Y11 HT2 Brain & Neuropsychology Knowledge Organiser

Key terms

Key Term	Definition
ANS	Autonomic nervous system – it is 'automatic' as the system operates involuntarily. It has 2 main divisions: the sympathetic and the parasympathetic nervous system.
CNS	Is made up of the brain and spinal cord. Where all complex commands and decisions are made.
Nervous system	Consists of the central nervous system and the peripheral nervous system.
PNS	Peripheral nervous system transmits info about voluntary activity, communicating between the CNS and the rest of the body. Coordinates some reflex responses.
SNS	Somatic nervous system – transmits info from sense organs to the CNS. Receives info from the CNS that directs muscles to act.
Fight or flight response	Is the immediate physiological response of an animal when confronted with a threatening or stressful situation. The sympathetic division of the ANS causes the release of adrenaline. This makes the body physiologically aroused and prepares the body to be able to fight the threat or run from it.
The James-Lange theory	Is a theory of emotion which suggests that our experiences of physiological changes comes first, which the brain then interprets as an emotion.
Emotion	A strong feeling or mood that has important motivational properties, it drives an individual to behave in a particular way.
Excitatory	Some neurotransmitters such as adrenaline (also a hormone) generally increase the positive charge of the next neuron, making it more likely to fire.
Inhibitory	Some neurotransmitters, such as serotonin, generally increase the negative charge of the next neuron, making it less likely to fire.
Neurons	Are cells that communicate messages through electrical and chemical signals throughout the nervous system. 3 different types: sensory, relay and motor.
Neurotransmitter	Is a chemical that is released from the synaptic vesicles. These send signals across the synaptic cleft from one neuron to another. Neurotransmitters can cause excitation or inhibition of the net neuron in the chain.
Synaptic transmission	Is the process by which neighbouring neurons communicate with each other. Neurons send chemical messages across the gap (the synaptic cleft) and separates them.
Hebb's theory of learning & neuronal growth	An early theory of 'plasticity' in the brain which suggests that learning causes synaptic connections between groups of neurons to become stronger. The groups of neurons are called cell assemblies, and the neuronal growth that occurs between these will create more efficient learning in the brain.
Cerebellum	The 'little brain' at the base of the brain above the spinal cord that coordinates movement with sensory input (sensorimotor) and also has a role in cognition.
Cerebral cortex	The very thin layer of brain tissue that gives the brain its pinky-grey appearance. Highly folded and complex in humans, which is what separates our brain from that of animals. It is the main centre of the brains conscious awareness.
Localisation	Refers to the theory that different brain areas are responsible for specific functions and behaviours.
Interpretive cortex	Is an area of the temporal lobe of the brain where interpretations of memories are stored, i.e. the emotional component of the memory.
Cognitive neuroscience	How mental processes (such as perception, learning and memory) and brain activity/biological structures of the brain are connected/influence one another.
Neurological damage	Any event, such as illness or injury which can result in neuron damage in the brain may lead to a loss of function or change in behaviour.
CT scan	A computerised tomography scan uses X-rays and a computer to create detailed images of the inside of the body, including the brain. The result is cross-sectional photographs.
Fmri	A functional magnetic resonance imaging scan uses radio waves to measure blood oxygen levels in the brain. Those areas of the brain that are most active will use most oxygen and 3D images of this activity are shown on a computer screen
PET Scan	Positron emission tomography scan is a scan that allows live brain activity to be observed. An injection of the radioactive substance is given to the patient. Those areas of the brain that absorb most glucose are usually represented in red on a computer screen.
Episodic memory	Describes memory for personal events. Includes memories of when the events occurred and of the people, feelings and sequence of what happened.
Semantic memory	Store for our knowledge of the world. Includes facts and our knowledge of what words and concepts mean.

