FACTBOOK

AO1 and AO3

BIOPSYCHOLOGY

Biopsychology

Divisions of the Nervous System

The divisions of the nervous system: central and peripheral (somatic and autonomic).

The nervous system has 2 parts; the central nervous system (CNS) and the peripheral nervous system (PNS).

The CNS consists of the brain and the spinal cord.

The brain provides conscious awareness and is involved in all psychological processes.

The brain consists of many regions, which are responsible for different functions.

The brain provides conscious awareness and allows for higher-order thinking, while the spinal cord allows for simple reflex responses.

The brain consists of multiple regions responsible for different functions, whereas the spinal cord has one main function.

The brain consists of four main lobes; frontal lobe, parietal lobe, temporal lobe and occipital lobe.

The frontal lobe is associated with higher-order functions, including planning, abstract reasoning and logic.

The parietal lobe integrates information from the different senses and therefore plays an important role in spatial navigation.

The temporal lobe processes auditory information.

The occipital lobe processes visual information.

The brain stem connects the brain and spinal cord and controls involuntary processes, including our heartbeat, breathing and consciousness.

The role of the spinal cord is to transfer messages to and from the brain, and the rest of the body.

The spinal cord is also responsible for simple reflex actions that do not involve the brain, for example jumping out of your chair if you sit on a drawing pin.

The role of the peripheral nervous system (PNS) is to relay messages (nerve impulses) from the CNS (brain and spinal cord) to the rest of the body.

The PNS consists of two main components; the somatic nervous system and the autonomic nervous system.

The somatic nervous system facilitates communication between the CNS and the outside world.

The somatic nervous system is made up of sensory receptors that carry information to the spinal cord and brain, and motor pathways that allow the brain to control movement.

The role of the somatic nervous system is to carry sensory information from the outside world to the brain and provide muscle responses via the motor pathways.

Impulses travel from the sympathetic nervous system to organs in the body to help us prepare for action when we are faced with a dangerous situation.

The autonomic nervous system plays an important role in homeostasis, which maintains internal processes like body temperature, heart rate and blood pressure.

The autonomic nervous system only consists of motor pathways and has two components; the sympathetic nervous system and the parasympathetic nervous system.

The sympathetic nervous system is typically involved in responses that prepare the body for fight or flight.

The role of the parasympathetic nervous system is to relax the body and return us to our 'normal' resting state.

The parasympathetic nervous system slows down our heart rate and breathing rate and reduces our blood pressure.

Structure & Function of Neurons

Neurons are cells of the nervous system that can transmit electrical impulses to facilitate communications between the brain and the rest of the body.

There are three main types of neurons, including: sensory, relay and motor.

Each neurons has a different function, depending on its location in the body and its role within the nervous system.

All three types of neuron consist of similar parts; however their structure, location and function are different.

A typical neuron is comprised of dendrites, an axon and a cell body.

Sensory neurons are found in receptors such as the eyes, ears, tongue and skin, and carry nerve impulses to the spinal cord and brain.

Not all sensory neurons reach the brain, as some neurons stop at the spinal cord, allowing for quick reflex actions.

Relay neurons are found between sensory input and motor output/ response.

Relay neurons are found in the brain and spinal cord and allow sensory and motor neurons to communicate.

Motor neurons are found in the central nervous system (CNS) and control muscle movements.

When motor neurons are stimulated, they release neurotransmitters that bind to the receptors on muscles to trigger a response, which lead to movement.

The dendrites receive signals from other neurons or from sensory receptor cells. The dendrites are typically connected to the cell body.

The axon is a long slender fibre that carries nerve impulses, in the form of an electrical signal known as action potential, away from the cell body towards the axon terminals, where the neuron ends.

Most axons are surrounded by a myelin sheath (except for relay neurons) which insulates the axon so that the electrical impulses travel faster along the axon.

The axon terminal connects the neuron to other neurons (or directly to organs), using a process called synaptic transmission.

Sensory neurons are the nerve cells that are activated by sensory input from the environment, e.g. when you touch a hot surface with your fingertips.

A sensory neuron (sometimes referred to as an afferent neuron) is a nerve cell that detects and responds to external signals.

Sensory neurons receive information via their receptors, which are part of the peripheral nervous system, and convert this information into electrical impulses.

