



My teen  
brain



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## 1. The brain undergoes major change during the teenage years

Until recently it was assumed that there was little further development in the brain after the end of childhood. However we now know that the brain continues to change and develop all through adolescence.

In fact, there is more change in the brain during adolescence than at any other time in human development apart from the first three years of life.

This means that the teenage years are a critical period. What happens during this period has major implications for later development.

Of course the brain does not develop in isolation. The brain and the environment interact, each influencing the other.

In this booklet we will be describing the changes that occur in the teenage brain. We will show how these changes affect behaviour. Finally we will outline how adults can use this knowledge to facilitate healthy brain development. The more adults understand what happens to the brain at this time, the more we can help teenagers manage this period of transition.

## 2. Here are some of the main changes that occur in the teenage brain

First, we should start by saying that the brain is immensely complex. The human brain is the most complex thing in nature. There are in the region of 100 billion nerve cells in the brain.

We know that during the teenage years there is a period of rapid and profound alteration in the brain. We know this because of the technology of scanning.

In late childhood there is a significant increase in the amount of grey matter. This is the area of the brain where most of the nerve cells are to be found. The grey matter is then gradually reorganised and re-arranged during the teenage years.

The networks of cells that are useful are reinforced, and the networks that are of little use are allowed to die away. This process is known as pruning.

The material that encases the nerve fibres – called myelin – is strengthened, so that impulses can travel faster and more effectively around the brain.

The bridge between the two halves of the brain becomes more developed, allowing the brain to use its capacity better.

### 3. Two main areas of the brain – those to do with emotion and thinking – are most affected

Two of the most important areas of the brain are the pre-frontal cortex and the amygdala. Both these areas undergo very significant change at this time.

The pre-frontal cortex is the area most associated with thinking, planning and problem-solving. The amygdala is the area associated with emotion, sensation and arousal.

Both these areas undergo major alteration during these years. The brain is maturing, but this does not happen overnight. It takes a long time for all parts of the brain to function well together.

In some young people the amygdala may develop at a faster rate than the prefrontal cortex, and this is sometimes considered to be an explanation for risky behaviour.

There are times when some teenagers simply do not think ahead and do not take into account the consequences of their actions.

In these circumstances the parts of the brain associated with pleasure and rewards are, for a time, more powerful than the areas linked to thinking and reasoning.

### 4. The teenage years are a time of significant change in the balance of hormones in the body

There are many different hormones that undergo change at this time. Most people know about the sex hormones, such as testosterone and progesterone, which become especially important at puberty.

Other hormones have an influence on the brain and how it functions. These hormones are sometimes called chemical messengers, as they affect the way messages travel around the brain.

Some hormones assist this process, whilst others act as inhibitors. One example of an inhibiting hormone is cortisol. This is released when we are anxious or under threat.

A small amount of cortisol is useful, as it helps us deal with threat. However, too much cortisol is unhelpful. It can inhibit the transmission of useful messages, and undermine the development of new neural pathways.

Another hormone which plays a big part in adolescence is dopamine. This is a hormone which is released when we get pleasure or enjoyment from an activity.

Dopamine levels can be low during the teenage years, and some risky or thrill-seeking behaviours can be explained by the need to raise dopamine levels.

## 5. The hormone melatonin affects teenage sleep patterns

One other hormone plays a big part in teenage development. This is melatonin, the hormone which is released at night to tell us it is time to go to sleep.

In the last few years we have learnt that melatonin is released later among adolescents than in other age groups. This means that many teenagers become sleepy later than their parents.

This has big implications. Sleep is important for teenagers. If they have to get up early for school, they may be missing some hours of much needed sleep.

Research tells us that sleep deficit (less than seven hours a night) can influence both learning and behaviour.

In recent years there have been attempts to address this problem. One suggestion has been to delay the start of the school day. This would allow young people to sleep later in the morning. However this has not been popular with either teachers or carers!

Another suggestion is to provide guidance about how to develop good sleep routines, so that the melatonin effect can be overcome.

**Here are some ideas about developing good sleep routines for teenagers:**

- Turn off all digital devices half an hour before bedtime;
- Turn lights down, put on soothing music;
- Have a hot drink of some sort (without caffeine);
- Most important of all, develop a routine. Adults can help with this. Routines make all the difference.

## 6. New skills are developing all the time

It is essential to keep in mind that the teenage years are a time of large gains in intellectual skills. The regions and networks in the brain that are to do with memory and learning are altering to allow new thinking and greater cognitive capacity.

As far as new thinking is concerned, as young people move through Key Stages 3 and 4 they begin to be able to think at an abstract level, and to pursue scientific reasoning.

Memory capacity also increases. Although this is not routinely tested in school, research shows that there is a marked change with age. As young people mature, their memory capacity expands, and there is a development of their ability to remember more facts for a longer time.

