Sereen Draghmeh

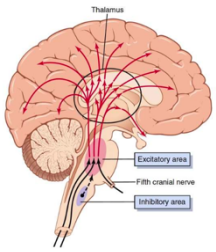
Behavior, motivation and emotions

Activating the brain

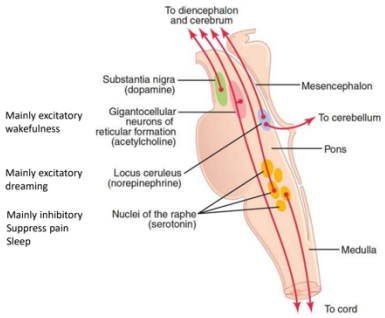
- **Without continuous transmission** of **nerve signals from** the **lower brain into** the **cerebrum**, the **cerebrum becomes useless**.
  - So a **cut between** the **midbrain** and the **cerebrum** this **will result in an irreversible problem**
  - **Signals from** the **brain stem come** from a **specific area**, the **reticular formation** (special structure found all through the brainstem) **and** the **lower part of the spinal corda** and the **lower part of the diencephalon**
    - The **reticular formation there** is **integration between white** and **grey matter** in **which they're not separate** and **plays** an **important role** in the **consciousness of the nervous system**
- **Nerve signals** in the **brain stem activate** the **cerebrum** in **two ways**:
  - (1) by **directly stimulating** a **background level** of **neuronal activity** in **wide areas** of the **brain**.
    - From the **reticular area** more specifically this area is called the excitatory area of the reticular formation
  - (2) by **activating neurohormonal systems** that **release specific facilitory** or **inhibitory hormone-like neurotransmitters into selected areas** of the **brain**.

Reticular formation

- **Exiting** the **excitatory area** are **neurons from** the **magnocellular cells through mostly through the thalamus** to **almost all areas** of the **cerebral cortex** to **wide spread areas** in the **cerebral cortex**
- So **these neurons** are **excitatory so** the **neurotransmitter is acetylcholine**
- But **how does** the **excitatory area get excited** in the **beginning**? There are **sensory signals from** the **periphery which** will **go** to the **excitatory area to simulate it**
- The **pain modality** is the **biggest modality** (most important one) to **excite this area**
  - Which makes sense because you cant sleep when you are pain
- The **sensory modality** that **doesn't reach** the **reticular formation** is the **olfaction**
  - In movies you sometimes see them wake a person up by making them smell something like onions or alcohol, keep in mind that the olfactory system isnt what made the person wake up but because of the intense stimulus stimulating the pain receptors rather than the olfactory



- The **central driving component** is an **excitatory area located** in the **reticular substance** of the **pons** and **mesencephalon**.
- This **area** is **also called** the **bulboreticular facilitory area**.
- **Most** of the **signals go first to** the **thalamus**, **where they excite a different set** of **neurons** that **transmit nerve signals to all regions of** the **cerebral cortex**, **as well as** to **multiple subcortical areas**.
- The **level of activity of** the **reticular excitatory area** in the **brain stem**, and **therefore** the **level of activity of** the **entire brain**, is **determined to a great extent by** the **number and type of sensory signals that enter** the **brain from the periphery**.
- **Pain signals** in **particular increase activity** in **this excitatory area** and **therefore strongly excite the brain** to **attention**.
- **feedback signals also return from** the **cerebral cortex back** to **this same area**.
- **Therefore**, **any time** the **cerebral cortex becomes activated by brain thought processes or by motor processes**, **signals** are **sent from** the **cortex to the brain stem excitatory area**, **which in turn sends still more excitatory signals** to the **cortex**.
- This **process helps** to **maintain** the **level of excitation of** the **cerebral cortex or even** to **enhance it.**



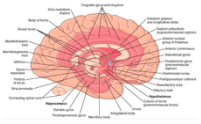
Thalamus

- **almost every area** of the **cerebral cortex connects with its own highly specific area in** the **thalamus**.
- **Therefore**, **electrical stimulation** of a **specific point** in the **thalamus generally activates its own specific small region** of the **cortex**.
- **Furthermore**, **signals regularly reverberate back** and **forth between** the **thalamus and** the **cerebral cortex**
  - So for example someone is studying a physiology lecture, when you are studying you are stimulating certain areas in the cerebral cortex, now this stimulated area will send positive stimulatory feedback to the excitatory area to be more attentive to focus more in the lecture

Reticular formation

- The **reticular inhibitory area** can **inhibit** the **reticular faciliatory area** **of** the **upper brain stem** and **thereby decrease activity** in the **superior portions of the brain**.
- **One** of the **mechanisms for this activity** is to **excite serotonergic neurons**, which **in turn secrete** the **inhibitory serotonin** at **crucial points in the brain**.

