EXAM PAPERS PRACTICE

BIOPSYCHOLOGY

Revision Notes

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Specification

BIOPSYCHOLOGY

- The divisions of the nervous system: central and peripheral (somatic and autonomic).
- The structure and function of sensory, relay and motor neurons. The process of synaptic transmission, including reference to neurotransmitters, excitation and inhibition.
- The function of the endocrine system: glands and hormones.
- The fight or flight response including the role of adrenaline.
- Localisation of function in the brain and hemispheric lateralisation: motor, somatosensory, visual, auditory and language centres; Broca's and Wernicke's areas, split brain research. Plasticity and functional recovery of the brain after trauma.
- Ways of studying the brain: scanning techniques, including functional magnetic resonance imaging (fMRI); electroencephalogram (EEGs) and event-related potentials (ERPs); post-mortem examinations.
- Biological rhythms: circadian, infradian and ultradian and the difference between these rhythms. The effect of endogenous pacemakers and exogenous zeitgebers on the sleep/wake cycle.

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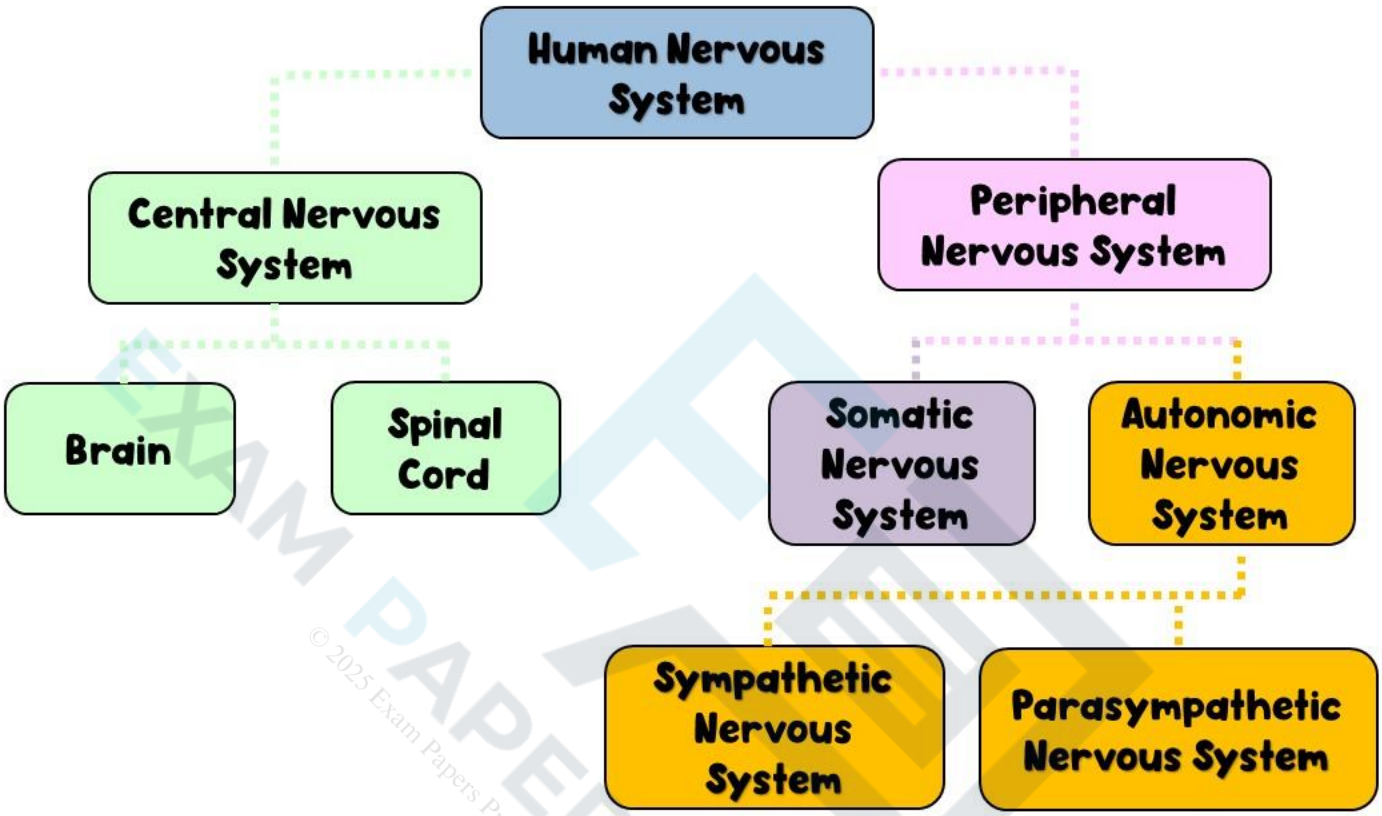
Nervous System



