COGS 17 Week 10

Spring 2024, A03

Slides Adapted From Previous Quarter

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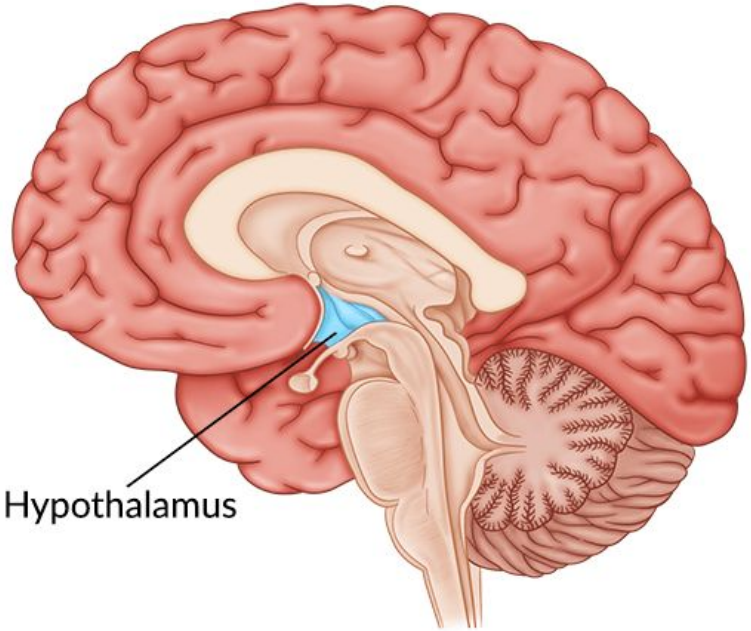
Problem Set for Today

- Link: https://docs.google.com/document/d/1XtNNYfFMBr-40n5tRaZc5KhVjJJgpCrKPpudmzlWtdI/edit?usp=sharing

Hypothalamus



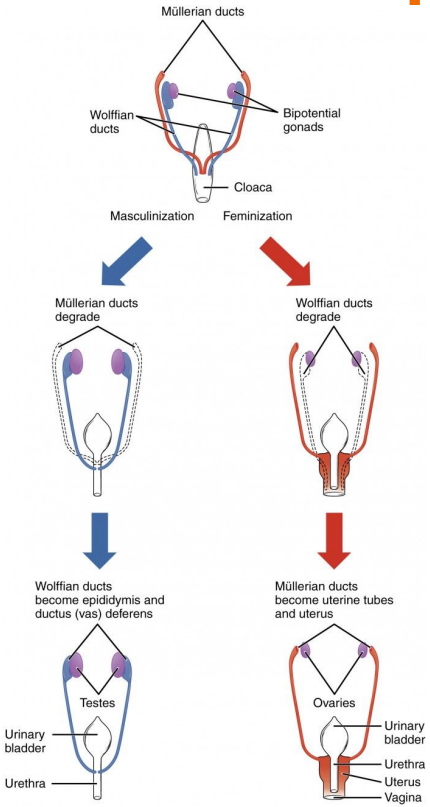
- Controls **endocrine** (hormone) systems via effect on adjacent Pituitary Gland
- Produces **Releasing Hormones** that flow via blood vessels to **Anterior Pituitary** stimulating gland to release its own hormones
- Produces other Hormones via **axons** to **Posterior Pituitary**, then circulate in bloodstream

Reproductive Hormones

- **Both sexes** have female (Estrogens) and male (Androgens) hormones, just in different **proportions**
- Produced mainly in Ovaries/Testes, but also in Hypothalamus and Adrenal Glands
- Have **Organizing** Effects (the development
- of sexual anatomy) & **Activating** Effects (influence behavior)