Motor neurons control movement.

Motor neurons are connected to effectors/ muscles for movement.

Motor neurons are efferent (meaning they carry information out towards the periphery from the central nervous system).

In motor neurons, the new nerve impulse is generated in the neuron of the motor cortex of the brain, whereas in sensory neurons, the new signal is generated in the peripheral nervous system.

Sensory neurons allow us to feel sensations.

A sensory neuron usually has the cell body on the axon, sticking out like a sore thumb.

Different types of sensory neurons respond to different stimuli, for example, some neurons detect temperature while others detect pain.

Relay neurons look long and thin (like some athletes).

Relay neurons allow motor neurons and sensory neurons to communicate with one another.

Relay neurons allow motor neurons and sensory neurons to communicate with one another.

The sequence of neurons goes from sensory to relay to motor.

The Process of Synaptic Transmission

Information is passed down the axon of the neuron as an electrical impulse known as action potential.

Once the action potential reaches the end of the axon it needs to be transferred to another neuron or tissue.

The electrical impulse must cross over a gap between the pre-synaptic neuron and post-synaptic neuron, which is known as the synaptic gap.

At the end of the neuron, in the axon terminal, are the synaptic vesicles which contains chemical messengers, known as neurotransmitters.

When an electrical impulse (action potential) reaches the synaptic vesicles, it releases neurotransmitter.

Neurotransmitters carry signals across the synaptic gap. They bind to receptor sites on the post-synaptic cell that then become activated.

Once receptors have been activated, they either produce excitatory or inhibitory effects on the post-synaptic cell.

Some neurotransmitters are excitatory and some are inhibitory.

Excitatory neurotransmitters (e.g. noradrenaline) make the post-synaptic cell more likely to fire.

Inhibitory neurotransmitters (e.g. GABA) make cells less likely to fire.

A synapse is a small gap between two neurons, where nerve impulses are relayed by a neurotransmitter from the axon of a presynaptic (sending) neuron to the dendrite of a postsynaptic (receiving) neuron.

A synapse is referred to as the synaptic cleft or synaptic gap.

During synaptic transmission, the action potential (an electrical impulse) triggers the synaptic vesicles of the pre-synaptic neuron to release neurotransmitters (chemicals).

Neurotransmitters diffuse across the synaptic cleft (the gap) and bind to specialised receptor sites on the post-synaptic neuron.

Neurons essentially communicate with each other through synapses.

Synapses can be either chemical or electrical and are essential to the functioning of neural activity.

Synapses play a vital role in a variety of cognitive functions, including learning and memory formation.

When an action potential arrives at the pre-synaptic terminal, it activates voltage-gated calcium channels (Ca^{2} +) in the neuron's membrane. Ca^{2} + are highly concentrated on the outside of the neuron and will rush into the neuron when activated.

Ca^{2} + allows the synaptic vesicles to fuse with the pre-synaptic terminal's membrane, enabling it to release neurotransmitters into the synaptic cleft.

When receptors are activated, there is an opening or closing of ion channels, which are membrane proteins that provide a passageway through which charged ions can cross.

Depolarising is making the inside of the cell more positive.

Hyperpolarisation makes the inside of the cell more negative, less likely to fire.

Neurotransmitters have their own specialised functions.

Dopamine and serotonin are common neurotransmitters found in the brain.

Serotonin causes inhibition in the receiving neuron, resulting in the neuron becoming more negatively charged and less likely to fire.

Adrenaline causes excitation of the post-synaptic neuron, increasing the positive charge, making it more likely to fire.

Neurotransmitters are made in the pituitary gland in the brain.

For a synapse to function effectively, it must be shut off once the signal is sent.

Signal termination allows the post-synaptic neuron to return to its resting potential state, ready for new signals.

When neurotransmitters get released into the synaptic cleft, not all of them are able to attach to the receptors of the next neuron.

Re-uptake is when neurotransmitters get reabsorbed back into the pre-synaptic neuron from which they came from.

Imbalances in the way serotonin is transmitted between neurons through too much reuptake has implications for contributing to mood disorders like depression.

SSRIs are antidepressants that prevent the reuptake of serotonin back into the pre-synaptic neuron.

