

The Power of the Adolescent Brain: A TAG Talk

Transcript — Full Length

Frances Jensen:

Hi, I'm Doctor Frances Jensen, and I'd like to talk to you today about the teen or adolescent and young adult brain. Aside from being a neurologist and a neuroscientist working on brain development, I am also the mother of two teenage sons, and I watched them change dramatically as they passed from childhood into adolescence. This led me to look at what is going on with the teenage brain, what's the new literature, what's the new research.

What I found was that until very recently, little was known about the teenage brain. Work had been done on early life changes and also on the aging brain, but this middle ground had been less studied. In the past decade, we've learned that the brain is the last organ in the body to reach full maturity, and therefore in the adolescent period it is not done yet.

Two major things are different about the adolescent brain. One is that our brain regions connect together by tracks, but that process doesn't complete until your mid-to-late 20s. It starts from the back and goes to the front, so the last part of your brain to reach full connectivity is your frontal lobe, and the frontal lobe is there to suppress impulses, suppress risk taking, make decisions, organization, judgment, empathy. All things that adolescents tend to be challenged by.

The other part of science is that we now know that each brain region itself is actually more active in childhood and adolescence than it will be later in life. Their capacity to learn is higher in adolescence than it is later in life. So, this is an actual wondrous time in development, where people can learn faster. In fact your IQ can even change in the adolescent years.

Our brain cells learn by increasing the strength of connections between them at a place called a synapse, and in fact children and teenagers have more synapses than adults, so they have more of the machinery to actually learn with. This is positive because it means that you can learn and work on your strengths and correct your weaknesses during adolescence, but it also suggests that their brains may be vulnerable to the effects of negative, not just positive things. This is basically increasing our understanding of how the adolescent brain is more vulnerable to addiction or to the effects of substances of abuse or even stress during this window.

Regions of our brain connect to each other through connections that actually have to be insulated like a wire would be insulated to have fast connections, fast real-time connections. This process is a wrapping process that we insulate our connections with something called myelin. The myelination of the brain takes almost two and a half decades. Hence, the last place it's connected, since it's going from the back to the front, is the frontal lobe, and this is where teenagers and adolescents have less connectivity relative to adults. Hence, they don't necessarily have the ability to have real-time access for decision making, impulse control, judgment and empathy.

I will talk more about teen behavior, addiction, mental health, and how parents and other adults can apply this knowledge to their interactions with adolescence.

Hi, I'm Doctor Frances Jensen, I'd like to talk to you today about teen and adolescent brains, and how brain development relates to risky behavior.

We've learned a lot about how neurobiology is explaining why teenagers have issues with risk taking, impaired decision making at times, and the inability to consider consequences of some of their actions. This can be vexing for adults, but there's really neurobiology behind this. The process of connecting the brain, connecting the part of the brain, the frontal lobe, which is responsible for impulse control and decision making, has not yet completed by adolescent years.

While the lack of connectivity, of full connectivity of the frontal lobe may be a vulnerability of the teenage brain, the teenage brain also has a great strength and that is that a teenager can learn faster than adults. Their synapses, parts of the brain where our neurons, our brain cells are connecting to one another, are more active and we use them to learn. Because teenagers have this extra strength in learning, they are learning machines. We could try to use that to help them learn cause and effect, while their frontal lobe is still coming online if you will.

Studies show that adolescents react more strongly to reward and risk than adults and children. Actually, the novelty seeking area of their brain, the reward center, is actually more active in adolescents compared to adults and children. Neuroscientists believe that the revved up response to reward and the underdeveloped impulse control, meaning the lack of full connectivity of their frontal lobe, really contribute to this greater risk taking behavior seen in teens and adolescents.

Most people respond negatively when you combine the word teen and risk-taking. We all know the negative risks we want to teens to avoid. Smoking, drinking, drugs, driving too fast, texting while driving, and a myriad of other poor choices that they can make. We often forget that teen and young adult life also requires some aspect of novelty seeking and positive risk taking, starting with your first job, volunteering in the community, going off to college, having your first romantic relationship, managing your own money, renting your first apartment. These are all positive risks that teens and young adults should take and learn from. It is truly a process of trial and error that shapes our brains.

The trick is pointing out their natural tendencies towards positive risks, and understanding that teens may need what we call a frontal lobe assist from the adults around them at times. Adults can help teens with thinking through their positive and negative consequences of some of their decision, before and after they take action.

Focusing on the positive aspects of teens risk and behavior may be more important as highlighting the negative parts. Adolescents have energy and enthusiasm, and they can learn so fast, that we can use this very positively. Teens are open to new experiences and intellectual challenges, more than they will later in life. They're ready to try new things, work to overcome obstacles and difficulties, and they will learn a great deal in this process.

