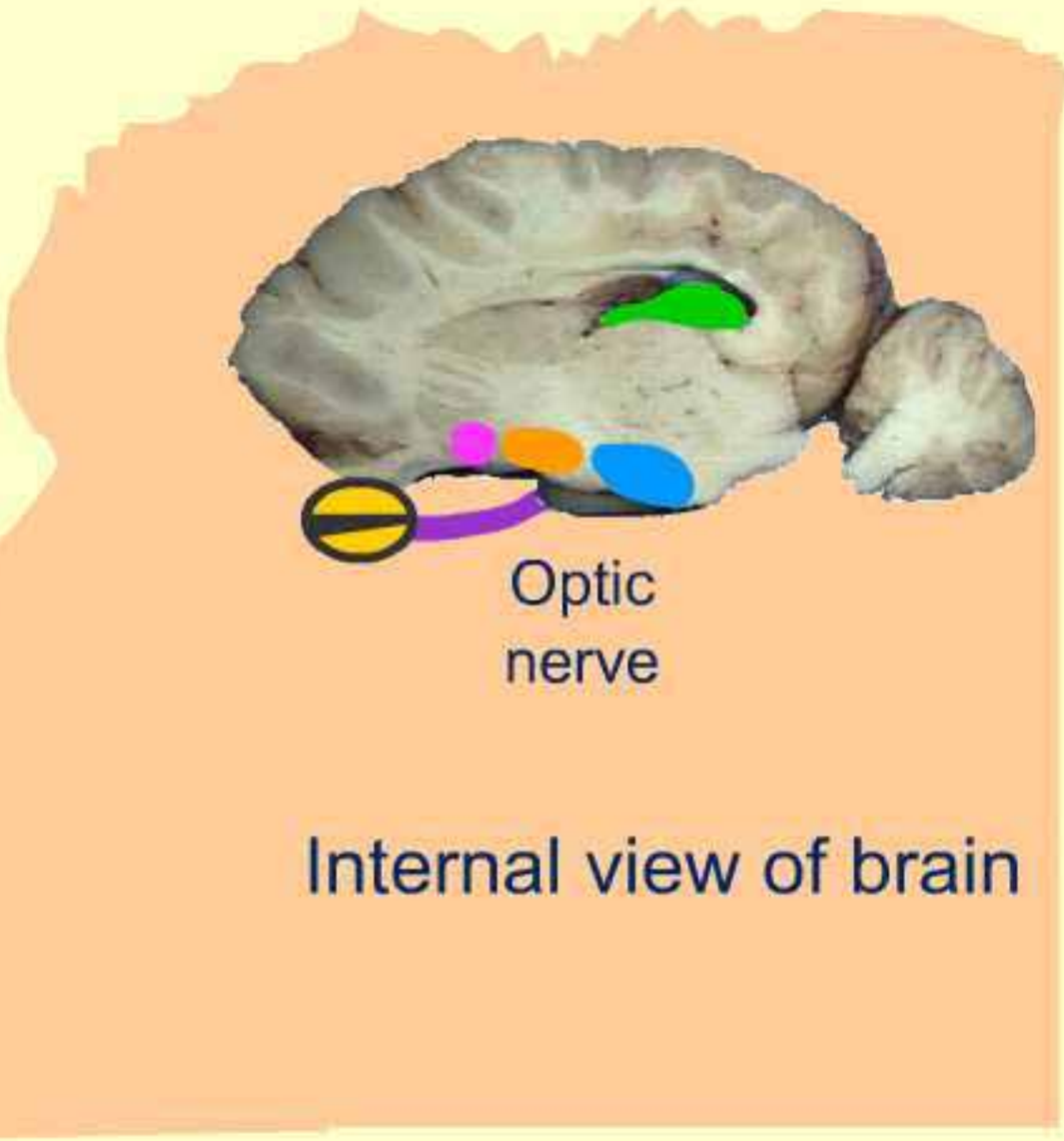
So how do hormones influence adult sexual behaviour ?