Neurons communicate with other in groups called neural networks.

Action potential can only travel in one direction (from pre-synaptic to post-synaptic).

Whether a post-synaptic neuron fires is decided by the process of summation.

Summation is the addition of positive and negative post-synaptic potentials. A neuron can receive both positive and negative potentials simultaneously. These are summed and if the net effect on the post-synaptic neuron is inhibitory, the neuron will be less likely to fire, and if the net effect is excitatory, the neuron will be more likely to fire.

The Endocrine System

The endocrine system works alongside the nervous system. It is a network of glands across the body that secrete chemical messages called hormones.

Instead of using nerves (sensory and motor neurons) to transmit information, the endocrine system uses blood vessels.

Hormones are chemicals produced in the endocrine system.

Hormones cause physiological changes in the body, which can impact our thoughts, feelings and behaviour.

Hormonal responses can be triggered by signals in the brain.

The hypothalamus is the control system which regulates the endocrine system.

The hypothalamus is connected to the pituitary gland and is responsible for stimulating or controlling the release of hormones from the pituitary gland.

The pituitary gland is sometimes known as the 'master gland' because the hormones released by the pituitary gland control and stimulate the release of hormones from other glands in the endocrine system.

Hormones are large chemicals released from glands into the bloodstream that travel to specific organs for functioning.

A gland is an organ in the body that synthesises substances such as hormones.

Each gland produces a different hormone, targeted for a specific function.

In females, the ovaries release oestrogen which controls the regulation of the female reproductive system, including the menstrual cycle and pregnancy.

Males and females have different sex organs, and in males the testes release androgens, which include the main hormone testosterone.

Hormones can disappear from the bloodstream quickly.

Activation of the sympathetic nervous system can increase the production of hormones such as adrenaline.

The adrenal gland is divided into two parts, the adrenal medulla and the adrenal cortex. The adrenal medulla is responsible for releasing adrenaline and noradrenaline, which play a key role in the fight or flight response.

The adrenal cortex releases cortisol, which stimulates the release of glucose to provide the body with energy while suppressing the immune system.

Adrenocortical trophic hormone (ACTH) stimulates the adrenal cortex and the release of cortisol, during the stress response.

The thyroid gland releases thyroxine which is responsible for regulating metabolism.

The main hormone released from the pineal gland is melatonin, which is responsible for important biological rhythms, including the sleep-wake cycle.

The Fight or Flight Response

The fight-or-flight response is thought to have evolved as a survival mechanism to help our ancestors deal with threats.

The sympathetic nervous system (SNS) and the parasympathetic nervous system (PNS) are activated during the fight or flight response.

When someone enters a potentially stressful or dangerous situation, the amygdala, which is part of the limbic system is activated.

The amygdala responds to sensory input (what we see, hear, smell, etc.) and connects this with emotions associated with the fight or flight response (e.g. fear and anger).

If a situation is seen as stressful/ dangerous, the amygdala sends a distress signal to the hypothalamus, which communicates with the body through the SNS.

If a stressful or dangerous situation requires a short-term response the sympathomedullary pathway (SAM pathway) is activated, triggering the fight or flight response.

Following the fight or flight response, the parasympathetic nervous system (PNS) is activated to return the body back to its 'normal' resting state.

The parasympathetic nervous system slows down our heart rate and breathing rate and reduces our blood pressure.

The parasympathetic nervous system acts like a brake and reduces physiological arousal brought on by the sympathetic nervous system.

When faced with a dangerous situation our reaction is not limited to the fight or flight response; some psychologists suggest that humans engage in an initial 'freeze' response.

Gray (1988) suggests that the first response to danger is to avoid confrontation altogether, which is demonstrated by a freeze response.

The main hormone involved in the fight or flight process is adrenaline which is released from the adrenal gland.

Adrenaline triggers physiological changes in the body like increased heart rate, which creates a state of arousal necessary for the fight or flight.

Even though the fight-or-flight response is very good at preparing the body to deal with threats or stresses, it also has negative consequences on the body.

Cortisol (stress hormone) can also have a negative impact on the human body.

Localisation of Function

Localisation of function is the idea that certain functions (e.g. language, memory, etc.) have certain locations or areas within the brain.

