|  |  |  |  |
| --- | --- | --- | --- |
| **Plasticity and Functional Recovery of the Brain After Trauma** | | | |
| **Plasticity and Functional Recovery of the Brain AO1** | | | |
| **Brain Plasticity**  Your brain is like plastic, it appears to change throughout life. The number of the brain’s synaptic connections grows rapidly during infancy, peaking at around 15,000 at age 2-3 years. This is twice as many as in the adult brain. Rarely used connections are deleted as we age, and frequently used ones are strengthened. This is called synaptic pruning.  It was once assumed these changes would only occur in childhood, and that the adult brain would remain fixed. However, more recent research suggests that existing neural connections can change at any time in life. New neural connections can be formed as a result of learning and experience.  **Research into Plasticity**  Maguire et al (2000) studied the brains of London taxi drivers and found significantly more volume of grey matter in the posterior hippocampus than in a matched control group. This area of the brain is associated with spatial and navigational skills in humans and other animals. The learning experience of their training alters the structure of the taxi drivers’ brains. Also, the longer they had been in the job, the more pronounced the structural differences.  Dragnaski et al (2006) also observed similar findings in medical students three months before and after their final exams.  **Functional Recovery of the Brain after Trauma**  Unaffected areas of the brain are often able to adapt and compensate for those areas damaged (e.g. from injury or stroke). Healthy brain areas may take over the functions of those areas that are damaged, destroyed, or even missing. This happens quickly just after the trauma, but slows down after a few weeks or months, so the individual might require rehabilitative therapy to further their recovery.  **What Happens to the Brain During Recovery?**  The brain rewires or *‘reorganises’* itself by forming new synaptic connections close to the area of damage. Secondary neural pathways (not usually used) are activated or ‘unmasked’ to enable continuing function. This is called *‘neural regeneration’*. This is supported by a number of structural changes:   * ***Axonal sprouting:*** growth of new nerve endings which connect with other undamaged nerve cells to form new neuronal pathways * ***Reformation of blood vessels*** * ***Recruitment of homologous (similar) areas*** on the opposite side of the bran to perform specific tasks e.g. if Broca’s area was damaged on the left side, the right-sided equivalent would carry out its functions. After a period of time, functionality may shift back to the left side. | | | |
| **Plasticity and Functional Recovery of the Brain AO3** | | | |
| **Practical Application**  P: One strength of the theory of plasticity and functional recovery of the brain after trauma is that there is wide practical application.  E: For example, understanding the processes involved in plasticity has contributed to the field of neurorehabilitation. Techniques include movement therapy and electrical stimulation of the brain when the body’s initial repair response begins to slow down. This leads to more successful recovery.  E: This is a strength because without the research and theory surrounding plasticity, it would not be possible to have these supervisions in place to account for the natural slowing-down of spontaneous bodily recovery post-trauma. Because we are aware of this instance however, the recovery rate is now much more successful.  L: As a result it increases the credibility of the theory of plasticity and functional recovery of the brain after trauma. | **Negative Plasticity**  P: However, one weakness of the theory of plasticity and functional recovery of the brain after trauma is that plasticity itself can sometimes have negative consequences, so the phenomena isn’t as positive and beneficial as first expressed.  E: For example, prolonged drug use has been shown to result in poorer cognitive functioning as well as an increased risk of dementia later in life. Also, 60-80% of amputees have been known to suffer from *phantom limb syndrome.*  E: This is an issue because although the theory is correct, the plasticity itself can lead to very negative and painful consequences due to the rewiring and cortical reorganisation. This is not considered by the theory; only the positives are outlined.  L: As a result, the explanatory power of the theory of plasticity and functional recovery of the brain after trauma is reduced. | **Age and Plasticity**  P: A strength of the theory of plasticity and functional recovery of the brain after trauma is that it has supportive evidence.  E: For example, Bezzola et al (2012) demonstrated how 40 hours of golf training produced changes in the neural representation of movement in PPs aged 40-60. Using fMRI the researchers observed reduced motor cortex activity in the novice golfers compared to a control group, suggesting more efficient neural representations after training.  E: This is a strength because it shows us that neural plasticity does continue throughout the lifespan, as suggested by the theory.  L: Consequently, the explanatory power of the theory of plasticity and functional recovery of the brain after trauma is increased. | **Support from Animal Studies**  P: One strength of the theory of plasticity and functional recovery of the brain after trauma is that there is supportive research.  E: For example, a pioneering study by Hubel and Wiesel (1963) involved sewing one eye of a kitten shut and analysing the brain’s cortical responses. It was found that the area of the visual cortex associated with the shut eye was not idle, but continued to process information from the open eye.  E: This is a strength because it developed the theory that our brain compensates when there is trauma, and that functional recovery will occur to allow for ‘regular’ neurological functioning.  L: As a result, the credibility of the theory of plasticity and functional recovery of the brain after trauma is increased.  *NB: Early studies such as this paved the way for modern research into neuroplasticity and functional recovery. Does what we learn from early studies such as these justify the procedures that were used which caused permanent damage to the animals? HINT: cost-benefit analysis could be discussed, or ethics.* |