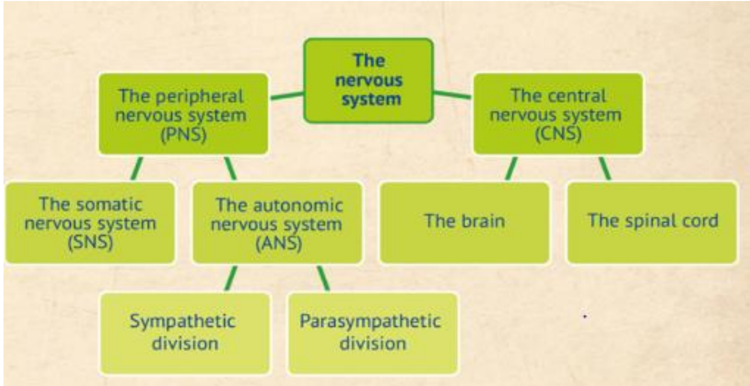
Structure & function of the nervous system

Structure of the NS

The nervous system has 2 jobs:

1. Collect and respond to information in environment
2. Control working of different organs and cells in body, inc. brain.

Subdivisions:



Functions of the NS

CNS – brain & spinal cord. Brain divided into 2 hemispheres; left & right. Right controls left. Left controls right. Centre of conscious awareness, decision making takes place here. Brain stem at the base of the brain: controls many basic functions e.g. sleep & reflexes. Brain stem connects brain to spinal cord. Spinal cord carries messages between brain and rest of body.

PNS – means on the 'outside'. PNS supports actions of CNS. Done through millions of nerve cells called neurons. PNS divided into ANS & SNS.

ANS – is automatic as it acts involuntary. Coordinates vital functions such as breathing, heart rate and digestion. Involved in body's response to stress. Has 2 parts: SYMPATHETIC & PARASYMPATHETIC.

SNS – controls voluntary movements of muscles. Only exception are reflexes that are not under voluntary control. Takes in info from sensory organs.

ANS

ANS control homeostasis: maintains a balanced internal state e.g. body temperature at 37'.

No conscious control because functions are vital to life e.g. heartbeat.

Sympathetic NS – physiological arousal, triggered when stressed and leads to fight or flight.

Parasympathetic NS – opposite to sympathetic; rest and digest.

Flight or fight

Brain detects threat – hypothalamus identifies a threat (stressor). Sympathetic NS kicks in – fight or flight.

Release of adrenaline: ANS changes from parasympathetic to sympathetic. Adrenaline released into bloodstream.

Fight or flight – Immediate & automatic. Physiological changes due to adrenaline release, e.g increase in HR. Body gets ready to confront (fight) or run (flight.

Once threat has passed – parasympathetic kicks in.

James-Lange Theory of Emotion

Physiological arousal first

Hypothalamus arouses sympathetic NS. Adrenaline released leading to physiological arousal (fight or flight).

Emotion afterwards

Brain interprets physiological arousal. Causes emotion. E.g. fear.

E.G.

Meet bear in forest. Sympathetic arousal: muscles tense, HR increases. Interpret as fear.

No physical changes = no emotion

Speaking in front of class, no increase in HR means you don't experience any sense of fear.

Evaluation:

1. Emotions do come after arousal; e.g. with phobias.
2. Challenged by Cannon-Bard theory – Some emotions occur at the same time as physiological arousal.
3. Extra: James-Lange theory may be too simple. Challenged by 2 factor theory, we need social cues to label emotion (Schachter & Singer).

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Neuron structure & function

Neuron and electrical transmission

Types of neuron:

1. **SENSORY –** From PNS to CNS. Long dendrite, short axon.
2. **RELAY –** connect sensory to motor. Short dendrite, short axon.
3. **MOTOR –** From CNS to muscles/glands. Short dendrite, long axon.

Structure of neurons

Cell body: Nucleus containing DNA.

Axon – Carries signals, covered in myelin sheath which helps and protects.

Myelin sheath – fatty covering of axon with gaps (nodes of Ranvier), insulation and speeds signal.

Terminal buttons – end of axon, part of synapse.

Electrical transmission: how neurons fire.

Resting state: negative charge.

