Adolescent Brain Development

Do adolescents need parents?

Absolutely! Especially as we learn more about the dramatic changes taking place in the teenager's brain. Previously, scientists thought that most brain development occurred by 6 years of age and that not much changed after that time. However, in the past 10 years, researchers have made some amazing discoveries. Now we know that the brain of the teenager is still very immature and will undergo many changes between 11 and 25 years of age. That's right. The brain is not fully mature until young adulthood. This means your teenager will need you now more than ever.

What changes take place in the teenage brain?

We know that every area of the brain is immature and changes dramatically during adolescence. One of the main areas of the brain that is developing is the **frontal lobe** – often called the "CEO" of the brain. The frontal lobe (or prefrontal cortex) is the judgment center of the brain. This is the area of the brain that helps us to think strategically, plan, problem solve, see consequences of our behavior, control impulsive behavior, and develop our ethics and morals. Since this area of the brain is not mature, your teenager will need you to help think, problem solve, plan for and protect his future.

Many other areas of the brain will mature during the adolescent years. The cerebellum, located in the back of the brain, is involved in decision-making, social skills and coordination. It is the last part of the brain to mature. The amygdala is the center of emotions and helps regulate our responses to fear. The hippocampus, the memory center of the brain, is also immature and is very susceptible to the affects of alcohol. Alcohol can hinder the ability to develop memories and thereby impact learning. Adolescents who binge

drink are particularly susceptible to the negative affects of alcohol on the developing hippocampus. (14)

What determines how the teen's brain develops?

Three factors mainly determine how the brain develops:

1. Genetics
2. Environment / experiences
3. Parenting – see how important you are!

How does genetics influence brain development?

More than 1/3 of our genes determine the development of our brains and our nervous system. The building block of the nervous system is the **neuron** – a cell that processes and transmits information by electrical stimulation or hormones. Neurons are the core components of the brain (and spinal cord) and the connection between two neurons is called a **synapse**.

There are two time periods of rapid brain growth – during fetal development with growth continuing throughout the first two years of life and then during adolescence. During these two periods of time, brain cells rapidly multiply and develop many connections to other cells. This is how learning takes place.

How does the environment influence brain development?

The brain must determine which of the numerous neurons and synapses will survive. So the brain uses several principles that control cell survival. One principle is 'use it or lose it.' Neurons and synapses that are used more frequently will be maintained. Those that are not used will be cut or 'pruned,' and die. For instance, if a child is not exposed to a language when young, she may never be able to make certain sounds in that language when trying to learn it at an older age. The neurons to make that sound have been pruned.

In the brain, pruning streamlines and/or consolidates brain function. There are fewer pathways from which to choose and therefore the ability to learn new tasks and/or skills is decreased each time synapses are lost. For example, if multiple languages, music and sports are being learned and reinforced, those connections will be 'hardwired' or kept. This 'use it or lose it' function actually affects an adolescent's future ability to think and act.

Another principle is the cells that "fire together, wire together." This means that if a brain cell has made a meaningful connection to another cell, the neurons will continue to stimulate each other and will become wired together – and will survive.

How do experiences affect brain development?

Experiences are crucial to the development of the adolescent brain. Experiences allow the teen to form and keep synapses. However, experiences do not have to be first-person. For example, if someone you know died in an alcohol-related car accident, there is direct and personal significance in understanding the relationship between alcohol and car crashes – you don't personally have to be in the crash (or even directly know the person who was) to understand its significance.

What affects brain development more – genetics (inheritance) or experiences? This is the old "nature versus nurture" question.

Previously, researchers argued about whether nature (genetics) or nurture (environment) made the most difference in brain development. We now know that *both* are equally important. The brain is genetically programmed to respond in certain ways. However, the experiences we have can alter or strengthen the programming and how we choose to respond.

More amazingly, recent research reveals that traits that are acquired (or learned) can actually change the person's genetic code. This means that the changes can be passed on to future generations.

How does parenting affect the teenage brain?

Parenting your teenager takes on much more significance when you realize that experiences your teenager has can affect not just them, but also your grandchildren! Since the brain of the adolescent is so immature, it is extremely important that parents provide guidance and continue to set limits. Preventing your teen from experiencing dangerous or potentially addictive behaviors may help keep your teen healthy throughout his /her life.