Parts of the Nervous System

The Brain	Made up of two hemispheres and the outer layer is called the cerebral cortex.
The Spinal Cord	Passes messages to/from the brain and the PNS. Also responsible for reflexes.
Somatic NS	Transmits information from the senses to the CNS and also directs muscles to act.
Autonomic NS	Transmits automatic signals i.e. breathing.
Sympathetic NS	Involved in preparation for 'fight or flight' response.
Parasympathetic NS	Returns body to resting state, also involved in 'fight or flight' response.

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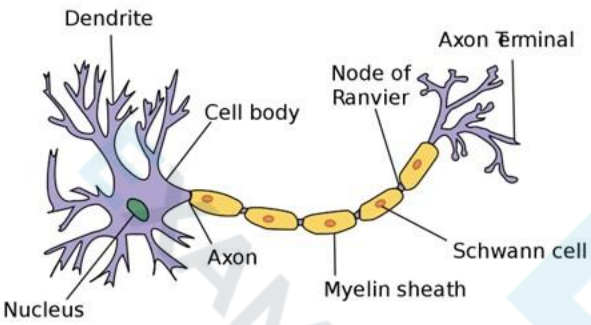
Neurons



Structure of Neurons

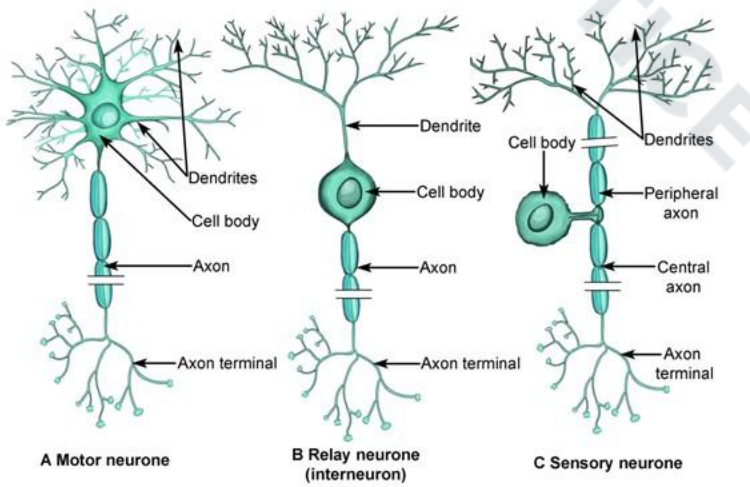
The **cell body** contains the **nucleus** (chromosomes), from the cell body . The **dendrites** extend from the cell body and carry electrical impulses from other neurons towards the cell body. The **axon** carries the impulses away from the cell body and is covered by a fatty layer of **myelin sheath** which increases the speed of transmission. There are breaks in the myelin sheath called **Nodes of Ranvier**, which force impulses to jump across the gaps and speed up the transmission.

Types of Neuron

Motor: Carry signals from the central nervous system to the effectors (muscles/glands). Short dendrites and long axons.

Relay: Connect sensory neurons to motor neurons or other relay neurons. Short dendrites and short axons.

Sensory: Carry signals from receptors to the central nervous system. Long dendrites and short axons



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Neurons

Synaptic Transmission

Neurons do not make direct contact. There is a very small gap between neurons called a **synapse**. The signal needs to cross this gap to continue on its journey to, or from, the CNS. This is done using **chemicals** which diffuse across the gap between the two neurons. These chemicals are called **neurotransmitters**.

1. An electrical impulse called an **action potential** travels along the axon of the transmitting neuron to the dendrites.
2. This triggers the nerve-ending of the **pre-synaptic** neuron to release neurotransmitters from **synaptic vesicles**.
3. These chemicals diffuse across the synapse and bind with **receptor sites** on the membrane of the **post-synaptic** neuron.
4. This stimulates the post-synaptic neuron to transmit the electrical impulse.
5. **Reuptake**: some of the neurotransmitter is reabsorbed back into the pre-synaptic neuron or is broken down by enzymes.