Localisation of brain function has been supported by recent neuroimaging studies and some early case studies like Phineas Gage.

Phineas Gage, who in 1848 while working on a rail line, experienced a drastic accident in which a piece of iron went through his skull.

Although Gage survived his accident, he did experience a change in personality, such as loss of inhibition and anger.

The change in Phineas Gage provided evidence to support the theory of localisation of brain function.

There are four key areas in the brain for functioning; motor area, somatosensory area, visual area and the auditory area.

The motor area is located in the frontal lobe and is responsible for voluntary movements by sending signals to the muscles in the body.

Hitzig & Fritsch (1870) first discovered that different muscles are coordinated by different areas of the motor cortex by electrically stimulating the motor area of dogs.

The somatosensory area is located in the parietal lobe and receives incoming sensory information from the skin to produce sensations related to pressure, pain and temperature.

Different parts of the somatosensory area receive messages from different locations of the body. This was mapped by Penfield (1959).

Penfield (1959) created a homunculus which was a visual representation of the mapping of body space in the somatosensory cortex of the brain. Each part of the body representing the size of the area of cortex devoted to it, and the sensitivity of that region.

Robertson (1995) found the somatosensory area of the brain to be highly adaptable, with blind Braille readers having larger areas in this part of the brain.

At the back of the brain, in the occipital lobe is the visual area, which receives and processes visual information.

Information from the right-hand side visual field is processed in the left hemisphere, and information from the left-hand side visual field is processed in the right hemisphere.

The visual area contains different parts that process different types of information including colour, shape or movement.

The auditory area is located in the temporal lobe and is responsible for analysing and processing acoustic information.

The primary auditory area is involved in processing simple features of sound, including volume, tempo and pitch.

Petersen et al (1988) used brain scans to show how Wernicke's area was active during a listening task and Broca's area during a reading task.

Advancements in brain scanning means the brain can be seen in more detail than ever before.

Dougherty et al (2002) offer evidence from neurosurgery that damage to the brain is linked to mental disorders like OCD.

Dougherty et al (2002) suggests that behaviours associated with serious mental health conditions may be localised in the brain.

Buckner & Petersen (1996) confirm that memories are localised in the brain.

Lashley (1950) challenged the idea of brain lateralisation suggesting the brain works more holistically.

Lashley (1950) removed parts of the brain of rats to see the effects on learning a maze. The brain required several parts of the cortex to function not just one.

Dick & Tremblay (2016) suggest the language centres may not be as localised as first thought.

Hemispheric Lateralisation

The brain is made up of 2 hemispheres, the left and right.

The left hemisphere is associated with language and logic.

The right hemisphere is associated with recognition and spatial awareness.

Individuals can be left or right dominant in the brain, or bilateral.

Individuals who are left brain dominant are believed to be better at maths and science.

Individuals who are right brain dominant are believed to be better at sports, creative arts or practical subjects.

Lateralisation of brain function is the view that distinct brain regions perform certain functions.

If a certain area of the brain becomes damaged, the function associated with that area will also be affected.

The human brain is split into 2 hemispheres, right and left. They are both joined together by the corpus callosum, a bundle of nerve fibres which is located in the middle of the brain.

Hemispheric lateralisation is the idea that each hemisphere is responsible for different functions. Each of these functions is localised to either the right or left side.

The left hemisphere is associated with language functions, such as formulating grammar and vocabulary.

The right hemisphere is associated with more visuospatial functions such as visualisation, depth perception, and spatial navigation.

The right hemisphere is not involved in language processing and has no language centres.

The left hemisphere is responsible for language functions, such as formulating grammar and vocabulary.

Damage to the left hemisphere can result in language impairments, such as aphasia.

Sperry & Gazzaniga (1967) highlights a number of key differences between the two hemispheres. Firstly, the left hemisphere is dominant in terms of speech and language. Secondly, the right hemisphere is dominant in terms of visual-motor tasks.

In an outdated treatment for severe epilepsy, the corpus callosum was severed, meaning the connections between the two hemispheres were prevented. This is known as split brain surgery.

Roger Sperry conducted experiments on split-brain patients to test whether there was a localisation of function in the hemispheres.

Sperry (1968) devised a system to study how the 2 hemispheres deal with information from visual and tactile tasks.