- Hippocampus - memory
- Amygdala - emotion
- Hypothalamus - sex
- nuc. accumbens - reward



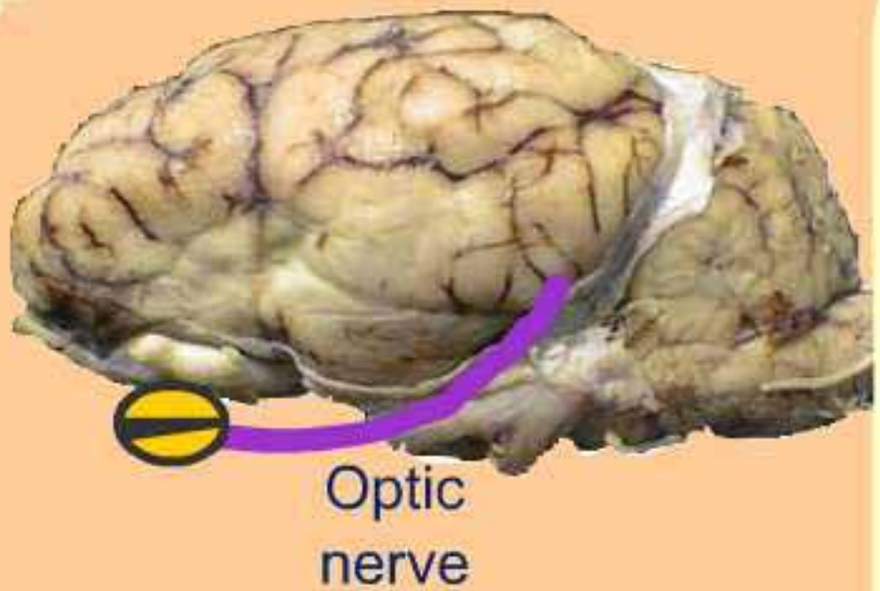
Internal view of brain

During oestrus - male attractive

So how do hormones influence adult sexual behaviour ?

Not during oestrus - male not attractive

So how do hormones influence adult sexual behaviour ?



External view of brain

Not during oestrus - male not attractive

So how do hormones influence adult sexual behaviour ?

Internal view of brain

'In sight, but out of mind ?'