Summation

- Neurotransmitters can be either **excitatory** or **inhibitory**
- Excitatory potentials increases a neuron's **positive charge** and make it more likely for a neuron to fire
- Inhibitory potentials increases a neuron's **negative charge** and make it less likely to fire
- The **summation** of these determines whether the neuron has a net effect that is excitatory or inhibitory and will therefore trigger the **action potential** when it reaches the **threshold**.

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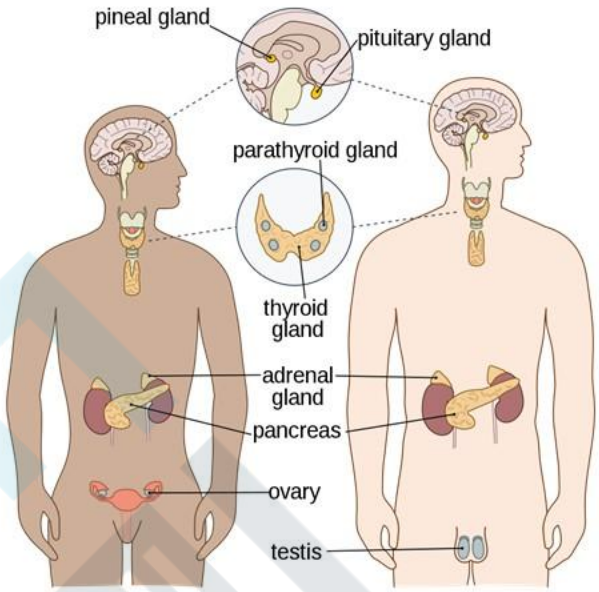
Endocrine System

Glands and Hormones

The endocrine system consists of glands which produce hormones which are released in the blood stream to control vital functions of the body.

The pituitary gland controls the release of hormones from all the other endocrine glands. Hormones work more slowly than nerve impulses but usually work together with the nervous system.



Functions of Glands and Hormones

Pituitary Gland	Master gland that controls other glands as well, as releasing ACTH during the stress response and oxytocin during childbirth.
Hypothalamus	Stimulates and activates the pituitary gland.
Pineal Gland	Releases melatonin to control biorhythms such as the sleep-wake cycle.
Thyroid Gland	Releases thyroxine to control metabolism.
Adrenal Gland	Adrenal medulla releases adrenaline/noradrenaline in fight or flight. Adrenal Cortex releases cortisol in chronic stress response.
Ovaries	Regulates the menstrual cycle and pregnancy by releasing oestrogen.
Testes	Produce testosterone for male sex characteristics and muscle growth.

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Fight or Flight

The endocrine system and autonomic nervous system work alongside each other during the fight or flight response.

A stressor is perceived in the environment

↓

The amygdala sends a stress signal to the hypothalamus

↓

The hypothalamus activates the pituitary gland which triggers the sympathetic nervous system (SNS)

↓

The SNS the activates the adrenal medulla

↓

The adrenal medulla releases adrenaline/noradrenaline

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The release of adrenaline/noradrenaline prepares the body for fight or flight

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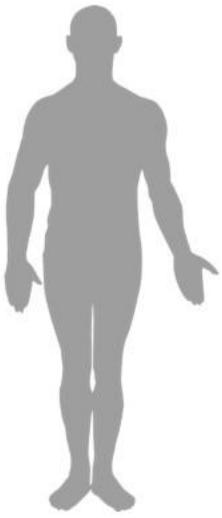
After a few minutes the parasympathetic branch activates bringing the body back to normal

Role of Adrenaline



- Increases heart rate
- Increases breathing rate
- Dilates pupils
- Inhibits digestion
- Inhibits saliva production
- Increased sweat