Sperry (1968) studied split brain patients using a tachistoscope and support the idea of hemispheric disconnection.

Sperry (1968) found that objects presented to the right visual field (RVF) could be described using language, as it is processed in the left hemisphere. Objects presented to the left visual field (LVF) could not because the right hemisphere has no language centres.

Sperry (1968) also conducted tactile tests on split brain patients and found that participants could pick up objects in their right hand and recognise if they had picked it up before, but they could not say what it was.

Sperry (1968) supports the idea that certain functions are lateralised in the brain.

Gazzaniga (1983) conducted an experiment using faces projected to both visual fields (VF). It was found that faces on the left VF, projecting to the right hemisphere, were recognised but could not be named.

Tomasi & Volkow (2012) found that males had increased right lateralisation of connectivity in areas of the temporal, frontal, and occipital lobes. In contrast, females had increased left lateralisation of connectivity in the left frontal lobe.

Phineas Gage supports the localisation of functions theory as it shows that control of social behaviour/ personality is located in the frontal lobe.

Luck et al (1989) showed that split brain patients performed better on certain tasks than a normal control group.

Fink et al (1996) used PET scans to identify areas of the brain which are active during a visual processing task. They found a specific area in the brain dedicated to this.

Rogers et al (2004) showed that lateralised chickens could find food while looking out for predators, while normal chickens could not.

Split brain research is limited to small sample sizes which cannot be generalised.

Nielson et al (2013) studied brain scans from over 1000 people and found no evidence for lateralisation.

Language Centres

Two areas of the brain have been identified as language centres; Broca's area and Wernicke's area.

The arcuate fasciculus is a bundle of nerve fibres that connects Broca's area and Wernicke's area, allowing for communication between the two language centres.

Broca's area has been identified in the frontal lobe, whereas Wernicke's area has been identified in the temporal lobe.

Broca's area is located in the left frontal lobe and is responsible for speech production.

Wernicke's area is found in the left temporal lobe and is involved in language comprehension.

Broca's area is responsible for speech production.

Broca's area is believed to be located in a part of the inferior frontal gyrus in the frontal lobe, on the left side of the majority of people.

Broca discovered his region in the brain while treating a patient named Leborgne, who was more commonly referred to as 'Tan'.

Broca's patient Tan could understand spoken language but was unable to produce any coherent words and could only say 'Tan'.

After Tan's death, Broca conducted a post-mortem on Tan's brain and discovered he had a lesion in the left frontal lobe. This led Broca to conclude that this area was responsible for speech production.

Broca's area has been found to be associated with multiple language functions, including speech and the ability to articulate words.

Damage to Broca's area is known as aphasia.

The main symptom of Broca's aphasia is a deficit in the production of spoken and written language.

People with damage to the left frontal lobe experience Broca's aphasia, which results in slow and inarticulate speech.

Carl Wernicke discovered another area of the brain that was involved in understanding language.

Wernicke's area was discovered after examining the brains of patients, where it was revealed that there were lesions at a junction of the upper temporal lobe in the left hemisphere.

Wernicke’s area is responsible for language comprehension.

Wernicke identified that some of his patients were able to speak but were not able to actually comprehend language.

Wernicke’s area is found in the left temporal lobe, and it is thought to be involved in language processing/comprehension.

People with damage to Wernicke's area struggle to comprehend language, often producing sentences that are fluent, but meaningless.

The angular gyrus, located in the parietal lobe, plays a role in reading and writing abilities.

Damage to the angular gyrus can result in difficulties with reading and writing, a condition called alexia, commonly known as dyslexia.

Plasticity & Functional Recovery

Brain injury can change a person's life, previous skills and abilities can be lost, as can aspects of their personality. This can be overcome through the brains ability to rewire itself.

Neural plasticity refers to the brain's ability to reorganise its structure and function in response to changing experiences and learning.

Brain plasticity, also known as neuroplasticity, is the brain’s biological, chemical, and physical capacity to reorganise its structure and function.

Brain plasticity refers to the brain’s ability to change and adapt because of experience.

Functional recovery can occur following brain injury or trauma, and it can be aided by rehabilitation.

Functional recovery can be helped by rehabilitation following injury or trauma.