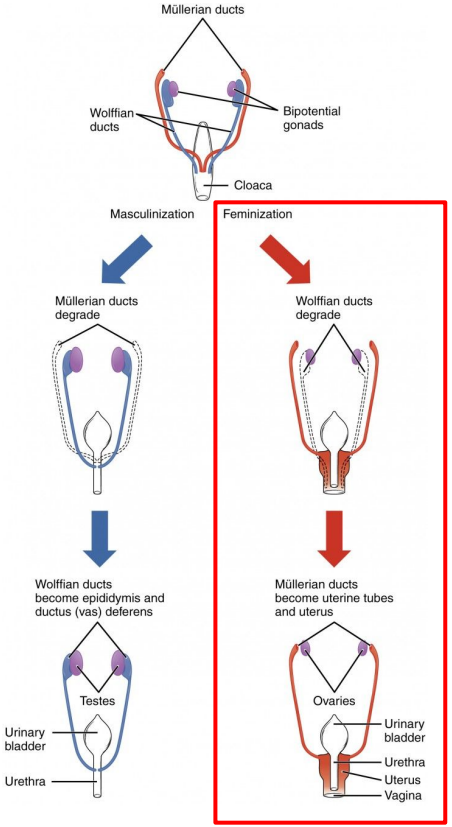
Organizing Effects

Fetal Development of Sexual Anatomy



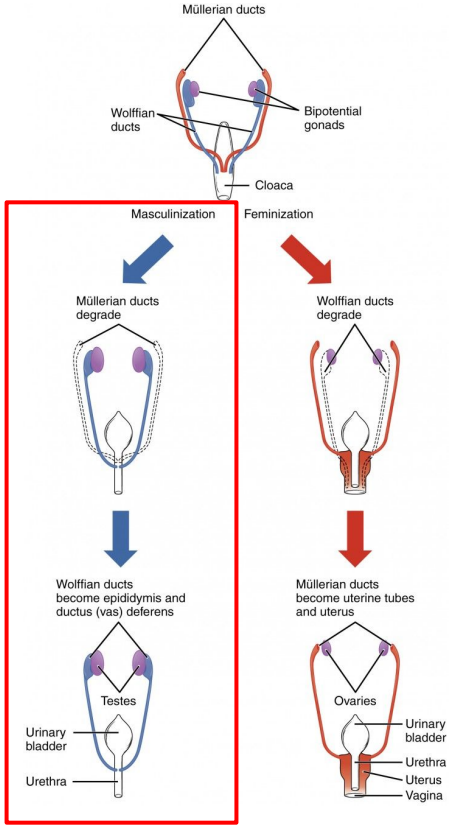
- Every mammalian fetus has the anatomical precursors for **BOTH** sexes (e.g. Gonads, Gentalias, etc.)
- The genes controlling male/female body & brain development are also present in **BOTH** sexes, HOWEVER,
- The “switch” is on the male’s **Y Chromosome**; it signals production of the Testis-Determining Factor (TDF) Enzyme
- If TDF is NOT present => Female
- If TDF is present => Male

If TDF is NOT Present



- Ovaries differentiate, Mullerian system develops, Wolffian regresses, female genitalia develop, **regardl essof genotype**
- If fetus is XY, but lacks specific gene (e.g. no SRY) for TDF (or other TDF deficit), will develop internally & externally as female
- If fetus is XO (Turner's Syndrome), will develop internally & externally as female