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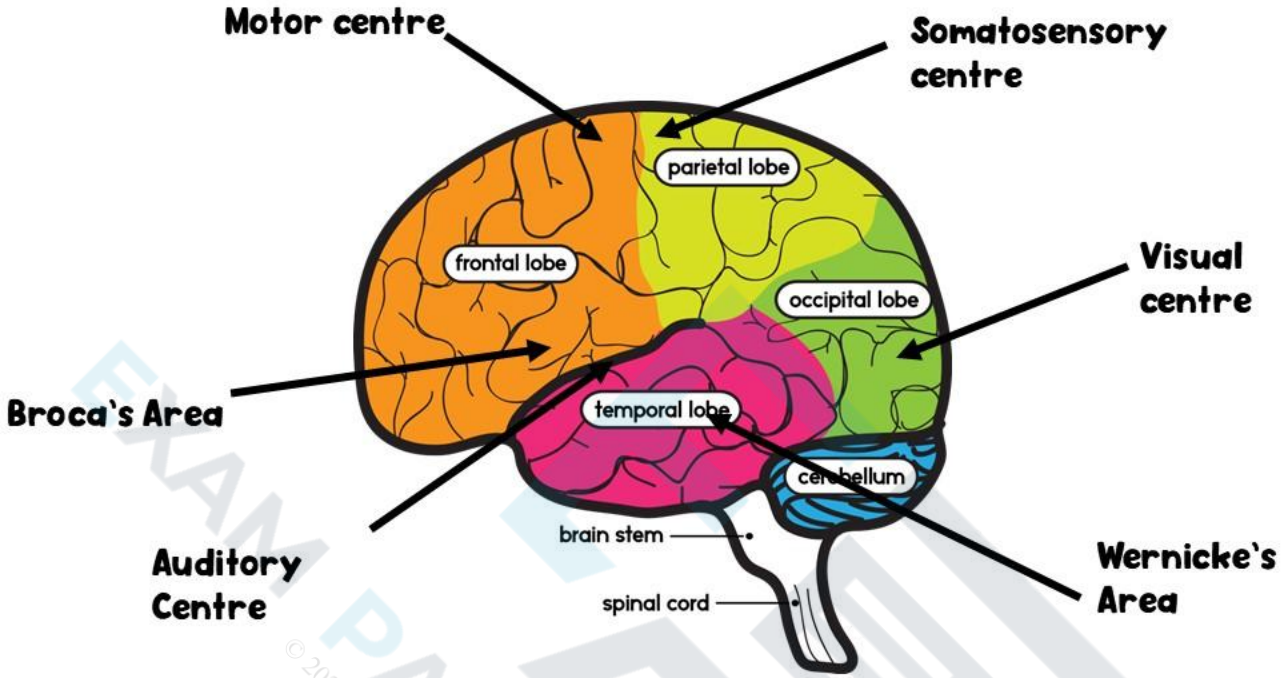
Localisation of Function



Functions of Different Areas

Motor Centre	Controls voluntary movement in the opposite side of the body (left hemisphere controls right side of body etc.).
Somatosensory Centre	Sensory information from the skin is processed here.
Visual Centre	Receives visual information from each eye. The left visual field will be processed in the right hemisphere and vice versa.
Auditory Centre	Processes speech based information.
Broca's Area	Mostly found in the left hemisphere and is responsible for speech production. If this area is damaged it, patients will struggle to speak fluently. This is known as Broca's aphasia.
Wernicke's Area	Also found in the left hemisphere in most people. Damage to this area will result in Wernicke's aphasia and patients will be able to speak but their words will lack meaning.

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Evaluation of Localisation of Function

Brain Scans

Petersen et al. (1988) used brain scans to show how Wernicke's area was active during a listening task and Broca's during a reading task. This shows that these areas of the brain have different functions.

Broca

Two of Broca's patients had their brains preserved. This has allowed for MRI scanning. The findings revealed that other areas of the brain could have also contributed to the patients' reduced speech abilities. (Dronkers et al (2007)

Holistic?

Not all researchers agree that cognitive functions are localised in the brain. For example, fMRI scans show that language function may be distributed across the cortex rather than just Broca's and Wernicke's areas.

Evidence Against

Lashley (1950) found that by removing different areas of the cortex in rats learning a route through a maze that there was no difference in their ability to learn after surgery. It suggests processes, such as learning, are not localised but processed more holistically.