All of this helps build positive self-concept, confidence, and independent living skills.

We've learned a lot about brain development in recent years. We know the brain is very different during teen and young adult years compared to later adulthood. We know that enriching positive experiences have lasting impact at this age, because of their ability to mold their brain to experiences. However, we also know that negative inputs can mold the brain also. Addiction is an example of this. Addiction is essentially a form of learning, but in the reward circuits in your brain. Just as adolescents can learn faster and build stronger connections when they're learning, unfortunately they can get addicted faster, because really they're just using the same process of learning but in the addiction circuit if you will.

Hence, adolescents can get addicted harder, stronger, longer, faster than an adult for a given exposure to a substance of abuse. This is paired of course with the fact that their frontal lobes, which is their

impulse control center, haven't been fully connected for fast access at this point in life. So, the risk reward parts of the adolescent brain are very active at a time where the frontal lobe, which normally suppresses and inhibits impulses, is not yet fully online if you will.

The big problem with the adolescent brain, because it's growing so rapidly, is chronic substance abuse. If a drug is being present across periods of time in the adolescent brain, damage can be done that may be irreversible. Both animal and human studies are showing an effect of chronic daily exposure to cannabis on later brain IQ and cognitive function.

Cannabis can affect synapses and how they function. It can also impair learning, and research has shown that cannabis can affect the way the brain wires itself during development if there is chronic exposure.

Some studies have shown that actually the connections to the frontal lobe, which are involved in decision making, seem to be less strong in people that have smoked marijuana during the teen years. This of course will affect their later ability to make decisions correctly, to control impulses and risk taking as adults.

Another area of concern is that many adolescents may actually be using marijuana as self-medication for anxiety. This will increase their chances of long-term brain affects with chronic daily usage.

We mentioned that adolescent brains can become more addicted than adults. A perfect example of this is nicotine addiction. We all know of adults that got hooked on cigarettes as teenagers, and how difficult it is for them to kick the habit if you will as adults, as opposed to, compared to people that get addicted as adults. The adolescent brain, because its reward systems are so much more active than the adult, and the fact that the synapses can be made stronger during the process of addiction, explains why nicotine exposure in adolescents causes much greater addiction than in the adult.

An area of concern is the increasing use of e-cigarettes. While cigarette smoking may be declining in teenagers, the use of vape cigarettes and e-cigarettes is increasing. In fact, e-cigarettes contain four to six times more nicotine than regular cigarettes. This means that e-cigarettes may pose a greater threat for nicotine addiction in teen years than in the past with regular, conventional cigarettes.

The part of the brain that controls addiction is more active in the teenager compared to the adult, and it's interesting that all kinds of addiction, not just addiction to drugs, but even video game addiction actually are using the same circuits. So, it starts to explain why teenagers can become so addicted to so many things, including electronic stimuli.

With addiction, peer pressure is another factor that's pushing the adolescent brain to a greater level of vulnerability compared to the adult. The emotional parts of our brain are connected up before, several years before, our frontal lobes are fully connected. This explains many aspects of teen behavior. Their vulnerability to peer pressure, because they don't have their frontal lobe to say, "This is a bad idea." They're really going on risk and reward system. It also explains why they take more risks with or without peer pressure. It also explains why their decision making may not be at the level of an adult. We need our frontal lobes for organizational prioritization of lists and planning, and the teenage brain does not have full access to that part of the brain.

The fact that the emotional parts of our brain connect up before our frontal lobes also explains why teenagers can be so emotional at times, and respond to things that we as adults may feel are inconsequential, as if they are international incidents. They really are experiencing emotion to a greater and higher, larger, extent than the adults.

Functional imaging has shown that when we confront the adolescent with an alarming image, their brain areas that control emotion actually turn on higher and to a greater extent than children or adults. They really are experiencing emotion in technicolor as opposed to adults experiencing emotion in relative black and white.

What we've learned about brain development helps us understand the bad reputation teens have for poor decision making, risk taking, and inability to consider the consequences of their behavior and think ahead. We now know that the teen's brain is wired for learning. Teens can learn more quickly than the adult, which helps us explain why teenagers may be the only one in your house who knows how to fix the computer or smart-phone.

The brain during the teenage years is also open to experiences that shape its development. This presents opportunities for parents, grand-parents, educators, and other adults to have a very positive impact on a teen's life. Scientists increasingly view mental illnesses as developmental disorders of the brain, and that many of them have their roots in the process of brain maturation. By studying how the circuitry of the brain develops, scientists hope to understand when and why brain development can result in mental illness.