If TDF is Present

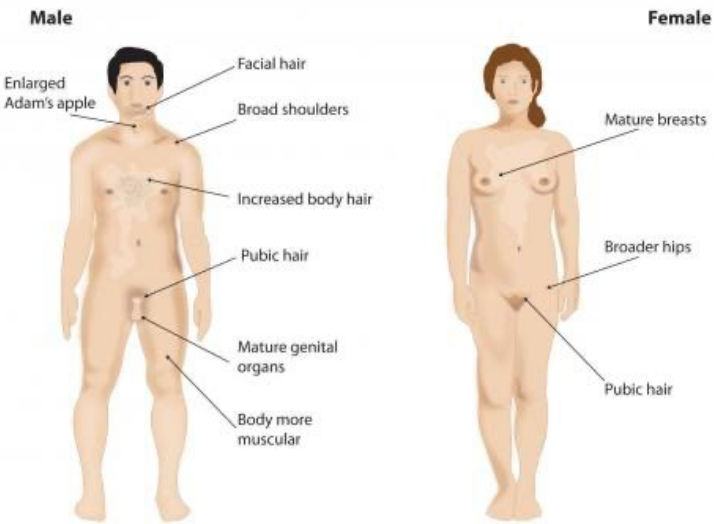


- Testes differentiate, producing Androgens, including Testosterone => Wolffian ducts and male genitalia develop
- Testes also produce Anti-Muellerian Hormone, **inhibits development of Muellerian system**
- If XY fetus is Androgen-Insensitive, will have no internal sex organs (& so is infertile) except rudimentary, internal testes, but external body develops as a female
- If XX fetus is exposed to Testosterone during **critical period**, develops male, or semi-male form, sometimes infertile

How Did Mother's Estrogen Masculinize Fetus

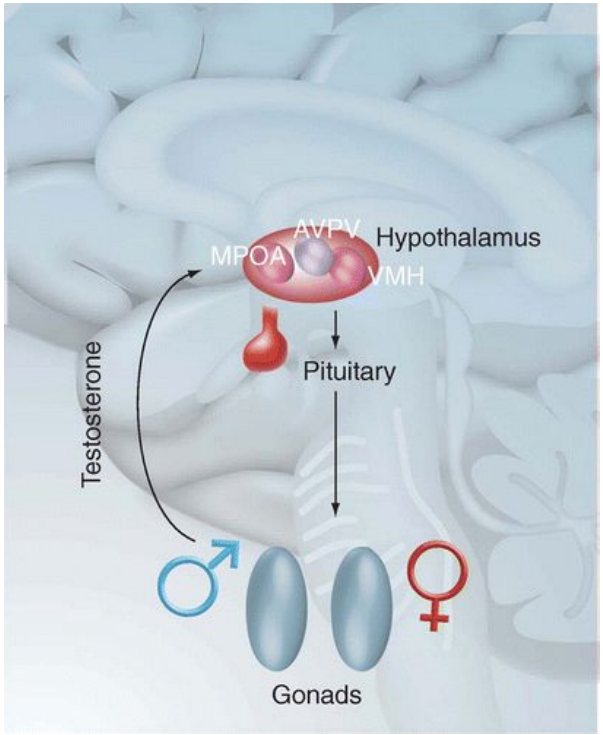
- When Testosterone enters cells, it is aromatized (converted) into Estrogen => Male development
- Alpha-Feto Protein -- in fetal/infant blood, binds with Estrogen, preventing it from entering fetal cells (later inactivated)
- Excessive Estrogens can still overwhelm this
- safeguard, masculinize fetus

Secondary Sexual Characteristics at Adolescence



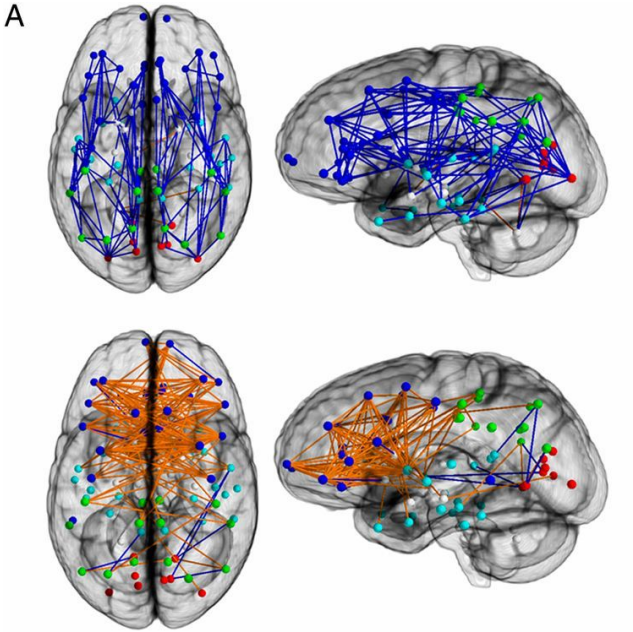
- In both sexes, Hypothalamus releases **GnRH**, causing Anterior Pituitary to release the Gonadotropic Hormones: **LH** and **FSH**
- In **Males**, these hormones >> Testes produce sperm and Testosterone (and other Androgens, and **low levels of Estrogens**) >> Male Secondary Sexual Characteristics
- In **Females**, these hormones >> Ovaries produce ova and Estradiol (and other Estrogens, and **low levels of Androgens**) >> Female Secondary Sexual Characteristics