Not during oestrus - male not attractive

hormones

Physical and behavioural similarities are attractive

Like attracts like

attraction

Physical and behavioural similarities are attractive

Like attracts like

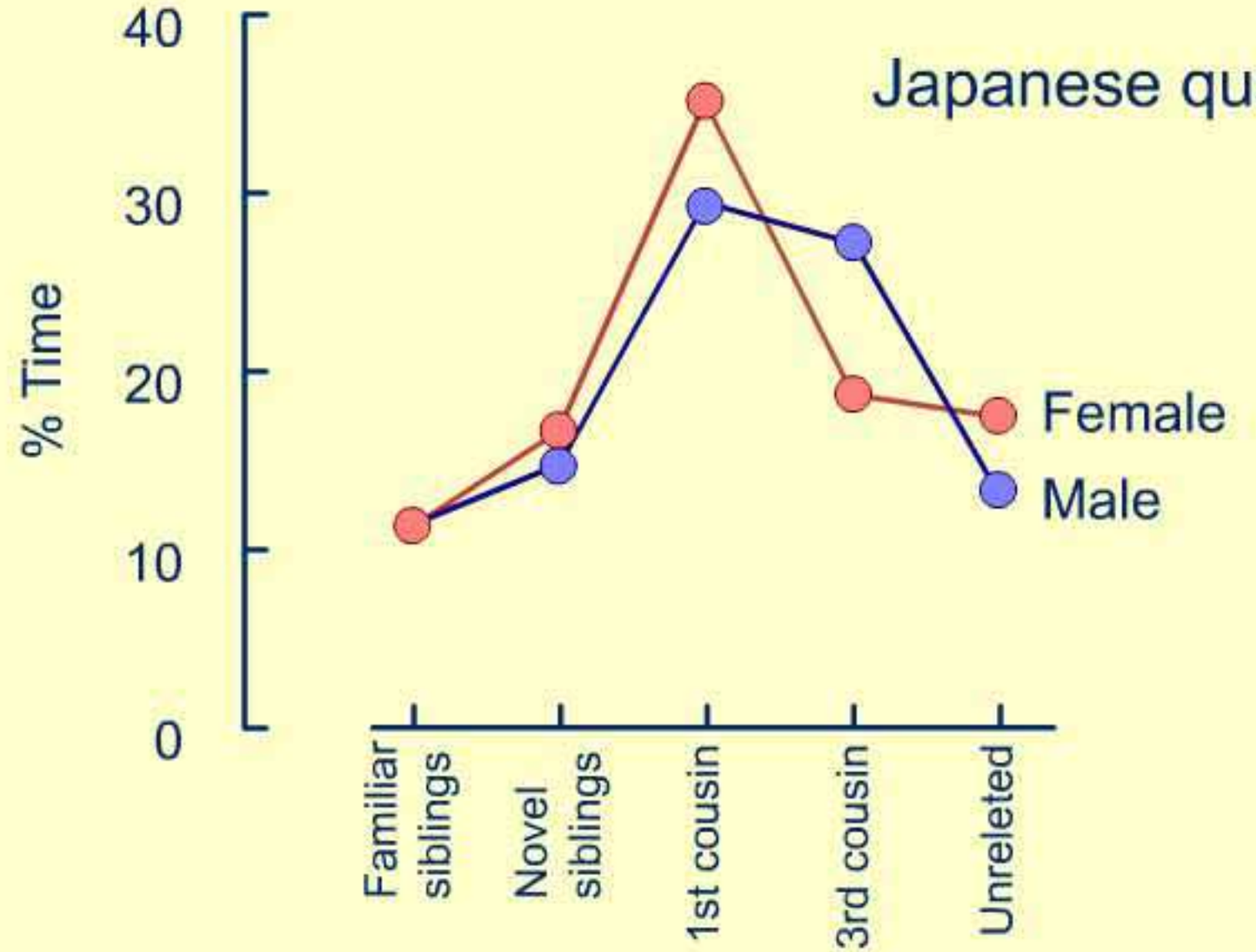
It makes sure your offspring have more of your genes

Couples with the greatest similarities tend to be more fertile

Relatives provide your DNA template

So how similar do you have to be ?

Maximal attraction to others occurs when they vary by about 12.5% genetically - i.e. 1st cousins



Human legislators managed to get this right without the benefit of research !

attraction

So why isn't incest more common ?

"Constant social familiarity in early life breeds subsequent sexual contempt" - this is the 'Westermarck hypothesis' (1891)

Failure of child marriages - kim-pua - and Kibbutz children

The same is true of Barbary macaques

The immune system also plays a role in attraction

We, and mice, are attracted to individuals with dissimilar immune complexes

The MHC complex provides a distinctive smell

The sweaty T-shirt competition

attraction

Perception of body symmetry is also important

Symmetry = attractive

Normal face

Perception of body symmetry is also important

Symmetry = attractive

Normal face

Perception of body symmetry is also important

Symmetry = attractive

Symmetry suggests good genes

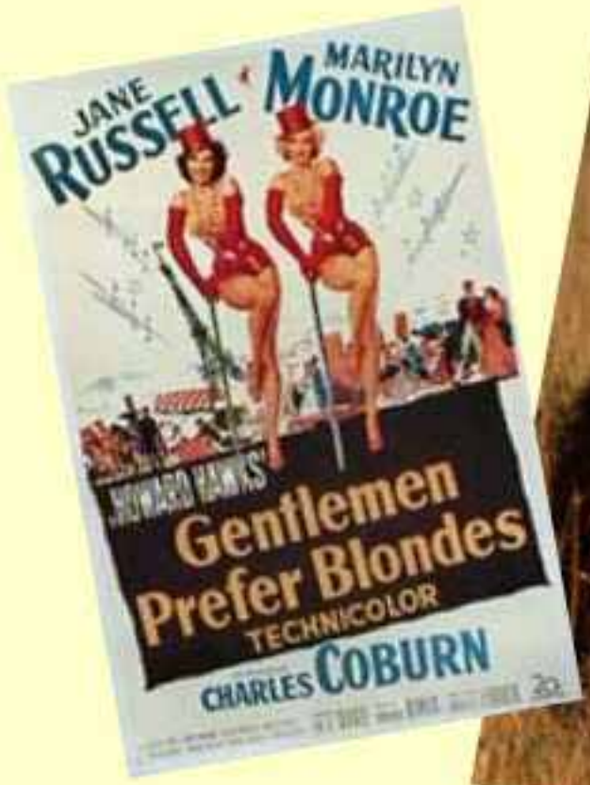
attraction

What determines attraction between the sexes ?