In fact, recent research is showing that many kinds of mental illness have their onset in late childhood, the teenage years, or early adulthood. This is not a coincidence. In fact, in order to be able to exhibit a mental illness, one has to have a certain level of brain development accomplished. An example of this would be schizophrenia, depression, bipolar disorder, which all need to have a certain level of functioning or dysfunction in the frontal and pre-frontal cortices. One thing we know is that adequate sleep is central to physical and emotional health. Research suggests that brain based changes in the regulation of sleep may contribute to a teens tendency to stay up late at night.

Along with the obvious affects, such as fatigue and difficulty maintaining attention, inadequate sleep is a powerful contributor to irritability and depression. Studies of children and adolescents have also found that sleep deprivation can increase impulsive behavior. Mental illness affects one in four people at some point in their life span. In fact almost two thirds of people with major psychiatric conditions have their onset between 15 and 25.

This means that the teen years and young adult years are a time of great vulnerability to the onset of these illnesses, and we should think about being extra vigilant for signs of mental illness at this window. This can be during high school or college, or a first job. These are typical times when someone might have their first symptoms of a mental illness.

Understanding the changes taking place in the brain during this period presents an opportunity to intervene early in mental illnesses that often have their onset during the adolescent and young adult years. Research findings on the brain also serve to help adults understand the importance of creating an environment in which teens and young adults can explore and experiment while helping them avoid behavior that's destructive to themselves and others.

So, what should all adults know about the new research that explains adolescent behavior?

First, adolescents seem to take a long time to process an experience or make plans, or organize themselves, and sometimes it takes them a long time to consider the consequences of their behavior. Also, the teens perception of stress and anxiety is actually amplified compared to the adult. The onset of serious mental illnesses actually happens, typically, in late adolescence or early adulthood, as a function of brain development.

It's important to know that the internet can actually amplify the consequences of teen behavior. Cyber bullying is an example, and this can increase the exposure to stressful stimuli of today's teens and young adults.

Because teens' brains can learn more quickly, teens are actually more prone to addiction than adults. But, on the other hand, they can learn faster. Given the new research about the teen and adolescent brain, these are things that all adults can do to support teens during this pivotal time of brain development.

Be available for support and advice, and thinking through consequences of behavior.

Provide a frontal lobe assist for your adolescent.

Recognize that there is biology behind why teens tend to make more mistakes, so use these as teachable moments for your teenager.

For instance, ask them, "Why do you think this happened?" And, "What could you do differently next time?" Work through the problems with them for a teachable moment.

Stay connected and engaged in their lives. Show an interest in their activities, their friends, and their feelings. They need you more than they recognize.

Sleep deprivation is not good for learning. Limit the use of electronics and other distractions at night while your teen is attempting to go to sleep. Learn how to use social media to stay connected to teens. Text, Twitter, Instagram, so that you can be part of their world. Share information about health and other risks without lecturing.

I speak regularly to teens about brain development, and talk to them about minding their brain. I find that teenagers are naturally interested in their level of brain development. This is new information, and this is the first generation of teenagers that have had this much new information about where their brains are in development. Teens are at a point of trying to identify who they are, and this information can come in as a very important tool for a teenager as they are trying to explain their own behavior.

Teens are excellent learners, and it is valuable to give them examples of cause and effect of some of the risks that they may be tempted to take, and their consequences.

It's important to realize that mental illness often has its first manifestations in the teen or young adult age window, and so therefore we have to be a little extra vigilant about changes in our teenagers. I would say changes in their social behavior, if they're isolating themselves to an excessive amount, if they're dropping contacts with their friends, changes in their appetite, weight loss, weight gain, major changes in sleep, excessive irritability, are all signs of a possible problem in your adolescent. What we really mean is this is all on an individual basis. If you see a change occurring over weeks or months from what used to be your teenagers baseline to something different, that is a cause to stop and try to learn more, and if necessary contact your healthcare professional.

There are some slight differences in brain development rates between girls and boys. In fact, on average, girls are approximately two years ahead of boys in the developmental trajectory. That means for a given age, girls will appear to be about two years ahead of boys on average. There are late girls and early boys, so it really is a very individual process.

There are often big differences between girls and boys in early teen years or mid teen years with respect to the amount of organizational behavior they exhibit. Girls tend to be a little bit more organized and putting together planning to a greater extent than boys. This is likely because they're that much further along in development and in that frontal lobe connectivity.

Similarly, studies show that males are often greater risk takers than girls, especially towards the end of the teen years. This may be explained by the fact that in general, male brains reach maturity later than female brain, and in late adolescence the frontal lobe of males may be less connected than females. As adults around teenagers, we may think about treating girls differently from boys, however actually it's a very individual process. I think we have to be mindful of where our teenager is with respect to their risk-taking behavior or ability to plan, and again, where necessary give a frontal lobe assist.