Sexual Differences in Brain Development



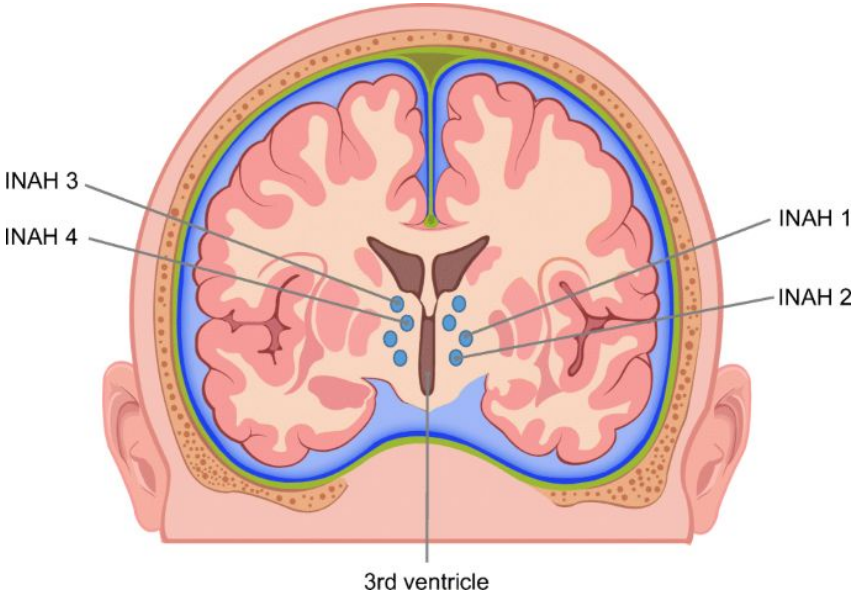
- Presence/Absence of Testosterone during prenatal period and early infancy => differences in brain
- Medial Preoptic Area (MPOA) of Hypothalamus, has Androgen receptor sites, is esp active during Male sexual behavior
- Ventro-Medial Hypothalamus (VMH), has Estrogen receptor sites, is especially active during female sexual behavior

Sexual Differences in Brain Development



- Males show more intra(within)-hemispheric connections while females show more inter (between)-hemispheric connections
- Suggests males may better integrate perception & action, females better integrate analytic & intuitive processing

INAH 3



- Part of Sexually-Dimorphic Nucleus,larger in Heterosexual Males, smaller in Females and Homosexual Males

Activating Effects

In MALES

- Medial Preoptic Area (**MPOA**) of Hypothalamus, including Sexually Dimorphic Nucleus, is critical for **sexual behavior**
- Pleasure Circuit -- includes VTA (Ventral Tegmental Area) > Nucleus Accumbens (Pleasure) near Basal Forebrain -- Releases
  Dopamine to Nucleus Accumbens in response to sexual stimulation
- MPOA also stimulates Basal Ganglia which communicates with
  Spinal Nucleus of the Bulbocavernosus (**SBN**)

In MALES

- Motor neurons of SBN => rhythmic contractions for ejaculation
- At orgasm, MPOA signals Posterior Pituitary to release **Oxytocin**
- After ejaculation, Anterior Pituitary releases **Prolactin**, producing **Refractory Period** before male can respond again
- MPOA also responds to input from Medial Amygdala, implicated in **aggression**