Functional recovery can occur following trauma such as brain injury or a stroke.

The brain appears to show evidence of functional recovery which is the transfer of functions from a damaged area of the brain after trauma to an undamaged area.

Recruitment of homologous areas (similar) in the opposite side of the brain can help brain damaged patients regain functioning.

The brain possesses a remarkable ability to rewire itself. These changes range from individual neuron pathways making new connections to systematic adjustments like cortical remapping.

Learning and having new experiences causes new neural pathways to strengthen, whereas neural pathways used infrequently become weak and eventually die. This process is called synaptic pruning.

Synaptic plasticity refers to the ability of synapses to strengthen or weaken over time, which is crucial for learning and memory processes.

According to Herholtz & Zatorre (2012) learning music or a second language can increase neuroplasticity in the brain.

Davidson et al (2004) demonstrated a permanent change in the brain can be generated by prolonged meditation. They found Buddhist monks who meditated frequently had a much greater activation of gamma waves.

Neurogenesis is the process of generating new neurons in the brain, which can contribute to learning and memory.

Rosenweig et al (1962) demonstrated that rats raised in an enriched, stimulating environment had increased cortical volume showing evidence of a greater number of synapses compared to rats raised in wire cages without any enrichment.

Tajiri et al (2013) showed rats injected with stem cells near the site of injury displayed evidence of neural recovery.

The phenomenon of long-term potentiation (LTP) is a form of synaptic plasticity that involves the strengthening of synaptic connections between neurons, leading to enhanced communication and learning.

Long-term potentiation is a process in which the strength of synaptic connections between neurons is increased, leading to enhanced communication and learning.

Research has demonstrated that the brain continues to create new neural pathways and alter existing ones in response to changing experiences.

According to Purcell & Zukerman (2011) as we mature, the neural connections we do not use are deleted, and the ones we use frequently are strengthened, this is called neural pruning.

A child has almost twice as many neural connections than adults (Gopnik et al, 1999).

Age has been associated with the ability to show brain plasticity; younger brains appear to show greater responses to treatment and rehabilitation.

Marquez de la Plata et al (2008) found that patients older than 40 years regained less function after treatment than younger patients. This could be due to younger brains having more plasticity than older brains.

Functional recovery can be done by neuronal unmasking where ‘dormant’ synapses, open connections to compensate for a nearby damaged area of the brain.

Following neuronal unmasking, new connections in the brain can be activated, recovering any damage occurring in specific regions.

Functional plasticity can occur through axonal sprouting, where undamaged axons grow new nerve endings to reconnect the neurons, whose links were severed through damage.

Axonal sprouting is the growth of new nerve endings which connect to damaged ones to form new pathways.

Denervation supersensitivity occurs when axons that do a similar job become aroused to a higher level to compensate for ones that are lost.

Research into brain plasticity and functional recovery has useful practical applications for people who have suffered brain injuries.

Bezzola et al (2012) demonstrated how 40 hours of golf training produced physical changes in the brain's neurology.

Medina et al (2007) found the brain's adaptation to prolonged drug use led to poorer cognitive functioning.

Draganski et al (2006) observed changes in the brains of medical students before and after sitting their exams.

Maguire et al (2000) studied London taxi drivers who had passed 'the knowledge' test. Maguire et al found more grey matter in the posterior hippocampus of the taxi driver group. This areas is associated with better spatial and navigation skills.

Maguire et al (2000) demonstrates brain plasticity using London taxi drivers and found an increase in the volume of grey matter in their posterior hippocampus compared to a control group.

Maguire et al (2000) also found a positive correlation between the time spent as a taxi driver and the volume of grey matter.

Kuhn et al (2014) found a significant increase in grey matter in various regions of the brain after participants played video games for 30 minutes a day over a two-month period.

One limitation of plasticity is there could be negative behavioural consequences as seen in dementia patients.

Individual differences also play a part in limiting the generalisations from research with brain-damaged individuals.

Many of the research studies have limited sample sizes making generalisations more difficult.

Case studies frequently show functional recovery but have limited generalisability.

Ways of Studying the Brain

Brain scans are a scientific way of studying the cortical and sub-cortical areas of the brain.

The anatomy of the brain can be studied focusing on structural abnormalities in the brain. Patients with brain damage or mental illness may have their brain compared to typical brains.