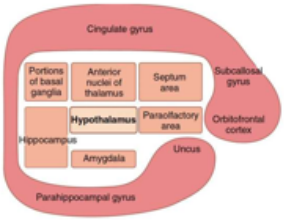
Neurohormonal control of brain activity



- **Often persist for minutes** or **hours** and **thereby provide long periods of control**.
- **These systems** have **different effects** on **levels of excitability** in **different parts** of the **brain**.
- there are **multiple neurohormonal systems** in the **brain**, the **activation of each of which plays** its **own role in controlling a different quality** of **brain function**.

Limbic system

- The **entire neuronal circuitry** that **controls emotional behavior** and **motivational drives**.
  - Structure in the limbic system
    - Amygdala
    - Hippocampus
    - Part of the basal nuclei
    - The anterior nuclei of the thalamus
    - The paraolfactory area
    - The septum area
    - The hypothalamus in the center – MOST IMPORTANTLY
      - Has so many connections with the other part

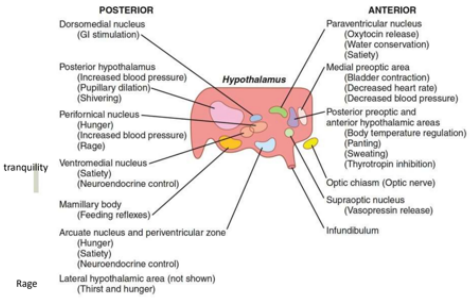


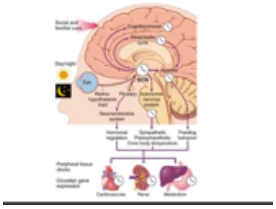
- they are an **interconnected complex** of **basal brain elements**.
- **Located** in the **middle of all these structures** is the **extremely small hypothalamus**.
- the **ring of limbic cortex functions** as a **two-way communication** and **association linkage between** the **neocortex** and the **lower limbic structures**.
- **Many of the behavioral functions elicited from** the **hypothalamus and other limbic structures** are **also mediated through** the **reticular nuclei** in **the brain stem** and **their associated nuclei**.

The Hypothalamus

- It **controls most** of the **vegetative** and **endocrine functions** **of** the **body and many aspects** of **emotional behavior**.
  - It basically has an **autonomic** and **endocrine control (by controlling the pituitary gland)**
- the **hypothalamus sends output signals** in **three directions**:
  - 1. **Reticular areas** in **the brain stem**.
  - 2. **Anterior thalamus** and **limbic portions of the cortex**.
  - 3. **Pituitary glands**.

- There are many nuclei in the hypothalamus and each one has a specific function
  - E.g:
    - The lateral hypothalamic area when stimulated it induces thirt and hunger senstations
      - They also found when they stimulated this area they expected just thirst and hunger sensations but no they also found an effective nature of the sensation(emotional part – due to the limbic system) in which this stimulation resulted in thirst and hunger associated with this rage kind of pattern of response
        - This makes sense cause the hypothalamus is found in the limbic system plus we can see that the people in ramadan when theyre hungry they are a little mad
    - While the ventromedial nucleus stimualtes satiety sensations
      - While the stimulate of this are which causes satiety they also found that it resulted in tranquility
    - The medial preoptic area causes a decrease in blood pressure
    - While the posterior hypothalams can cause an increase in the blood pressure
  - There are so many nuclei for specific functions for the autonomic nervous sytem control





- The **suprachiasmatic nucleus** (SCN) of the **hypothalamus contains** about **20,000 neurons** and is **located above the optic chiasm**.
- **biological clocks** are **found** in **nearly every tissue** and **organ of the body** and **capable** of **maintaining their own circadian rhythms**, **although** their **circadian rhythms** are **usually maintained for only** a **few days** in the **absence of signals from** the **SCN**.
- **Although** the **circadian rhythms of** the **SCN** are **endogenous and self-sustained**, they are **altered by environmental changes such as temperature** and **timing of** the **light-dark cycle**.

Reward or punishment

- **Several limbic structures** are **particularly concerned** with the **affective nature** of **sensory sensations**–that is, **whether the sensations** are **pleasant or unpleasant**.
- These **affective qualities** are **also called reward or punishment**, or **satisfaction** or **aversion**.

Punishment centers

- **Aquiduct** of **Sylvius**.
- **Periventricular area of hypothalamus**.
- **Less potent punishment areas** are **found** in **some locations** in the **amygdala** and **hippocampus**.
- It is **particularly interesting** that **stimulation in the punishment centers** can **frequently inhibit the reward** and **pleasure centers completely**, **demonstrating that punishment** and **fear can take precedence over pleasure and reward**.
    - So basically the punishment centers kind of override the reward centers
- An **emotional pattern** that **involves** the **punishment centers** of the **hypothalamus** and **other limbic structures** and that **has also been well characterized** is **the rage pattern**.
- **Normally**, **the rage phenomenon** is **held in check mainly by inhibitory signals from** the **ventromedial nuclei** of the **hypothalamus.**
- In **addition**, **portions of the hippocampi** and **anterior limbic cortex**, **help suppress the rage phenomenon**.