Male mice, pheromones and the TRP2 gene

Male rats and mice learn attraction to female urine

Lionesses are attracted to males with large, dark brunette manes



attraction

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For sheep it can all be in the face

attraction

What determines attraction between the sexes ?

Is there a hard-wired 'X-factor' in humans ?

- the perfume industry clearly hopes so !

Experience and cultural changes suggest learning is more important

attraction

...and finally

Females take more factors into account than males in deciding level of attraction

Females make sure they invest their valuable eggs wisely !

attraction

Do other animals enjoy sex ?

For males, sex is clearly enjoyable

Having sex activates parts of the brain that control reward

Males will also work very hard to get access to females !

Do other animals enjoy sex ?

For females, appearances can be deceiving

Sex also activates reward centres in the female brain

Females will pursue males for sex

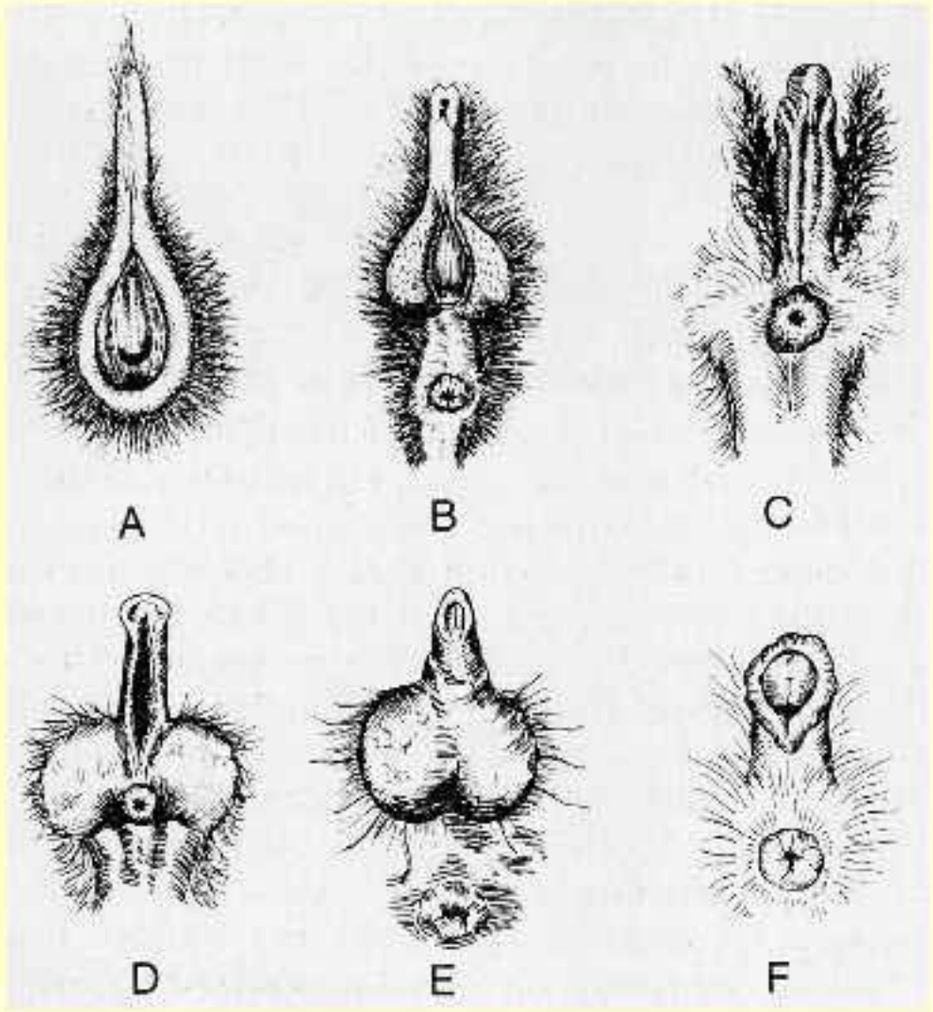
Too much sex can be a turn-off

Scratching an itch ?