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Hemispheric Lateralisation

Left and Right Hemispheres

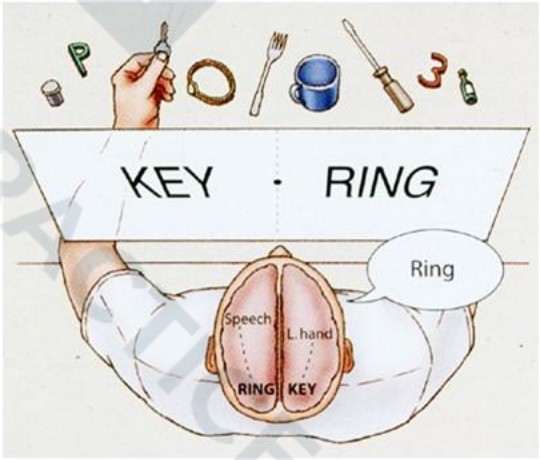
Language is **lateralised** as the Broca's and Wernicke's areas are predominantly found in the left hemisphere. Many other functions are not lateralised as they found across both hemispheres e.g. the motor centre.

The brain is **cross-wired** in that the left hemisphere controls the right side of the body and the right hemisphere controls the left side of the body e.g. visual processing or movement.

Split Brain Research

Sperry's Research

- 11 participants who had an operation to cut their corpus callosum, due to epilepsy, were studied alongside a control group of non epileptics.
- Using a split visual field, images were presented to either the left visual field or right.
- If it was shown to the right visual field then participants could describe what they saw but not if it was shown to the left visual field.
- This is because the messages from the right hemisphere could not process language or communicate with the left hemisphere, where language can be processed.
- However, if they were asked to select a matching object with their left hand they could, even if they could not describe it.



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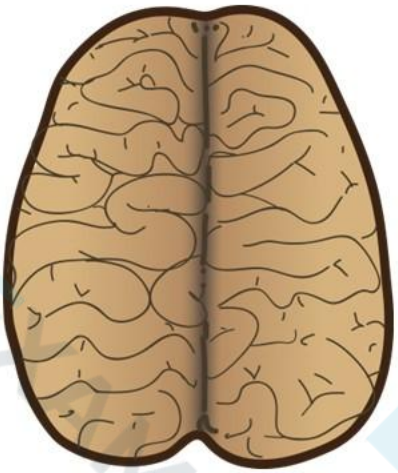
Evaluation of Lateralisation of Function



Individual Differences

Some of the brains of the participants were more 'disconnected' than others and some had been on drug therapy longer than others.

Oversimplified

Split brain research has caused oversimplification of the functional differences between hemispheres. Plasticity shows us that the other hemisphere can perform the same function when required to do so i.e. functional recovery.

Validity

The set up of the study was artificial and lacked ecological validity. This is because in real life, using both eyes would compensate for a severed corpus callosum and so these studies do not represent how the brain would work in reality.

Generalisability

The control groups did not have a history of epilepsy and so it was not a valid comparison. The split brain patients also have very different brains to people without epilepsy and so the results are not generalisable to a wider population.

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Plasticity

What is Plasticity?

This describes the brains tendency to change and adapt (functionally and physically) as a result of experience and new learning. Between 2 and 3 years old we have twice as many neural connections as we do as an adult. **Synaptic pruning** strengthens connections we use and deletes those that we don't. Our brains are plastic throughout our lives.

Maguire et al. (2000)

- Used London taxi drivers as participants who had taken the 'The Knowledge' test.
- Used MRI scans and found that there was increased grey matter in the posterior hippocampus in comparison to a control group.
- This area is associated with spatial and navigational skills.
- The longer they had been on the job the more grey matter they had (positive correlation).
- Suggests that the brain had changed as a result of the learning taking place.

Evaluation

Supporting Research

Draganski et al. (2006) examined brains of medical students three months before and after final exams. There were changes in the posterior hippocampus and parietal cortex.

Good Design

The use of a control group allows us to say that there is a significant difference between taxi drivers and other non-taxi drivers.

Meditation

Tang et al. (2012(found that 4 weeks of meditation increases white matter in the anterior cingulate cortex. Which is responsible for self control and regulation.

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Functional Recovery

What is Functional Recovery?

After an injury or trauma the brain can use unaffected areas to compensate and adapt for the damaged areas. Functional recovery is therefore a form of plasticity. Initially, this happens quickly but will then slow down over several weeks/months, after which therapy is useful. Recovery is more likely the younger you are.

How Does it Recover?

