The Teenage Brain

Have you ever wondered why teenagers are so impulsive and seemingly unable to make rational decisions? Advances in neuroscience have allowed a fascinating insight into the structure of the teenage brain. We now know it is fundamentally different to that of either the child or adult brain.

Pruning

Just before and during early adolescence, there is a rapid increase in the amount of neurons (brain cells) in the frontal cortex of the brain. This growth spurt produces far more neurons / cells than can survive or be used, so they have to be cut back (pruned). Like the branches of a tree, connections between the neurons become thicker and stronger with pruning thus making them more efficient.

Pruning begins at the back of the brain in the areas most associated with emotion and pleasure seeking meaning these sensations are heightened during adolescence.

In contrast, the frontal cortex, the part of the brain associated with important processes such as decision making, judgement, planning and risk assessment, develop last - at around the age of 20. This effectively means adolescents are operating with a brain that is still under construction.

Emotions

Have you ever known a teenager who appears to over-react to something that appears relatively normal? Neuroscience may well offer an explanation as to why. As previously alluded to, pruning begins in the amygdala, the part of the brain linked with raw emotion and gut reactions. The amygdala is more active in teenage brains. This essentially means adolescents are working on instinct rather than logic and may explain why adolescent reactions are faster and more intense.

In addition, research (Ekman and Friesen) has revealed most teenagers have an inability to 'read' facial expressions. In this study, most teenagers were wrong in their interpretation of fear and instead read the expression as anger, shock or disgust. This apparent inability to interpret expressions correctly may lead to some

unexpected and strong reactions to, for example, adult expressions of concern. There is also some evidence to suggest that this could extend to misinterpretation of tone of voice.

Thrill Seeking and Risk Taking

How much risk taking behaviour teenagers engage in depends on a range of factors including gender, personality and experience. In general terms, adolescence is a time when teenagers engage in high risk, low effort activities. We know that parts of the brain which deal with risk taking are not well developed at this age. A further suggestion for this type of behaviour is that dopamine, the neurotransmitter involved in activating pleasure, is at lower levels in the teenage brain. This means that greater stimulation is required to trigger a neuronal response so adolescents will take things to extremes in order to provoke that response. A further theory suggests some children already have more active dopamine systems, which increases to dopamine overload in adolescence. In these circumstances the greater the excitement, the more dopamine is released into the brain, which results in a craving for more making thrill-seeking addictive.

Alcohol, Drugs and Tobacco

These substances deserve special attention because, for reasons not yet fully understood, teenage brains are extremely vulnerable to the effects of alcohol, drugs and tobacco. In terms of risk taking, alcohol and some drugs increase dopamine levels and further reduce inhibitions and the capacity to assess risk. When alcohol is involved, teenagers are more likely to engage in risky behaviours such as unprotected sex (risk of pregnancy or STDs) or fighting and they are at greater risk of serious injury as a result of an accident. Additionally, there is a higher risk of addiction for adolescents who begin smoking, taking drugs or drinking heavily before the age of 15. Due to the massive changes going on inside the teenage brain, alcohol and drugs can also cause irreparable damage. The hippocampus (associated with memory) and the frontal cortex (the 'thinking' part of the brain) appear to be particularly vulnerable.

Sleep

Sleep is important at every stage of life and each stage requires a different amount of sleep to function effectively. Most adolescents need around 9 ¼ hours of sleep every night. Recent research of teenage sleep patterns however estimate that most are managing an average of 7 ½ hours and some are only getting 6 ½ hours. This amounts to a significant sleep debt of 10 hours or more by the end of an average school

week. During adolescence, melatonin, the hormone that induces sleep, tends to be released later at night (around 11pm) and remain in the brain longer in the morning. Consequently teenagers have a naturally later sleep - wake pattern. Couple this with an increase in computer, games console and social media use, which stimulate the brain and increase 'shut down' time and it's easy to see how some teenagers are awake into the early hours. Unfortunately, most schooling starts well before teenagers would get up if left to their natural sleep - wake cycle. So, not only is sleep shortened by 2-3 hours a night but teenagers are also missing out on REM sleep, which is thought to be vital for cognitive functioning, memory and growth.

Shortened sleep can also have a detrimental effect on adolescent mental health and can be a contributory factor in depression. Depression is more common in teenagers than in children and rises from around 5% (7-12 year olds) to 15-20% in 13 – 18 year olds. Evidence suggests it affects twice as many girls than boys. An imbalance of serotonin (a neurotransmitter) is a factor in adolescent mood swings and depression. However, it is not clear whether lower serotonin levels are a symptom or cause of depression.

Plasticity

The enormous changes taking place in the teenage brain provide challenges but it also means that adolescence is also a window of opportunity to develop a faster, more efficient and smarter brain. Neuronal connections and pathways that are formed and used regularly are strengthened, while others that are not used are pruned away. This brain plasticity provides an opportunity to both acquire new learning and, with practise, improve existing skills.

Conclusion

The teenage brain is unique and all adolescents go through this period of change and development. It is also a time when adolescents are expected to make decisions about which subjects to take, possible careers or university courses. Given teenagers are operating on instinct and their capacity to predict outcomes and consequences is impaired, making logical decisions presents a challenge for most. Understanding what is going on in the teenage brain and the reasons for some adolescent behaviour can help adults to view teenagers differently and support adolescents to navigate through this challenging process.