Teenagers are naturally novelty seeking. This is actually a consequence of their brain stage, in that their reward systems, their novelty seeking systems, are actually on high energy compared to later in life. At the same time, their frontal lobes are less connected than they will be later. This is of course one of the root causes of them taking risks, and sometimes those risks can be dangerous. However, there are good risks to take too, and we have to think about how we can take advantage of that natural novelty seeking behavior of a teenager to ask them to experiment with positive influences in their life. After all, we shape our brains through trial and error. Nature versus nurture. The environment shapes our brains.

So, teenagers have an opportunity to even get more out of the environment than the adult for a given experience. We could imagine letting the teenager experience community service, or a summer job, or giving them new responsibilities at home, as well as of course all the opportunities that are available to them through their school.

A really important message for adults, especially parents, is that teen behavior can be at times very frustrating to us as adults, and really provoke a sense of anger at times in adults. I would implore adults to use the new research on the teenage brain to actually be more patient with their children. Actually, behavior can be explained a lot by biology, and if you just step back and take that into account, it might help you to count to 10 and not alienate your teenager.

They are going to need you for help with planning, assessing risk, and this is where we've often said an adult whose frontal lobe is healthily attached can give their teenager a frontal lobe assist.

So, one thing that teenagers do have is an incredible ability to learn, and to learn lessons. As adults, we can use events that are happening around the teenager in their own life, or even events from your own personal history to explain to them the cause and effect, especially when it is around risk taking and dangerous risk taking and bad consequences.

I think it's important that adults help the teenager understand where they are in development, and that they have sort of hidden strengths that they're not going to have again. One important message is that the brain is changing every day, every week, during this window of development, so what environment that the teenager is in during those days and weeks and years of adolescence, actually shapes their brain. It's a time of incredible scaffolding of the brain, and therefore I think we can explain to them that they have the ability to change their brain for better or worse, and of course we'd like the former not the latter. One message to teenagers is to use the research and the data that we have available to us from neuroscience to teach them these new facts.

Teenagers are part of a data driven generation. We can use that to help them guide themselves, and recognize that this is a window of opportunity. I often say, "Mind your brain now, and it will mind you later."

In this series we've pointed out several times that the teenage brain, the adolescent brain, has hidden strengths. One of those hidden strengths is their ability to learn. They have more synapses in their brains. We do our learning at our synapses, the connection between our brain cells, and they are able to grow more synapses and shape more synapses with experience than they will later in adulthood. Therefore it is a window of opportunity for them.

Importantly, negative things can impact their ability to learn, which is a little ironic given the one thing they do really well is learn, and yet they put themselves in positions that might threaten their ability of the brain to learn. These include sleep deprivation, substance abuse, and stress. I think as adults we can inform teenagers of the effects of these negative influences on their brains ability to grow, develop, and to sustain that heightened ability to learn.

Sleep is a really important factor in the brains ability to function normally. We consolidate our memories during sleep. Sleep deprivation impairs our ability to learn at any age, but of course teenagers, because they're learning so fast, are even more vulnerable to the effects of sleep. Interestingly, teenagers have a different sleep cycle than adults. I think many people think that teenagers are just lazy, they're not. It is because their sleep cycle is shifted. They release a hormone called melatonin at a later time than adults, and this brain chemical actually is what stimulates sleep and makes our brain want to go to sleep. We as adults put melatonin out at about 8:30, 9:00 at night, and about an hour and a half we feel sleepy.

Teenagers on the other hand release melatonin more like 10:30, 11:00, so they aren't even ready to sleep until after midnight. In addition, they threaten their ability to sleep because they stimulate themselves with numerous electronic devices and light that will prevent their brain from going to sleep. As a result, teenagers can get sleep deprived very easily. Because their sleep cycle is shifted, we are waking them up at a time that their brain is naturally still wanting to sleep, so at 6:00 or 7:00 a.m. when the day starts for most of us, teenagers are basically in the same place as an adult would be at about 3:00 a.m., because of this shift. Therefore, they may start the day in a somewhat sleep deprived state.

We know a lot about the effects of sleep deprivation on the process of learning, and in fact sleep deprivation can prevent your synapses, those connection points, from actually becoming stronger during learning. Sleep deprivation can weaken that process. On the other hand, as I said before, sleep can actually strengthen learning that has already happened, so that if you fall asleep after you've learned something, you will actually consolidate that memory better.

It really matters what the teenage brain is exposed to on a daily basis, and there can be long-term consequences of chronic exposure to negative things. Just like drugs and chronic use of drugs can affect later life brain function, chronic stress can actually affect the brain as well. It's been shown that chronic stress during adolescence can actually cause an increase in the risk of depression in adulthood.

Of course, there's a lot of research that's very well established about the effects of stress and impoverished environments on children, but importantly, new research shows that this vulnerability extends to adolescence as well. That adolescence and young adulthood is also a time where stress can leave a long lasting mark on the brain.