- **Axon sprouting:** new nerve endings grow and connect with undamaged areas to create new pathways.
- **Recruitment of homologous (similar) areas:** The same areas on the opposite side of the brain (hemisphere) take over e.g. Broca's area.
- **Reformation of blood vessels**
- **Neuronal unmasking:** Dormant synapses open connections near damaged areas.

Evaluation

Supporting Research

Taijiri et al. (2013) found that if rats had their brains injected with stem cells at the site of trauma then new neuron-like cells migrated to the injury site.

Real World Application

This has led to the development of neurorehabilitation which uses movement therapy with stroke patients.

Age

Ebert et al. found that neural regeneration is less effective in older brains. Therefore, individual differences need to be considered when assessing recovery.

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Ways of Studying the Brain

	What is it?	Evaluation
Post-Mortem Examinations	When the person dies, the researchers can examine their brain to look for abnormalities that might explain any unusual behaviour they displayed in their lifetime.	+ Useful before technology was developed. E.g Broca and Wernicke. - Cause and effect is a problem, the differences observed can be unrelated to the behaviour. - Informed consent: some patients lose the ability to consent during their life time and is needed from relatives (and needed quickly).
Functional magnetic resonance imaging (fMRI)	Functional magnetic resonance imaging measures changes in blood flow in the brain which indicates increased activity. Produces 3D images to show which parts of the brain are active during tasks.	+ It's risk free and non-invasive. + It produces high resolution images that are accurate to the millimetre . - It has a poor temporal resolution as there is a 5 second time delay between the neuron firing and it being detected.
Electroencephalogram (EEG)	Measures electrical activity in the brain. Electrodes placed on the scalp detect small electrical charges resulting from the activity of brain cells. Useful in detecting disorders such as epilepsy.	+ High temporal resolution (as can detect activity in under one millisecond). - It cannot pinpoint exact sources of activity as it only detects many neurons firing at once.
Event Related Potentials (ERP)	Uses the original EEG data and uses a statistical averaging technique to isolate specific neural responses.	+ High temporal resolution and more specific than EEG. - There is a lack of standardisation of procedures amongst researchers. - To be successful all extraneous interference needs to be eliminated and this is hard to achieve.

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Biorhythms

Different Types of Biorhythm

Circadian Rhythm	Subject to a 24 hour cycle (once a day)
Infradian Rhythm	Less than one cycle in 24 hours (longer than a day)
Ultradian Rhythm	More than one cycle in 24 hours (happens more than once within a day)

Circadian Rhythms

Sleep-Wake Cycle

Daylight (exogenous zeitgeber) alters the feeling of alertness during the day and drowsiness at night. Our internal biological clock (suprachiasmatic nucleus – SCN) also governs this cycle as light can reset it.

Core Body Temperature

Our CBT is lowest in the morning around 4am at 36 degrees. It is highest around 6pm at 38 degrees. The warmer we are the better our cognitive abilities.

Evaluation

Siffre's Cave Study

Spent time living in a cave with no natural light and found his biorhythm settled around 25 hours.

Shift Work

Research has shown disruption to circadian rhythms due to shift work can cause poor health and so has implications for productivity.

Real World Application

By understanding circadian rhythms and their impact on health, it can help determine the best time to administer drug treatments.

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Biorhythms

Infradian Rhythms

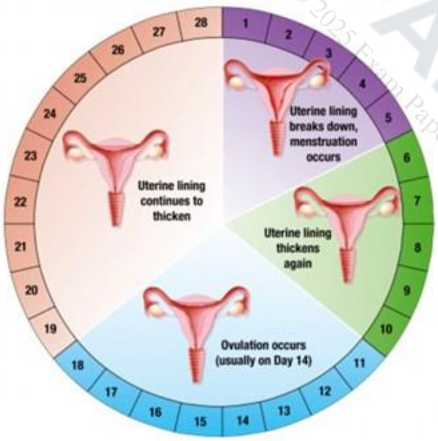
Menstrual Cycle

The menstrual cycle is governed by hormones roughly on a 28 day basis. Oestrogen levels rise to release an egg from the ovary and progesterone helps the womb lining to grow. If there is no pregnancy then the womb lining sheds.

Seasonal Affective Disorder

A type of depressive disorder which is seasonal. When there are reduced daylight hours in the winter it can trigger a low mood in sufferers. It is called a circannual rhythm. The lack of light causes increased melatonin levels which creates the low mood.