Do other animals enjoy sex ?

Orgasm is not unique to women, it occurs in chimpanzees, rhesus and stumptail macaques

All female primates have a clitoris



Do other animals enjoy sex ?

The stumptail macaque has a distinctive facial expression during climax

Is there such a thing as prostitution in other species ?

Sex for gifts is common in primates

The penguin prostitute !

Payment is in stones

How and why did social sex develop ?

The how is relatively straightforward:

Control of sex was divorced from control of ovulation

Hormonal influences on sexual receptivity were reduced

Brain control of inviting sex separated from that accepting it

How and why did social sex develop ?

The why is more difficult:

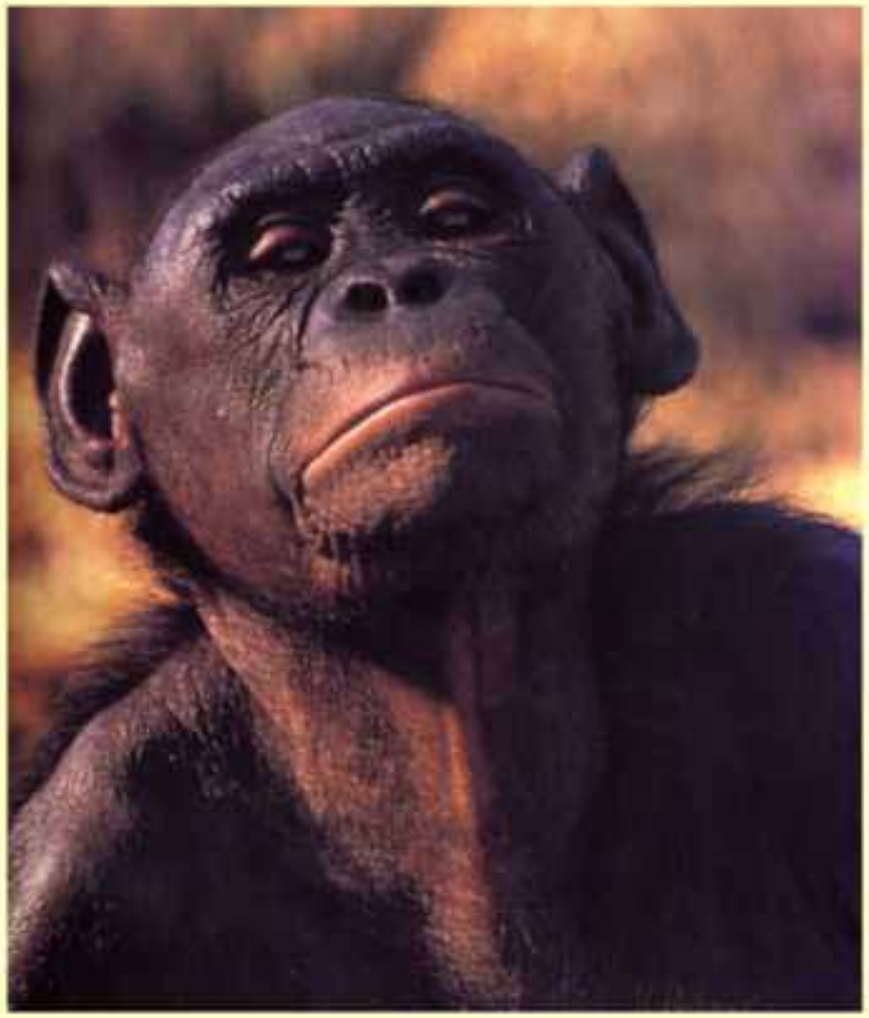
Keep the males around to exploit

Reduce male aggression - the 'make love not war' scenario

Enjoy sex more often

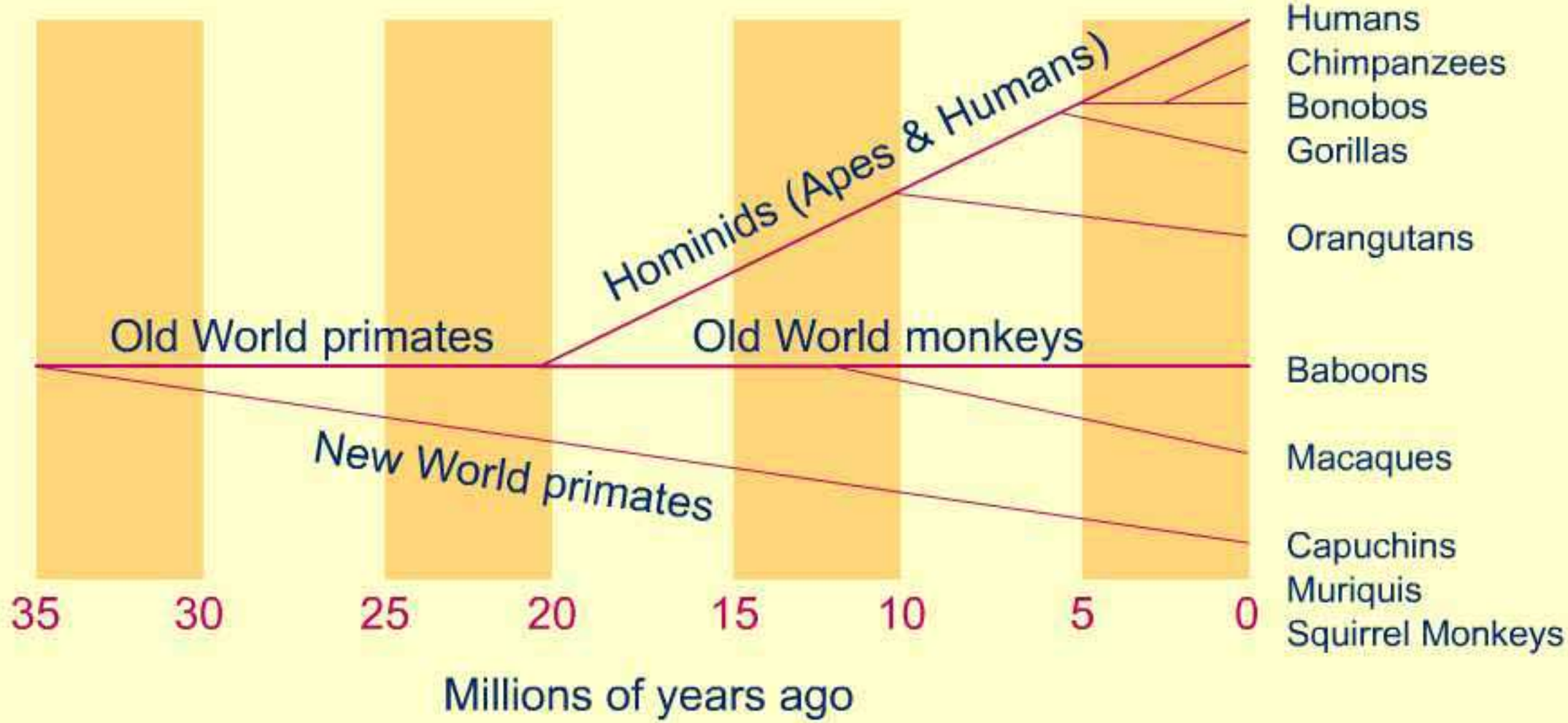
How and why did social sex develop ?

Ask a Bonobo !



How and why did social sex develop ?

Their family tree....



How and why did social sex develop ?

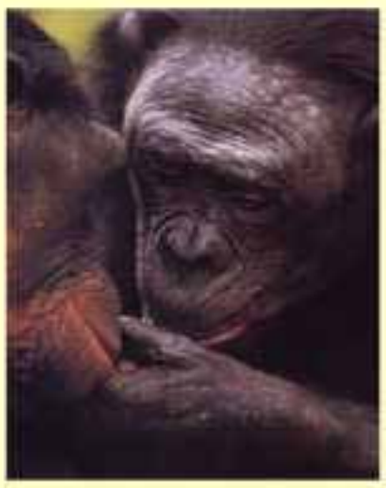
Females dominate but males don't look after the kids !