When firing, the charge inside the cell changes which increase its action potential.

Synapses and chemical transmission

The synapse

Where neurons communicate with each other; terminal button at presynaptic neuron + synaptic cleft + receptor sites on postsynaptic neuron.

Release of neurotransmitters

Electrical signal causes vesicles (in presynaptic terminal button) to release neurotransmitter into synaptic cleft.

Reuptake of neurotransmitter

Neurotransmitter in synaptic cleft attaches to postsynaptic receptor sites. Chemical message turns into electrical message. Remaining neurotransmitter is reabsorbed.

Excitation and inhibition

Excitatory neurotransmitter increases postsynaptic neuron's charge, more likely to fire. Inhibitory neurotransmitter increases negative charge, less likely to fire.

Summation

More excitatory then inhibitory signals means that neuron fires, creating an electrical impulse.

Hebb's theory

The brain is plastic

Synaptic connections become stronger the more they are used. Brain can change and develop.

The brain adapts

Brain changes in response to new experiences, at any age.

Learning produces an engram

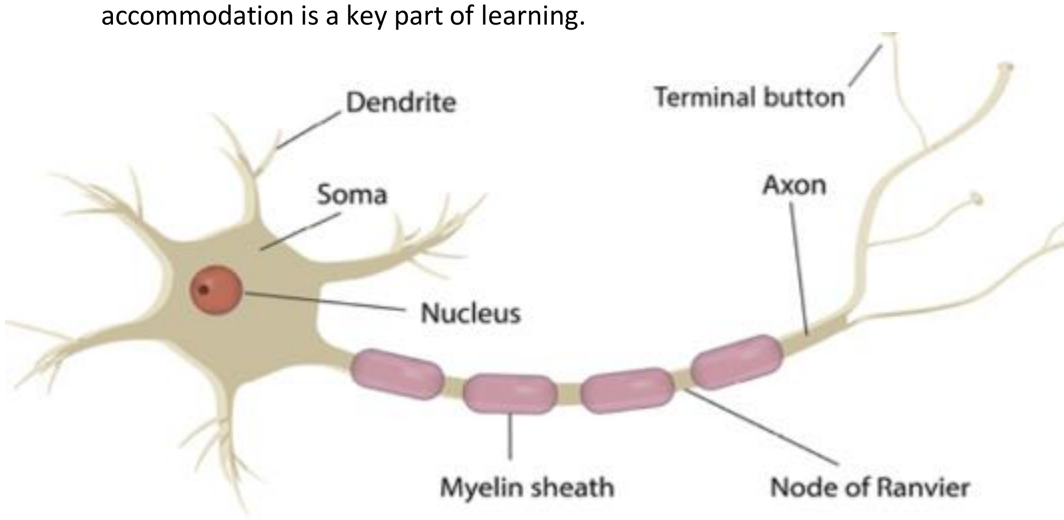
Learning leaves a trace called an engram. This can be permanent if we rehearse learning.

Cell assemblies and neuronal growth

Groups of neurons that fire together. Neuronal growth occurs as cell assemblies rewire.

Evaluation

1. **Hebb's theory is scientific**
   Objective basis gives theory validity and credibility.
2. **Real-world application**
   Stimulating school environment can increase neuronal growth.
3. **Extra – reductionist theory.**
   Reduces learning to neuronal level. Ignores higher levels, e.g. Piaget's idea that accommodation is a key part of learning.



Structure & function in the brain

Structure & function of the brain

2 hemispheres, 4 lobes:

Top layer of brain is the cerebral cortex, divided into 4 lobes:

1. **Frontal lobe**: contains motor area at the front of the brain. Controls thinking, planning and motor area controls movement.
2. **Parietal lobe**: contains somatosensory area. Behind frontal lobe. Is where sensations are processed.
3. **Occipital lobe**: contains visual area. At back of brain, controls vision.
4. **Temporal lobe**: contains auditory/language area. Behind frontal lobe and below parietal lobe. Auditory (sound) area, related to speech and learning.