Language is another area which shows marked change at this time. Vocabulary increases, as does the ability to communicate more effectively.

Adults sometimes find this hard to comprehend, since many teenagers come across as either tongue-tied or unwilling to talk to adults. Nonetheless communication skills do develop during these years as areas of the brain related to language go through a process of development.

## 7. There are links between risk-taking and brain development

One of the most common ideas about teenagers is that they are risk-takers. They do not think ahead, they do silly things and do not take into account the consequences of their actions. Since research on the brain has become available it has been possible to understand this more clearly.

In the first place, as was suggested on Page 3, it may be that the area of the brain to do with thinking and planning matures more slowly than the area to do with sensation and arousal. If this is the case, behaviour may be more under the control of the parts of the brain to do with short-term rewards rather than with the areas related to problem-solving and thinking about consequences.

Although this is not the case with everyone, this may be the case with some young people, and could be one explanation for risky behaviour. Another possible explanation has to do with the role of the hormone dopamine. Low levels of dopamine may have the effect of leading some teenagers to seek thrills and pleasure, without having taken into account what may happen as a result of these activities.

Finally it is important to keep in mind that the environment plays a part too. What is happening in the brain interacts with the experiences of the young person, as well as the influences of key people.

Adverse childhood experiences may increase the likelihood of risk-taking because of the impact of these experiences on brain development. The behaviour of important adults and of the peer group can also influence the degree of risk-taking on the part of the young person.

## 8. One aspect of development has to do with the social brain

The term “social brain” refers to the regions that have to do with understanding other people. On the one hand the development of the social brain brings with it new skills.

On the other hand there are also some short-lived deficits that make it hard for the teenager to see the wider picture.

Looking first at the new skills, these have to do with understanding the thoughts or intentions of others. Skills include being able to take the perspective of another person, understanding the mental states of others, recognising emotions and making assessments of people. All these are essential as the teenager becomes more involved with the peer group.

Strangely, however, just as these new skills are developing, the young person also becomes more self-conscious and self-centred. There are times when the ability to see the other person’s side of the story appears to desert the teenager.

It is at this stage that the young person becomes preoccupied with her or her own emotions, and sees the world from one perspective only. Some writers have called this “adolescent egocentrism”.

We should not be surprised that all this appears contradictory. Major structural change is happening in the brain, and this cannot happen overnight. It takes time for all areas of the brain to function effectively together. There will be occasions when self-consciousness will be developing alongside the growth of new skills.

## 9. Brain development can contribute to increased vulnerability

There are many ways in which teenagers show their vulnerability. This may be through moods and emotions, through behaviour, poor health, or troubled relationships. The brain plays some part in all this, but it is only one part. Childhood experiences and the circumstances around the young person will play their part too.

As far as the development of the brain is concerned, there are many ways in which this can contribute to increased vulnerability. As has been mentioned on the previous page, major structural change is happening, and this will not always proceed smoothly. It is inevitable that such a degree of change brings with it a period when things are a little off-centre. It is completely understandable that things will take some time to settle down following such a period of alteration and reorganisation.

The hormone balance will have an influence as well. Hormones play a critical role in either helping or hindering the flow of messages around the brain. When hormones are out of balance this can make it difficult to concentrate in class, or to manage relationships in a sensible manner.

As far as the influence of the environment is concerned, adverse childhood experiences such as trauma and abuse will inevitably have an influence on brain development. However we still know relatively little about how these contribute to vulnerability in adolescence.

Positive experiences during the teenage years may do something to mitigate the negative effects of adverse events. It is here that adults can play such a crucial role. Stability and ongoing support during these years will have a clear benefit for brain development in adolescence.

## 10. Adults can encourage healthy brain development

Throughout this booklet there has been an emphasis on the fact that the environment around the teenager makes a difference. Here are four things that adults can do which will have a positive impact on brain development.

### Understanding

If adults can make allowances for the fact that teenagers are experiencing a major upheaval and readjustment of their brains, this will make relationships easier and contribute to well-being.

### Hormone balance

A good balance of hormones is essential if the brain is to manage the process of pruning unwanted connections, whilst developing and cementing useful neural pathways. If the young person experiences too much anxiety or stress the hormone balance will hinder this fundamental process. There is no way to avoid some degree of anxiety and stress, but adults can do all they can to keep this to a reasonable level. In addition they can help young people learn to manage these difficult emotions.

### The amygdala and the prefrontal cortex

The more adults can do to encourage the development of the prefrontal cortex, the better for emotion regulation. The more enriching the environment, and the wider range of activities the young person is engaged in, the more opportunities there will be for the prefrontal cortex to mature faster.

### Good routines

For teenagers routines make a difference. Where sleep is concerned, the melatonin effect can be overcome, but only with good sleep routines. This is hard to manage on your own, so adult help can make a significant difference.