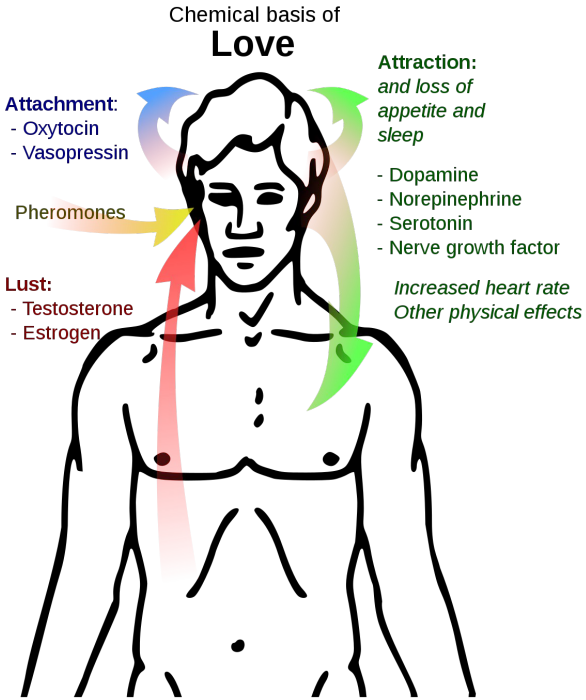
In FEMALES

- Androstenedione (chemically like Testosterone), an Androgen produced by adrenals, for sexual motivation
- Gets converted into Testosterone in bloodstream, activates MPOA
- MPOA > GnRH > LH & FSH > stimulates Ovaries and Adrenals (short-term positive feedback)
- Estrogens from Ovaries stimulate Ventro-Medial Hypothalamus (VMH), this region is most activated during female sexual behavior

In FEMALES

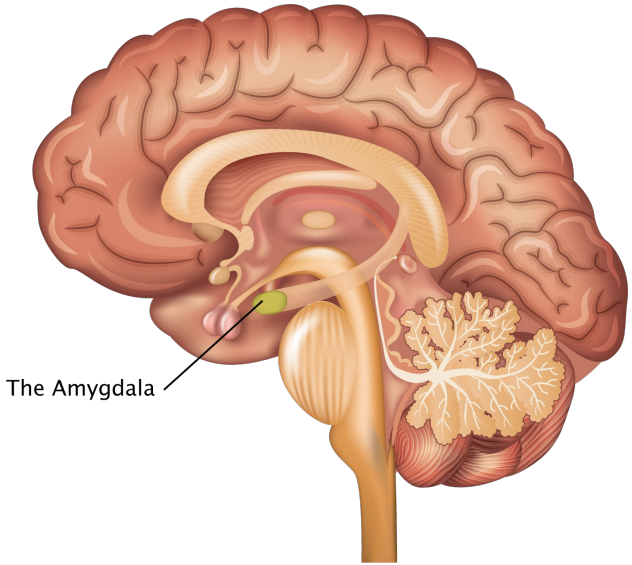
- VMH and MPOA stimulate pleasure circuit: VTA releases Dopamine to Nucleus Accumbens for reinforcement > Basal Ganglia > SBN for rhythmic contractions, as in males
- VMH also stimulates Periaqueductal Gray Area which produces **Endorphins**, in part to **suppress Pain**, and signals Posterior Pituitary to release **Oxytocin** (at time of orgasm)
- After sex, females do **not** show same Prolactin release or Refractory Period