Cerebellum: receives information from spinal cord and the brain. Coordinates movement and balance; attention and language too.

Localisation of function in the brain

Specific brain areas do specific jobs.

Motor area: Damage to the left hemisphere affects the right side of the body and vice versa.

Somatosensory area: most sensitive body parts take up most 'space'. Damage means less ability to feel pain.

Visual area: Damage to left hemisphere affects right visual field of each eye and vice versa.

Auditory area: damage can lead to deafness.

Language area: usually in left hemisphere only. Broca's area: damage leads to difficulty remembering and forming words. Wernicke's area: damage leads to difficulty understanding and producing meaningful speech.

Penfield's study of the interpretive cortex (Key Study)

AIM

To investigate the function of the temporal lobe using the Montreal procedure.

METHOD

Operated on patients with severe epilepsy. Could stimulate areas of the brain in a conscious patient who reported the experience.

RESULTS

Temporal lobe stimulation; experiences and feelings (hallucinations)associated with those experiences including déjà vu.

CONCLUSION

Area of brain called interpretive cortex stores the personal meaning of previous events.

EVALUATION

1. Precise method: he could stimulate the exact same area of the brain and have verbal reports from awake patients.
2. Unusual sample: All p'ts had severe epilepsy so their behaviour may not reflect people with 'normal' brains.
3. Extra – mixed results in later research: the interpretative cortex may not always respond as Penfield had concluded.

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An introduction to neuropsychology

Cognitive neuroscience
Aims to create a detailed map of localised functions in the brain.

Structure & function of the brain relates to behaviour
Frontal lobe and motor area: movement. Temporal lobe and amygdala: processes emotion and aggression.

Structure & function of the brain relates to cognition
Different types of memory are in different areas of the brain.

Cognitive neuroscience and mental illness
Low serotonin affects thinking (e.g. suicidal thoughts) and behaviour (low mood, depression).

Neurological damage
The importance of localisation: damage to specific areas of the brain affect certain areas/behaviours.

The effects of stroke
When brain is deprived of oxygen areas of the brain die leading to effects on behaviour, unless other areas take over localised functions.

Effects of neurological damage on motor ability
Damage to motor area can lead to problems with fine and complex movement. Damage to the left hemisphere affects the right side of the body and vice versa.

Effects of neurological damage on behaviour
Broca's aphasia; problems producing speech. Wernicke's aphasia; problems understanding speech.

Tulving's gold memory study (Key Study)

AIM
To investigate if episodic memories produce different blood flow patterns to semantic ones.

METHOD
6 p'ts injected with radioactive gold. Repeated measures used with 4 episodic and 4 semantic memory trails. Monitored blood flow using PET scan.

RESULTS
Different blood flow in 3/6 pt's. Semantic memories in posterior cortex. Episodic memories in frontal cortex.

CONCLUSION
Episodic and semantic memories are localised. Memory has a biological basis.

EVALUATION
1. Objective evidence – evidence from brain scans is difficult to fake, producing unbiased evidence.
2. Problems with the sample – 6 p'ts inc. Tulving and conclusion based on just 3 of the p'ts.
3. Extra – Are there different types of memory? Episodic and semantic memories are hard to separate. Which may explain inconclusive evidence.

SCANNING TECHNIQUES

	EVALUATION
CT SCANS Large doughnut shaped scanner that rotates. Takes a lot of X rays of brain which are combined to give a detailed picture.	**Strength:** Quality is higher than traditional X rays. **Weakness:** High levels of radiation and only produces still images.
PET SCANS Patient injected with radioactive glucose. Brain activity shown on computer screen.	**Strengths:** Shows brain in action and localisation of function. **Weaknesses:** Expensive and may be unethical because of radiation.
fMRI SCANS Measures changes in blood oxygen levels. Displayed as a 3 D computer image.	**Strengths:** Superior as produces clear images without use of radiation. **Weaknesses:** Expensive and have to stay very still.