Females are more overtly social and form the strongest bonds

The boys stay at home while the girls leave to have babies elsewhere

How and why did social sex develop ?

They are not monogamous and have an amazing capacity for sex in pretty much every possible combination



How and why did social sex develop ?

So female Bonobos have used social sex to dominate and pacify males

Bonobos have sex before other activites that might cause conflict

- i.e. sex is not a way of resolving an argument, it is a way of not having one in the first place

They don't have sex with relatives

Are problems in sexual orientation, deviation and dysfunction unique to humans ?

So, pretty much every aspect of the normal human heterosexual response has equivalents in some other animal species

Is this true of other aspects of human sexuality ?

Are problems in sexual orientation, deviation and dysfunction unique to humans ?

Sex play

Socially or sexually motivated ?

Bruce Bagemihl in "Biological Exuberance" (1999) claims homosexuality in 200 different species

This is probably an exaggeration

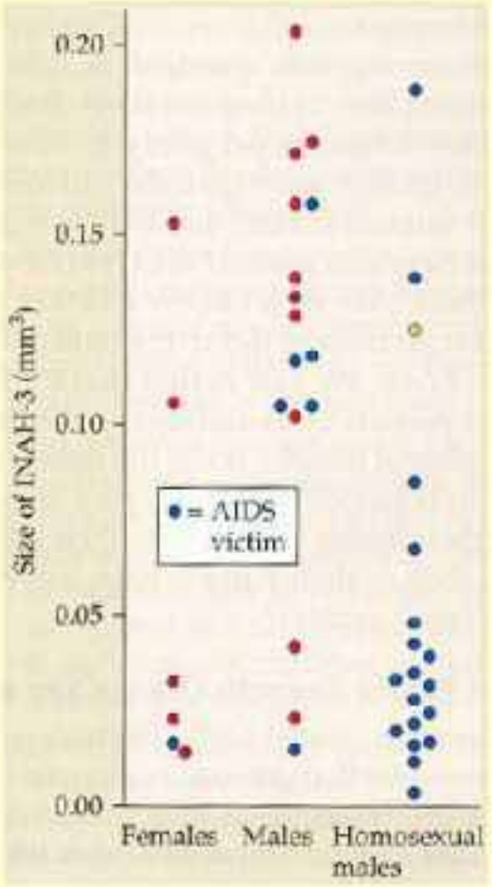
Are problems in sexual orientation, deviation and dysfunction unique to humans ?

Homosexuality in sheep and monkeys

2% of male sheep show exclusive male sexual orientation - compared with 2 - 4% in humans

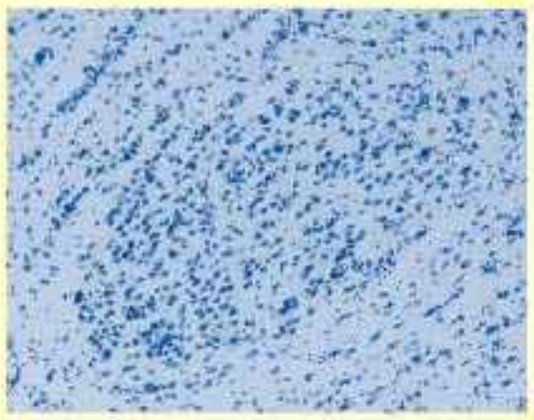
Are problems in sexual orientation, deviation and dysfunction unique to humans ?

Brain differences in homosexuals

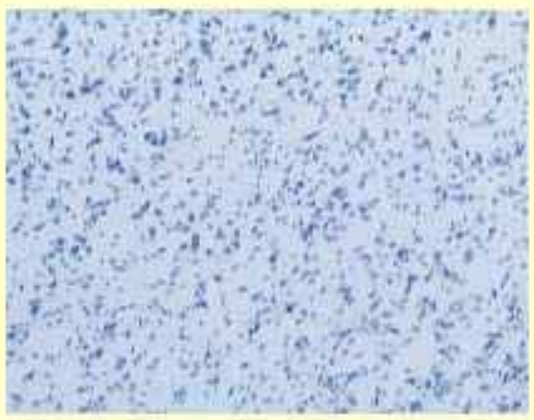


Data from LeVay and Hamer 1991

Cells in INAH 3
(from Scientific American)



Heterosexual man



Homosexual man

Sexual dysfunction

Are problems in sexual orientation, deviation and dysfunction unique to humans ?