Post-mortem examinations are conducted on the anatomy of the brain, which is studied after death to investigate any possible brain damage.

A post-mortem examination is when researchers study the physical brain of a person who displayed a particular behaviour while they were alive that suggested possible brain damage.

Iverson (1979) examined the brains of deceased schizophrenic patients and found that they all had a higher concentration of dopamine, especially in the limbic system, compared with brains of people without schizophrenia.

Post-mortem examinations provide a detailed examination of the anatomical structure as well as neurological aspects of the brain, which is not possible with other scanning techniques.

Post-mortem examinations provide detailed anatomical analysis of brain structure that cannot be achieved with other scanning techniques.

Post-mortem examinations are 'invasive' but this is not an issue because the patient is not alive anymore.

There can be ethical issues in relation to informed consent and whether or not a patient provides consent before his/her death.

An issue with post-mortem studies is identifying the cause and effect.

There are many extraneous factors that can affect the results of a post-mortem examination, making reliable conclusions more difficult.

Medication a person may have been taking, their age, and the length of time between death and post-mortem examination, are all confounding factors that make the conclusions of such research questionable.

fMRI is a brain-scanning technique that measures blood flow in the brain when a person performs a task.

As deoxygenated haemoglobin has a different magnetic quality from oxygenated haemoglobin, an fMRI scan can detect the difference.

When haemoglobin is released for use by active neurons, it becomes deoxygenated and can be detected on an fMRI scan.

fMRI works on the premise that neurons in the brain which are the most active (during a task), use the most energy.

An fMRI creates a dynamic (moving) 3D map of the brain, highlighting which areas are involved in different neural activities.

In an fMRI scan, when the brain is more active, it consumes more oxygen, directing blood flow to the area, showing up on the 3D image on the scan.

fMRI scans simply measure changes in blood flow and therefore it is impossible to infer causation.

fMRI brain scans are non-invasive, which make them more ethical to use with patients.

fMRI scans have good spatial resolution. This refers to the smallest feature (or measurement) that a scanner can detect.

fMRI scans are reliable and objective ways of studying the brain.

fMRI scans have poor temporal resolution. This refers to the accuracy of the scanner in relation of time, or how quickly the scanner can detect changes in brain activity. There is usually a 1-4 second lag behind.

An EEG works on the premise that information is processed in the brain as electrical activity in the form of action potentials or nerve impulses, transmitted along neurons.

EEGs measures electrical activity through electrodes attached to the scalp. Small electrical charges that are detected by the electrodes are graphed over a period of time, indicating the level of activity in the brain.

Synchronised patterns of brain activity are recognised waveforms on an EEG scan.

There are four types of EEG patterns including alpha waves, beta waves, theta waves and delta waves.

EEG scans are often used to record sleep patterns in psychological research.

EEGs are useful in clinical diagnosis, for example in detecting epilepsy.

ERPs use similar equipment to EEGs (electrodes attached to the scalp); however, they present stimuli to people and the researcher looks for activity related to that stimulus.

ERPs are able to pinpoint localisation of function.

An advantage of EEG and ERP scans is that both techniques are non-invasive.

EEG/ ERPs have poor spatial resolution, making it difficult to detect small changes in activity.

EEG/ERPs have good temporal resolution as they can take readings every millisecond.

Biological Rhythms

Biological rhythms are regulated by endogenous pacemakers, which are the body's internal biological clocks.

Biological rhythms are also determined by exogenous zeitgebers, which are external cues, including light, which help to regulate the internal biological clocks.

Although endogenous pacemakers are internal biological clocks, they can be altered and affected by the environment.

The most important endogenous pacemaker is the suprachiasmatic nucleus (SCN), which is closely linked to the pineal gland, both of which are influential in maintaining the circadian sleep/wake cycle.

The suprachiasmatic nucleus (SCN), which lies in the hypothalamus, is the main endogenous pacemaker.

The SCN sends signals to the pineal gland, which leads to an increase in the production of melatonin at night, helping to induce sleep.

Many studies demonstrate the significance of the SCN and how endogenous pacemakers are important for biological circadian rhythms.

Exogenous zeitgebers can include social cues such as mealtimes and social activities, but the most important zeitgeber is light.

