Biological Level of Analysis

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| One study related to localization of function. (SAQ 2012) | Define the concept of **localization of function**  **Longitudinal Case study: HM by Milner (1957) originally but up until his death in 2008**  HM suffered epileptic seizures after a bicycle accident. Surgery was performed to stop the seizures. Tissue from the temporal lobe and **hippocampus** was removed.  Findings: HM’s personality was unchanged but he suffered from **amnesia**. HM could store new procedural memories (new actions/skills) but he was not able to store new semantic (knowledge/facts) or episodic memories (events/times). The **Hippocampus** plays a critical role in converting STM to LTM. The Hippocampus must be a **temporary store** because HM could retain memories of what happened before the surgery**.** Procedural memory must not be stored using the hippocampus. It is also evidence that memory is complex and many structures must be involved in it.  MRI scans by **Corkin et al** show that HM had severe brain damage to the hippocampus, which is critical in the storage of information into LTM.  Evaluations  + Brain damage was unanticipated (seizures were cured)  + Many tests were carried out and results contribute enormously to the knowledge of how memory processes are related to specific brain areas.  -Ethical concerns. HM was not able to remember all of his participation in research. Therefore full consent cannot be obtained. Justified by the importance of the findings.  - Cannot generalize findings to a larger population (lacks population validity). |
| Using one or more examples, explain effects of neurotransmission on human behavior. (SAQ Nov 2011) | **Describe nerve function** in general. Then go on to explain the release of neurotransmitters across the synaptic gap-mention: **receptors, reuptake.** Neurotransmitters affect all aspects of behaviour including the physiological system, cognition and mood. Could name other neurotransmitters i.e. dopamine.  **Serotonin Hypothesis Coppen (1967)**  Depression is caused by low levels of serotonin. Serotonin is a neurotransmitter produced in specific neurons in the brain called “serotonergic neurons”.  + Use of SSRI drugs **Elkin et al (1989).** Well controlled outcome study. Sample of 280 patients assigned to different treatment groups. Depressive symptoms were reduced in 50% of patients using SSRI’s compared to 29% on the placebo group.  **- Counter study Henninger et al (1996)** reduced serotonin in healthy individuals but did not induce depressive symptoms. They argue that the serotonin hypothesis needs to be revised.  **Other aspects of behaviour: Marazziti et al 1999 (from Human relationships attraction)**  A study in Pisa Italy. 20 participants had fallen in love within 6 months, 20 were untreated OCD, 20 normal. Serotonin levels in the blood of new lovers were equivalent to low levels found in OCD sufferers. This could explain the focus on the beloved. |
| Using one or more examples, explain functions of two hormones in human behavior (SAQ May 2011 x 2) | Define what a hormone is. Hormones are released/secreted by glands directly into the blood and they cause differing physiological responses. State which two hormones you will discuss.  **Oxytocin and attachment/trust (from Human relationships attraction)**  This is secreted by the hypothalamus and released into the blood. In the brain oxytocin acts as a neurotransmitter. It is linked to increased trust. Released during childbirth AND during touching and sex. Betrayal disrupts bonds and may cause you to avoid the person who betrayed you. We need to learn who to trust.  **Baumgartner et al 2008 The role of oxytocin in trust in economic behavior**  Aim: To investigate the role of oxytocin after breaches of trust in a trust game  Method: “Investor” (player 1) receives a sum of money and decides whether to keep it or share with a “trustee” (player 2). If the sum is shared it is tripled. Then player 2 has a turn at the game. fMRI scans were carried out on 49 participants. They received oxytocin or placebo via a nasal spray. In 50% of the games their trust was broken, feedback on this was given by experimenters during the game.  Results: Participants in the placebo group were likely to show less trust after feedback on betrayal, they invested less. Participants in the oxytocin group continued to invest similar rates after of breaches of trust.  fMRI scan showed there were decreased responses in the amygdala, which has many oxytocin receptors.  + Explains why people can forgive and restore trust in a long term relationship.  -Scanner research maps brain activity but nothing definite can be deduced from this at this point.  -This false way of receiving oxytocin may cause it to have different physiological effects.  OR  **The Cortisol Hypothesis (Abnormal, biological etiology of depression)**  Cortisol is a hormone produced by the adrenal cortex in response to stress. Prolonged stress may result in prolonged cortisol secretion and this can lead to physiological changes such as a damaged immune system and impairment of learning and memory.  People with MDD often have high levels of the hormone cortisol. Cortisol is known as the stress hormone because it is produced in times of stress. This is not surprising as many depressive episodes are preceded by stressful events. However, the relationship between stress and depression are not fully understood.  + **Fernald and Gunnar 2008 Poverty and child depression**  639 Mexican Mothers and children. Children of depressed Mothers living in extreme poverty produced less cortisol (hormone that helps us cope with everyday life). This low level indicates that the stress system was “worn out”, leaving children vulnerable to depression and autoimmune diseases. **Also links to social factors in depression**  + There is a link between long-term stress and MDD. This has been supported by findings of victims of child abuse.  + There is a high prevalence of MDD among people with Cushing’s syndrome-a disease which results in excessive production of cortisol. When drug’s which normalize levels of cortisol are given, depressive symptoms disappear.  +/- High levels of cortisol may lower the density of serotonin receptors. This demonstrates how complex the brain’s chemistry is. This link is not fully understood and more research is needed.  - It may be a result rather than a cause of depression.  - People can develop depression without previously being stressed. People subjected to terrible stress do not always get depression.  OR  **Vasopressin**  **Winslow et al. (1993)**  Vasopressin is associated with long tern commitment. It is also released during sex. An experiment on the role of vasopressin was conducted using prairie voles. These animals tend to form stable pair bonds and have more sex than is necessary for reproduction, just as humans do.  When male prairie voles were given a drug that suppressed the effects of vasopressin, they lost their devotion to their mates and no longer protected them from potential suitors.  This provides evidence that **vasopressin** plays an important role in males’ attachment and mating behavior.  Evaluation  + Research indicates that there are universal biological systems involved in attraction and love.  - Data from brain imaging can indicate activity in an area, but the brain is complex and it is not yet possible to explain human attraction.  - Evolutionary theories cannot explain attraction and love between same sex partners as they do not produce offspring.  - Cultural factors in attraction are ignored. |
| Discuss two effects of the environment on physiological processes | Effect 1: Brain Plasticity  **Rosenzweig and Bennett 1972**  Before the 1960’s the brain was thought to be only influenced by genetics and therefore unchangeable. Brain plasticity refers to the brains ability to rearrange the connections between its neurons. Specifically, changes that occur in the structure of the brain are the result of learning or experience. The brain is constantly changing, particularly the cerebral cortex which is the area of higher cognitive functioning. Plasticity can change the functional qualities of various brain structures. High levels of a particular type of stimulation can increase the density of neural connections in the corresponding part of the brain. When you study a lot, every time you learn something new, the neurons connect to create a new trace in your brain. This is called **dendritic branching.**  **Perry (1997)** investigated case studies of neglected children. The children had grown up in total neglect and had little experience of language, touch or interaction. The brain scans of normal children at 3 years old had a much larger cortex.  It is not possible to carry out deprivation studies in humans for ethical reasons but they have been carried out in animals. It is hoped that the findings can be generalized to humans.  **Rosenzweig and Bennett** (1972) carried out their study on rats  Aim: To investigate whether the environmental factor of an enriched or impoverished/deprived environment can affect development of neurons in the cerebral cortex.  Method: Rats were place in an Enriched Condition (EC) or an Impoverished condition (IC). In the EC there were 10-12 rats per cage with different stimulus objects to explore. They also received maze training. In the IC each rat was in an individual cage with no stimulation. The rats spent 30-60 days in their environments before they were killed so the researcher could study their anatomy.  Results: The brains of EC rats had increased thickness and higher weight of the cortex. Specifically the frontal lobe, which is associated with thinking, planning and decision-making, was heavier in the rats that had been in the stimulating environment.  EC rats developed more acetylcholine receptors in the cerebral cortex (neurotransmitter important in memory and learning)  Evaluation:  Strengths: Rigorously controlled lab experiment so cause and effect can be established. In fact, a follow up study showed that just 2 hours of EC a day produced the same plasticity changes in the brain. This shows that the brain is very adaptable. Brain plasticity in humans is assumed to follow the same pattern, therefore the human brain will be affected by environmental factors.  Weaknesses: Animals were used so it may be difficult to generalize the findings to humans. There may be individual differences in what is considered an enriched environment.  Effect 2: Stress and hippocampal damage in PTSD patients  A stressor is an event that threatens to disrupt the body’s normal balance and starts a stress response such as the release of hormones, or activation of the “fear sensor” in the amygdala.  The stressor could be **acute** (single incident such as an accident) OR **chronic** (long term fear of violence). Long term stress is associated with high levels of **cortisol** which can influence the size of the hippocampus which plays a major role in memory.  Traumatic episodes (frightening situations from which a person cannot escape) produce intense fear. In about 5% of the population this leads to PTSD. This can last for a brief period or a lifetime. PSTD sufferers have a lot of stress related problems such as forgetfulness and difficulty learning. In such patients changes have been observed in the brain, particularly the **hippocampus** which is involved with memory recall.  **Bremner et al (2003) Stress, PTSD and memory problems related to the reduction of hippocampal volume**  Aim: To measure the volume of the hippocampus to see if stress reduces it due to increased cortisol levels.  Method: Participants were veterans or female victims of early childhood sexual abuse. Not all had PTSD. Participants took part in MRI scans and memory tests.  Results: The hippocampus was smaller in the PTSD group compared with the control group. The veterans with the most memory problems also had the smallest hippocampus. There was also a clear correlation between the number of years of abuse as measured by a trauma test, memory problems and hippocampal volume.  Evaluation:  - The sample is very small so it is difficult to establish a definite relationship.  - People with PTSD often also have depression, which could lead to the observed changes in the brain.  + The findings of a large reduction in hippocampal volume in combat related PTSD have been repeated many times. |