Evaluation



Mate Preference

Research suggests women prefer feminised faces of men in their least fertile stage and more masculine faces in their most fertile stage (Penton-Volk et al. 1999).

Real World Application

A lightbox can be used to reset melatonin levels and relieve symptoms in up to 80% of SAD patients (Sanassi, 2014).

External Factors

Stern & McClintock (1998) found that women could synchronise their periods by being exposed to other womens' pheromones. This suggests we should take into account external factors in infradian rhythms.

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Biorhythms

Ultradian Rhythms

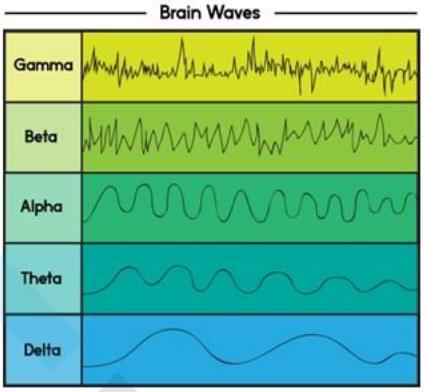
Sleep Cycle

There are 5 stages of sleep which can be identified using an EEG, showing the electrical activity of the brain.

Stages 1 and 2: Light sleep where you can be easily woken. In stage 1 alpha waves are produced and in stage 2 **alpha waves** continue but with sleep spindles (occasional random changes)

Stages 3 and 4: Deep sleep or slow wave sleep. The brain produces slower **delta waves** which have a lower frequency and higher amplitude. It is more difficult to wake someone up in these stages.

Stage 5: Rapid Eye Movement (REM) sleep. The body is paralysed and the activity of the brain resembles someone who is awake. It produces **theta waves** and the eyes sometimes move around. This is when dreams are most likely to occur.



Evaluation

Controlled Methods

Using EEGs to record sleep brain wave activity is very controlled although can be invasive and disturb the sleep of those taking part. This could lack ecological validity.

Improved Understanding

Researchers now understand that older people have less slow wave sleep and can recommend medications and relaxation techniques.

Individual Differences

Tucker et al. (2014) has found large differences between the durations of each stage for different people.

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Endogenous Pacemakers & Exogenous Zeitgebers

Effect of Endogenous Pacemaker on the Sleep-Wake Cycle

Endogenous pacemakers are sometimes referred to as internal biological 'clocks'. The suprachiasmatic nucleus (SCN) is a collection of nerve cells behind the hypothalamus in each hemisphere. The nerve fibres (from the eye) cross the optic chiasm to the visual area of cerebral cortex with the SCN lying just above. It receives information from here about light. It maintains the sleep-wake cycle by passing information to the pineal gland about light levels. When it is dark the pineal gland increases the production of melatonin, which induces sleep.

Evaluation

Reductionist

Peripheral oscillators found in other organs have their own circadian rhythms, suggesting the influence on the sleep-wake cycle is more complex than previously thought.

Research Support

Morgan (1955) bred hamsters with circadian rhythms of 20 hours rathe and then transplanted their SCN neurons into the brains of normal hamsters, which subsequently displayed the same rhythm.

Chipmunks

DeCoursey et al. (2000) destroyed the SCN connections in 30 chipmunks and returned them to the wild. Many of them were killed by predators not long after, as they had left their nests at the wrong time of day.

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Endogenous Pacemakers & Exogenous Zeitgebers

Effect of Exogenous Zeitgebers on the Sleep-Wake Cycle

There are two external factors, known as exogenous zeitgebers, that help regulate the sleep-wake cycle. These are **light** and social cues. Light can be detected by the eyes but also by the skin. This influences hormone secretion and blood circulation. **Social cues** such as mealtimes and bedtimes train babies' circadian rhythms to match 24 hours.

Evaluation

Real World Application

Knowledge of exogenous zeitgebers can help decrease the impact jetlag has on our sleep wake cycles by providing light and meals at certain times on a plane to match the destination's time zone.

Endogenous Pacemakers

People who live in the Arctic circle experience around 6 months of total darkness per year. But yet their sleep patterns do not vary. This suggest endogenous pacemakers may be more important.

Siffre

Siffre believed the date to be a month earlier than it was when he emerged. This suggests that his cycle increased without external cues.