Exogenous is external, whereas endogenous is internal.

One biological rhythm is the 24-hour circadian rhythm.

The circadian rhythm is often known as the internal 'body clock'.

The sleep-wake cycle is an example of a circadian rhythm.

Body temperature is a circadian rhythm. Human body temperature is at its lowest in the early hours of the morning and at its highest in the early evening.

Circadian rhythms last about 24 hours (e.g. the sleep-wake cycle) and are controlled by an endogenous pacemaker.

Siffre (1975) found that the absence of external cues significantly altered his circadian rhythm.

When Siffre returned from an underground stay with no clocks or light, he believed the date to be a month earlier than it was. This suggests that his 24-hour sleep-wake cycle was increased by the lack of external cues.

There are differences between individuals when it comes to circadian rhythms.

Stern & McClintock (1998) suggest that individual differences in the duration of rhythms might be due to biological factors or external factors. They found the onset of menstruation can be affected by exposure to pheromones released in the sweat of women at another stage of their cycle.

Duffy et al (2001) suggest that some people have a preference for going to bed early and rising early (larks) compared to those who prefer the opposite (owls).

Aschoff & Wever (1976) found that people placed in a WW2 bunker underground with the absence of any environmental/ social cues displayed circadian rhythms between 24-25 hours, with some as long as 29 hours.

Morgan (1955) bred hamsters so that they had circadian rhythms of 20 hours rather than 24.

Infradian rhythms are biological cycles that last longer than 24 hours and can be weekly, monthly or even annually.

An example of a monthly infradian rhythm is the female menstrual cycle.

Reinberg (1967) examined a woman who spent three months in a cave with only a small lamp to provide light. It was noted that her menstrual cycle shortened from the usual 28 days to 25.7 days.

Russell et al (1980) found that female menstrual cycles became synchronised with other females through odour exposure (external factors).

A second example of an infradian rhythm is related to the seasons in seasonal affective disorder (depression caused by a lack of light).

In seasonal affective disorder (SAD) the lack of light during the winter months results in a longer period of melatonin secretion, which has been linked to the depressive symptoms.

Terman (1988) found that the rate of SAD is more common in Northern countries where the winter nights are longer.

Ultradian rhythms last fewer than 24 hours and can be found in the pattern of human sleep.

The problem with studying sleep cycles is the differences observed in people, which make investigating patterns difficult.

When investigating sleep patterns, participants must be subjected to a specific level of control and be attached to monitors that measure such rhythms, making them lack ecological validity.

Folkard et al (1985) found that when they manipulated the times on clocks to appear to be faster, some participants adjusted their cycles to the new times.

One practical application from research on biological rhythms is for people doing shift work.

Shift workers working during the night have to change their biological rhythms to suit their lifestyle.

Shift workers working at night cannot be influenced by exogenous zeitgebers like lack of light, otherwise they could not do their jobs.

Boivin et al (1996) found night workers experienced a lack of concentration around 6am, making more mistakes.

Knutsson (2003) highlighted the relationship between shift work and poor health.

Solomon (1993) concluded high divorce rates in shift workers may be due to lack of sleep.

Circadian rhythms can help increase the effectiveness of drug therapy, by understanding the rise and fall of biological processes throughout the day.

Czeisler et al (1999) found individual differences in sleep/wake cycles varying from 13 to 65 hours.

Sanassi (2014) found light therapy to be effective in 80% of people with seasonal affective disorder (SAD).

Research into ultradian rhythms has improved our understanding of age-related changes in sleeping patterns.

Van Cauter et al (2000) suggest sleep deficit may explain many issues in old age.

Many sleep studies are conducted in artificial settings in the lab, so lack ecological validity and mundane realism.

Kleitman (1969) explained the existence of BRAC (basic rest-activity cycle) to be around 90 minutes.

BRAC is characterised by a period of alertness followed by a spell of physiological fatigue, which recurs throughout the day.

Ericsson et al (1993) found that successful violinists who practiced for 3, 90-minute sessions during the day, performed better.

Research on biological rhythms has led to the development of strategies to reduce the impact of shift work and jet lag. The manipulation of light levels allows shift workers to sleep when their bodies would normally be awake.