How do hormones affect the teen's brain?

Hormones play a very vital role in our brains. They control everything from the onset of puberty to the amount and type of sleep that we experience. Hormones can regulate stress, body temperature and moods. Hormones active in the brain include dopamine, serotonin, oxytocin and vasopressin.

Dopamine:

- Creates a pleasure response to various experiences and activities.
- Released during any experience or activity that a person finds pleasurable
- Repeated positive experiences can be reinforcing, such as winning awards
- Rapid growth of dopamine- rich areas of the brain occur during adolescence, making teens more susceptible/vulnerable to addictive behaviors
- Teens are looking for more excitement than young children or adults
- Activities that cause a release of dopamine (excitement) are seen as pleasurable

- The desire to experience pleasure is intense and leads teens to repeat the activities that caused the most dopamine release.
- This easily leads to addictions - and addictive behaviors (including playing video games, gambling, viewing pornography, sexual activity, alcohol and drug abuse) often begin during adolescence
- However, because levels of dopamine are naturally higher in adolescents than adults, an adolescent will require a more exciting experience to have the same level of satisfaction as an adult.
- Alcohol increases levels of dopamine, causing the teen to feel more pleasure
- A teen who normally does not enjoy taking risks can become a high-risk taker when under the influence of alcohol.

Serotonin:

- Generally considered the "calming" influence
- Plays a role in the modulation of anger, aggression, body temperature, mood, sleep, sexuality, appetite and metabolism.

Oxytocin:

- The greatest levels occur during breast feeding and sexual orgasm; also released during labor/childbirth
- Involved in social recognition and bonding as well as formation of trust and generosity in both genders;
- Oxytocin is also released during close physical contact. Even holding hands can cause the release of oxytocin. This hormone serves to "bond" an individual to the sexual partner
- Because oxytocin is the "glue" that cements relationships, the incredible pain experienced after a break-up can now be explained by hormonal changes in the brain
- Oxytocin acts on the frontal lobe and turns off the judgment center (CEO) of the brain. This may explain why women return to abusive partners

Vasopressin:

- Primary effect is to increase water re-absorption in the kidneys.

- Implicated in memory formation and social behavior.
- Released during sexual intimacy—promotes bonding with sex partner – mainly in men
- Male brain has significantly more receptors for vasopressin

Melatonin:

- Hormone released by the pineal gland in the brain
- Induces sleep
- Sleep is more necessary during times of increased development – young childhood and adolescence
- Unfortunately, melatonin is secreted later at night in the brain of the adolescent
- So…the teen is unable to fall asleep early in the evening – and easily becomes sleep deprived

How does alcohol affect the brain of the adolescent?

Alcohol seriously affects the developing brain of the adolescent – and does so in ways that are even more dangerous than in adults. Alcohol can do the following:

- Interfere with ability to make memories
- Interfere with ability to recall previously known information and memories
  - Alcohol does this by affecting the growth of cells in the hippocampus (a small area in the center of the brain that is involved specifically with memory formation)
  - Because the adolescent brain is developing, alcohol can cause the hippocampus to be smaller for the rest of the teen's life, permanently affecting learning
- May NOT cause the same sleepiness/sedation as seen in adults
  - So, teens are more likely to remain awake while intoxicated – and can continue to drive / participate in risky behaviors
- May NOT cause the same symptoms such as slurred speech as seen in intoxicated adults

- So, teens are less likely to notice warning signals, less likely to be aware that they are becoming intoxicated
- This is why you hear stories of teen's dying from overdoses of alcohol

· More likely to become addictive
- Alcohol increases dopamine release, causing increased pleasure
- Neurons in the brain are beginning to "wire together"
- Neurons are more likely to "learn" that they need alcohol for pleasure

· Causes more learning problems when person engages in "binge drinking" – and teens are more likely to do this

So, for many reasons, alcohol is even more dangerous for teenagers and causes more permanent learning impairments than in adults. Your teenager needs you to teach her about the dangers of alcohol. She also needs you to set limits and provide protection so she does not find herself in dangerous situations.