Brain differences in homosexuals

Some endocrine responses to sex hormones also more closely resemble those of females than heterosexual males

There are very similar patterns of brain and endocrine differences in 'gay' sheep

Is this cause or effect ?

Are problems in sexual orientation, deviation and dysfunction unique to humans ?

Is homosexuality genetically controlled ?

In humans 65-75% of identical twins both have homosexual orientation compared with 29-33% of dizygotic ones

Genetic concordance in the tail region of the X-chromosome (Xq28) between gay brothers is also a good predictor

Left-handed males or females are also more likely to be homosexual than right handed ones

Are problems in sexual orientation, deviation and dysfunction unique to humans ?

What about experience ?

Birth order, absent or distant fathers, close mother-son relationships have also been shown to have effects

In sheep, being reared in all male groups after weaning may contribute

Are paraphilias unique to humans ?

Percentages of men and women who report having experienced certain paraphilic activities

Type of Paraphilia	% Men	% Women	Sample sizes	
			Men	Women
Sado-masochism	14	11	1336	1406
Dominance/bondage	11	11	1331	1403
Fetishism	11	6	1329	1399
Verbal humiliation	5	7	1342	1411
Urophilia	6	4	1291	1381
Coprolagnia	1	0	1241	1310
Necrophilia	0	0	1291	1367
Paedophilia	2	0	1340	1413

Data compiled from Janus and Janus (1993)

Are paraphilias unique to humans ?

Do other animals commit rape ?

Gang-rape in Mallards

Imprisonment of females for sex in dolphins

Forced copulations in orangutans and in some macaques

Are paraphilias unique to humans ?

Experimentally induced 'zoophilia' in sheep and goats

The mother's effect is much stronger in males

Are paraphilias unique to humans ?

There are no documented examples of other paraphilias in animals - including paedophilia

It is possible that some domestic animals and monkeys develop fetishes since sex with objects can be observed

Are paraphilias unique to humans ?

There are no documented examples of other paraphilias in animals - including paedophilia

It is possible that some domestic animals and monkeys develop fetishes since sex with objects can be observed

Indeed, both rodents and men can learn to be sexually aroused by neutral objects and environments if given the right incentive

Sex with consenting juveniles can be observed in Bonobos but this cannot be construed as akin to paedophilia

Are paraphilias unique to humans ?

In humans experiential factors identified as contributing to paraphilias (but unlikely to occur in other species) are:

Cultural suppression of the expression of juvenile sex play

Early experience of sexual abuse by family members

Problems with social interactions with the opposite sex

Paraphilias are reportedly absent in some human cultures (Yolngu)

Do other animals experience sexual problems or loss of libido ?

Can early negative experience cause sexual dysfunction in animals ?

Effects of preventing juvenile sex play

Do other animals experience sexual problems or loss of libido ?

Effects of being reared without parents

Harlow and Harlow (1966)

Do other animals experience sexual problems or loss of libido ?

Stress is definitely a big turn-off

Reproductive suppression in New World monkeys

Sex drive in other species also decreases with age

What can we conclude from all this ?

There are no major qualitative differences between humans and other mammals

Dependence on hormones has been reduced with increased neo-cortical development

Many elements of sexual attraction are learned

What can we conclude from all this ?

Homosexuality is not unique to humans

Enhanced capacities for learning, and emotional reactions to sexual abuse and taboos may have increased human paraphilias

Females may have used social sex as a way to control male aggression and resource provision

This also allowed increased female enjoyment of sex

What can we conclude from all this ?

The 'make love not war' strategy can lead to females dominating males - as in Bonobos

Is this happening in humans ?

Will our environment ever be stable enough to dispose of males ?

What can we conclude from all this ?

Conflict between the sexes is a major survival tactic for most species, and where one sex gains a temporary advantage one can be sure that the other will find a way to counteract it