Role of Pheromones in Mediating Sexual Behavior



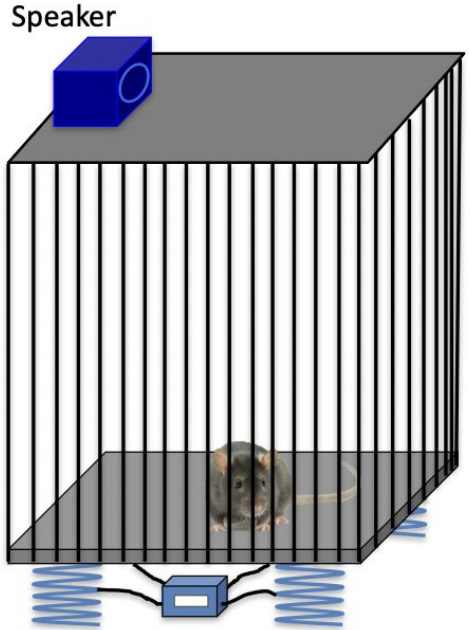
- Pheromones = Hormones released by one individual that affect behavior/physiology of the same species; Found in **sweat** of humans
- In most mammals, detected by Vomeronasal Organ (VNO) – specialized olfactory receptors, respond only to pheromones
- Humans **DO** appear to respond to pheromones (e.g. synchronization of menstrual cycles in females)

Amygdala

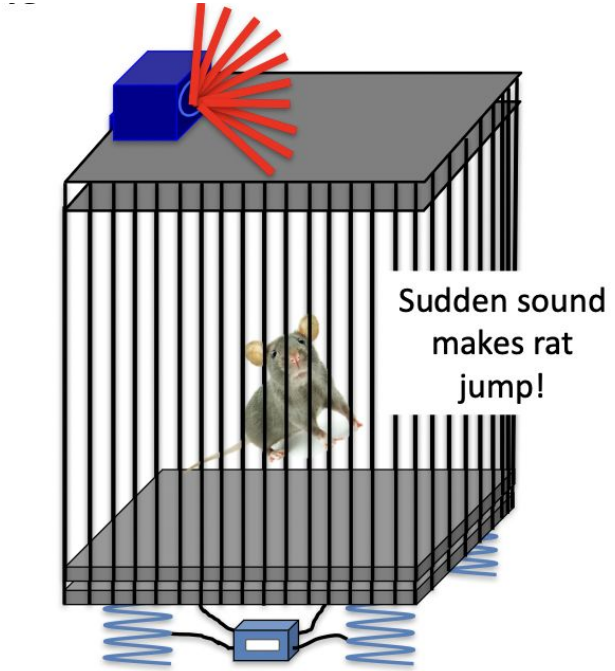


- Has multiple Nuclei with various functions and patterns of connection with other brain areas
- Corticomedial Area -- Primed to **Attack**, prolonged inclination toward **aggression**
- Lateral Nuclei => Startle Reflex, which is influenced by Amygdala connections
- Central & Basolateral Nuclei => Conditioned fear, via integration of sensory info (e.g. vision + pain)

Startle Reflex



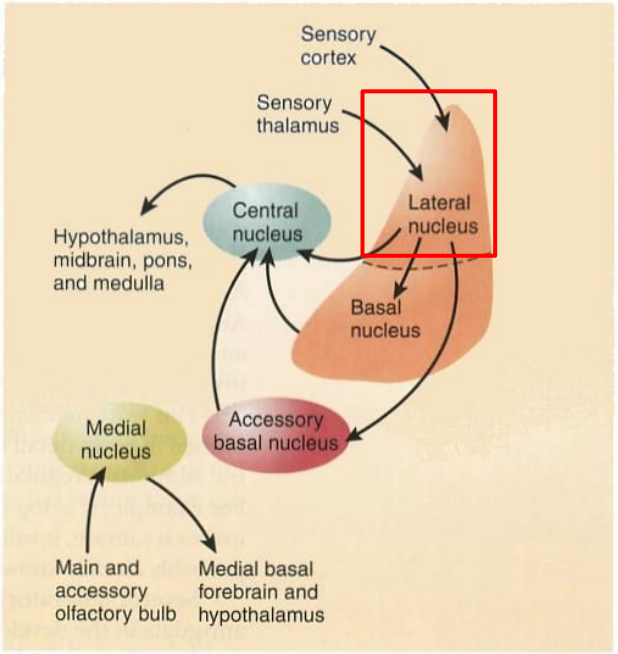
Springs under cage record pressure rat exerts on floor of cage