| Examine one interaction between cognition and physiology in terms of behavior (ERQ 2012) | Learn as SAQ only.  Various areas of the brain are involved in cognitive processes. For example there are many cases in which damage to the brain causes memory loss. Recently researchers have been interested in how cognition and physiological processes **interact**. They are particularly interested in people who meditate. Could **meditation** (a cognitive process) change brain activity (a physiological process).  **Davidson et al (2004)**  Aim: To investigate whether meditation can change brain function.  Method: Participants were 8 monks who practiced meditation for many years and a control group of 10 students who had one week of meditation training. When cognitive activities are carried out, neurons fire in the brain and this results in electrical activity (brain waves). This can be recorded by an EEG (electroencephalograph). Participants were asked to meditate on **love and compassion**. As part of the training session students were asked to meditate about love and compassion whilst thinking about someone they cared about. After that they were asked to generate an objective feeling of love and compassion without thinking about anyone in particular.  Results: The EEG of the monk’s brains showed greater activation as well as better organization and coordination of gamma waves. There was a positive correlation between hours of practice and levels of gamma waves.  Conclusion: Davidson argued that meditation could have significant long term effects on the brain and the way it processes emotion. The brain adapts to stimulation from our own cognitive processes.  Evaluation: Is the difference due to individual differences? |
| Discuss the use of brain imaging technologies in investigating the relationship between the biological factors and behavior (ERQ May 2011) | Scanning is used to investigate the relationship between brain structure and behaviour. It can be particularly useful after brain damage or to find out which areas of the brain are involved in cognitive processes.  **EEG scan: Electroencephalogram**  The EEG print out is often thought of as “brain waves”. The electrical charge passed on by neurons can be registered. The EEG registers the patterns of voltage in the brain.  Strengths  + Psychologists have used EEG’s to investigate and get a better understanding of sleep, emotions and epilepsy.  Weaknesses  - Information is limited. It cannot reveal what is happening in deeper brain regions.  - It cannot show actual functioning of the brain.  Supporting study: **Recycle Davidson et al (2004) Brain waves and compassion meditation OR Leuchter et al (2002) Changes in brain function during treatment with placebo**  **MRI scan:** Magnetic Resonance Imaging  These give detailed pictures of internal structures using an electromagnetic field.  Strengths  + Show how blood flows in the brain and be used to identify problems with blood circulation. They can be used for early detection of Alzheimer’s disease  + They are safe to use as no radioactive material is used.  + Non invasive so no ethical concerns  Weaknesses  - Very expensive  - Movement may affect the picture and some people find it difficult to be still  - They cannot say anything about the cause of the problem or specify the effects.  - Not a natural environment. May lack ecological validity.  - Colours may exaggerate the different activities of the brain  Supporting study: **Recycle Bremner et al 2003 Stress and PTSD OR Corkin et al (1997) The case study of HM**  **fMRI scan:** Functional magnetic resonance imaging  The fMRI scanner can measure blood flow in the active brain. This is associated with the use of oxygen and is linked to neural activity during information processing. When participants are asked to perform a task, the scientists can observe the part of the brain that corresponds to that function. fMRI scanning is widely used by cognitive neuroscientists.  Strengths  + It does not use radioactive substances  + It can record activity in all regions of the brain  + Non invasive so no ethical concerns  Weaknesses  - The focus is mostly on localized functioning in the brain and does not take into account the distributed nature of processing in neural networks.  - They cannot say anything about the cause of the problem or specify the effects.  - Not a natural environment. May lack ecological validity.  - Colours may exaggerate the different activities of the brain  Supporting study: **Recycle** Baumgartner et al 2008 The role of oxytocin in trust in economic behavior  **Overall evaluation of brain imaging technology**  Brain imaging technology is a promising way to investigate the relationship between biological factors and behaviour, but scans are limited in their use. They can only register activity in certain structures. They can not clearly explain the cause of the behaviour and the effect of the activity in detail. It may be possible to identify brain structures that are active during a task but the brain is very complex. Most structures are linked to other structures in networks and it is not possible to say at this point exactly where things happen in the brain. Brain imaging is most useful at the moment for identifying brain abnormalities. |