Reward centers

- **Exactly the opposite emotional behavior patterns occur when the reward centers are stimulated**: **placidity and tameness**.
- **Almost everything** that **we do is related** in **some way to reward and punishment**.
- If we are **doing something that is rewarding**, we **continue to do** it; if it is **punishing**, we **cease to do it**.
- **Therefore**, the **reward and punishment centers undoubtedly constitute one of the most important** of **all the controllers** of **our bodily activities**, **our drives**, **our aversions**, and **our motivations**.

Role of reward and punishment in learning and memory

- **Animal experiments** have **shown that a sensory experience that causes neither reward nor punishment** is **hardly remembered at all**.
- **Electrical recordings from the brain show** that **a newly experienced sensory stimulus almost always excites multiple areas** in the **cerebral cortex**.

Habituation

- **However**, if the **sensory experience does not elicit** a **sense of either reward** or **punishment**, **repetition** of the **stimulus over** and **over leads** to **almost complete extinction** of the **cerebral cortical response**–that is, the **animal becomes habituated** to that **specific sensory stimulus** and **thereafter ignores it**.

Reinforcement

- If the **stimulus does cause reward or punishment** **rather** than **indifference**, the **cerebral cortical response becomes progressively more** and **more intense during repeated stimulation instead** of **fading away**, and **the response is said to be reinforced**.
  - This is **important** for **learning** and **memory**
- An **animal builds up strong memory traces** for **sensations that are either rewarding** or **punishing** but, **conversely**, **develops complete habituation** to **indifferent sensory stimuli**.
- Almost **any type of sensory experience causes activation** of **at least some part** of the **hippocampus**, and the **hippocampus in turn distributes many outgoing signals** to the **anterior thalamus, hypothalamus, and other parts of the limbic system, especially through the fornix, a major communicating pathway.**
- Thus, the **hippocampus** is an **additional channel through which incoming sensory signals** can **initiate behavioral reactions** for **different purposes**.

The Hippocampus

- As in **other limbic structures**, **stimulation** of **different areas** in the **hippocampus** can **cause almost any** of the **different behavioral patterns** **such as pleasure**, **rage**, **passivity**, or **excess sex drive**.
- **Another feature** of the **hippocampus** is **that it can become hyperexcitable**.
- For **example**, **weak electrical stimuli** can **cause focal epileptic seizures** in **small areas** of the **hippocampi**.
- These **seizures often persist** for **many seconds after** the **stimulation is over**.
- **During hippocampal** seizures, the **person experiences various psychomotor effects**, **including olfactory**, **visual**, **auditory**, **tactile**, and **other types of hallucinations** that **cannot be suppressed** as **long as the seizure persists**.

The Hippocampus and memory

- **Subjects** with **lesion** in the **hippocampus are capable** of **short-term memory** for **seconds up to a minute or two**, **although** their **ability** to **establish memories lasting longer** than a **few minutes** is **either completely** or **almost completely abolished**.
- This **phenomenon**, **called anterograde amnesia**.
- **Memory consolidation**.
  - When the **short term memory** is **converted** into the **long term memory**

Amygdala

- **Olfaction**
- The **amygdala receives neuronal signals from all portions** of the **limbic cortex**, **as well** as **from the neocortex** of the **temporal**, **parietal**, and **occipital lobes**–**especially from** the **auditory** and **visual association areas**.
- **Because** of **these multiple connections**, the **amygdala** has been **called** the "**window**" **through which** the limbic system sees the **place of the person** in the **world**.
- In **turn**, the **amygdala transmits signals** (1) **back into these same cortical areas**, (2) **into the hippocampus**, (3) **into** the **septum**, (4) **into** the **thalamus**, and (5) **especially into** the **hypothalamus**
- **In general**, **stimulation in the amygdala can cause almost all the same effects as** those **elicited by direct stimulation of the hypothalamus**, **plus other effects**.
- **can also cause**:
  - **Several types** of **involuntary movement**.
  - **Sexual activities**.
  - **Stimulation** of **certain amygdaloid nuclei** can also **cause a pattern of rage** and **punishment**.
  - **Stimulation** of **other amygdaloid nuclei** can **give reactions** of **reward** and **pleasure**.
  - the **amygdala is believed** to **make** the **person's behavioral response appropriate** for **each occasion**.

The limbic cortex

- the **limbic cortex** in **effect functions** as a **cerebral association area** for **control of behavior**.
- **many behavioral patterns** can be **elicited** by **stimulation of specific portions** of the **limbic cortex.**