How do video games affect the brain of the adolescent?

Playing video games can cause excitement - and so causes release of dopamine. The sexual and violent content of many video games can also cause the release of testosterone and adrenaline.

So… playing video games can become addictive.

New research also demonstrates that the frontal lobe of the brain (the judgment center) appears to be turned OFF while playing video games – and may even be less active when NOT playing video games.

So… playing video games may make it more difficult for teens to make good decisions.

Video games provide players with a sense of adventure, a sense of becoming the "conquering hero", and a sense of being "the rescuer". Video games meet many of the emotional needs of teenagers (especially boys) with a virtual reality that true life cannot match.

So… playing video games may cause a teen to be less willing to face real life situations.

What does all this research mean? What should parents of teenagers do?

Adolescence rivals the "terrible twos" as a time of rapid brain growth. Just as toddlers need parents to set limits and teach them what is appropriate behavior, so teenagers need parents to guide them through these difficult years and continue to teach them how to make decisions and respond to the world around them.

Parents must think carefully about the experiences they want the adolescent to have, knowing these experiences can affect how the brain develops as well as cause permanent changes that can be passed on to future generations.

Parents are even more important today than in the past. Historically children were raised in a very structured society, in which parents, teachers, media, and church all portrayed similar values. In addition, children were considered mature at younger ages 12 – 14 years of age. However, now children are raised in a more complicated society, in which inconsistent values are portrayed and children have more opportunities to participate in high risk activities.

Since each area of the teen's brain is immature, parents must function as an additional, assistant brain for the adolescent. Be your teen's frontal lobe (CEO):

- Judgment –
  - Help your teen see the consequences of action
  - Discuss implications of behaviors
  - Set boundaries
  - Point teens in the right direction
- Strategizing / planning
  - Help your teen divide projects into smaller tasks that can be accomplished
  - Encourage teen as each task completed
  - Reinforce new information

- Use "graphic" organizers
- Discuss the future
- Encourage teen to investigate careers
- Teach teens new tasks that will help them function independently – changing a tire, balancing a check book, cooking, doing laundry

· Ability to see consequences of behaviors
- Allow teen to experience some consequences of actions
- Don't rescue teen from consequences
- Link increasing privileges with demonstration of increasing responsibility

· Moral intelligence
- Convey your values – teens ARE listening
- Allow discussions about differing values
- Provide rationale to support your values

· Impulse control
- Set limits!
- Limit access to dangerous situations – be a "hands on' parent (see below)
- Have consistent expectations and routines
- Define consequences for inappropriate behaviors

What is a "hands on" parent?

A study from Columbia University demonstrated that teens participated in fewer high risk behaviors when their parents were "hands on parents" – parents who monitored all of their children's activities, including school performance, internet use, music, movies, magazines, and friends. A "hands on" parent also imposes a curfew, eats meals with the teen, conveys values, and assigns chores.

Control your teen's dopamine:

· Explain potential for addiction after just one exposure to pleasurable activity

- Explain increased difficulties with alcohol
- Limit access to media, internet, video games, "screen time"
  - Delay the introduction of video and computer games
  - Control the access to electronic games
  - Control the time spent playing
  - Control the content
- Explain how emotions normally fluctuate

Control your teen's bonding hormones:

- Become aware of and avoid sexually explicit images – for young children!
- Avoid sexually explicit material
  - Be aware of pornography downloaded to cell phones
  - Be aware of more advanced levels of video games
- Avoid sexually charged situations
  - Avoid dances for early teens
  - Avoid boy-girl parties for early teens
  - Encourage group dating for older teens
  - Set appropriate curfews
  - Discuss "bonding hormones"
- Keep your teen busy in other activities that encourage creativity, athletics and the learning of new skills

Assist your teen's melatonin:

- Realize teens need more sleep; allow additional sleep on weekends / holidays
- Realize teens CANNOT fall asleep early – don't expect it / don't argue about it
- Encourage healthy sleep habits –
  - Discourage caffeinated drinks
  - Discourage jobs that keep teen out late
  - Encourage quiet environment after 10 p.m. – no screen time, cell phone use