Impact on springs when rat hits the floor = how high it jumped = measure of **Startle Reflex**

Lateral Nuclei

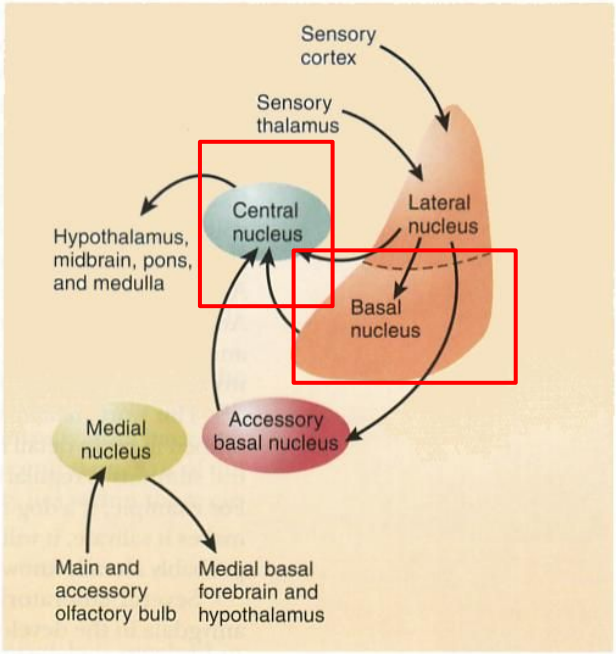
A much-simplified diagram of the major divisions and connections of the amygdala that play a role in emotions.



- Multiple connections
- From Pain fibers, and Visual and Auditory input, to **detect and learn** negative associations
- To Central Gray Area of Midbrain = Part of Tegmentum for motor control, esp of neck muscles
- To Hypothalamus => Influences **Autonomic** NS response (e.g. inc blood pressure, Heart rate, etc)

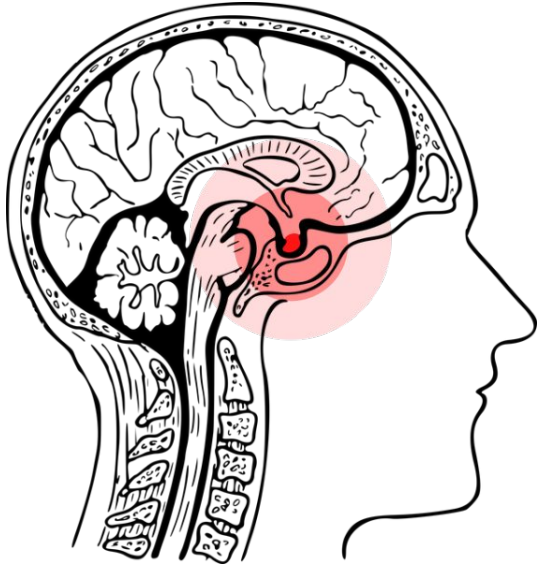
Central & Baso-Lateral Nuclei

A much-simplified diagram of the major divisions and connections of the amygdala that play a role in emotions.



- For "Conditioned Fear"-- Unlearned Startle Reflex becomes **associated** with other stimuli/contexts
- Can be **enhanced/reduced**
- Associated with PTSD -- Post-Traumatic Stress Disorder

Urbach-Wiethe Disease



- Damage in Amygdala
- Impaired ability to recognize **Facial Expression**, especially fear and untrustworthiness
- Patients show a "flattening of affect" (less emotional expression), and problems with Interpreting emotions in others

Thank you!

Questions?

Office Hours: Mon 5-6 pm

To get the section slides: https://github.com/JasonC1217/COGS17-A03-Sp24

OR: