***The Teenage Brain: A Neuroscientist’s Survival Guide To Raising Adolescents and Young Adults***

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**Introduction**

The teen brain is at a very special point in development. As this book will reveal, I learned that there are unique vulnerabilities of this age window, but there is also the ability to harness exceptional strengths that fade as we enter into adulthood.

Children’s brains continue to be molded by their environment, physiologically, well past their mid-twenties. So in addition to being a time of great promise, adolescence is also a time of unique hazards. Every day scientists are uncovering ways in which the adolescent brain works and responds to the world differently from the brain of either a child or an adult. And the way that the adolescent brain responds to the world has a lot to do with the impulsive, irrational, and wrongheaded decisions teens seem to make so frequently.

The teen brain offers major advantages on the one hand but unperceived and often unacknowledged vulnerabilities on the other.

The most important advice I want to give you is to stay involved. As the mother of two sons I adore, I couldn’t physically maneuver them into doing what I wanted them to do when they were teenagers, not in the way I could when they were small children. Eventually they were just too big to just pick up and put down where I wanted them to be. We lose physical control as children leave childhood. Our best tools as they enter and move through their adolescent years is our ability to advise and explain, and also to be good role models. If there’s anything I’ve learned with my boys, it’s that no matter how distracted or disorganized they seemed to be, no matter how many assignments they forgot to bring home from school, they were watching me, taking measure of their mom as well as all the other adults around them.

**Chapter 1: Entering the Teen Years**

There are a few things I say to parents right off the bat: The sense of whiplash you are feeling is not unusual. Your children are changing, and also trying to figure themselves out; their brains and bodies are undergoing extensive reorganization, and their apparent recklessness, rudeness, and cluelessness are not totally their fault! Almost all of this is neurologically, psychologically, and physiologically explainable. As a parent or educator, you need to remind yourself of this daily, often hourly!

One of the chief areas of focus in the study of puberty has long been “hormones,” but hormones have gotten a bad rap with parents and educators, who tend to blame them for everything that goes wrong with teenagers. I always thought the expression “raging hormones” made it seem as though these kids had taken a wicked potion or cocktail that made them act with wild disregard for anyone and anything. But we are truly blaming the messenger when we cite hormones as the culprit. Think about it: When your three-year-old has a temper tantrum, do you blame it on raging hormones? Of course not. We know, simply, that three-year-olds haven’t yet figured out how to control themselves.

In some ways, that’s true of teenagers as well. And when it comes to hormones, the most important thing to remember is that the teenage brain is “seeing” these hormones for the first time. Because of that, the brain hasn’t yet figured out yet how to modulate the body’s response to this new influx of chemicals.

Adolescence is a time of increased response to stress, which may in part be why anxiety disorders, including panic disorder, typically arise during puberty. Teens simply don’t have the same tolerance for stress that we see in adults. Teens are much more likely to exhibit stress-induced illnesses and physical problems, such as colds, headaches, and upset stomachs. There is an epidemic of symptoms ranging from nail biting to eating disorders that are commonplace in today’s teens. We have a tsunami of input coming at teens from home, school, peers, and, last but not least, the media and Internet that is unprecedented in the history of mankind.

**Chapter 2: Building a Brain**

Even the average human brain is said by many scientists to be the most complex object in the universe.

Multitasking is not only a myth but a dangerous one, especially when it comes to the teenage brain. “Multitasking” has become a household word. The research in Sweden suggests that there are limits. Teenagers and young adults pride themselves on their ability to multitask. Have today’s teens and young adults imprinted on a multitasking world? Maybe. In studying on how young adults these days handle distractions, researchers at the University of Minnesota have shown that the ability to successfully switch attention among multiple simple tasks is still developing through the teenage years. So it may not come as a surprise to learn that of the nearly six thousand adolescents who die every year in automobile accidents, 87 percent die because of distracted driving.

**Chapter 3: Under the Microscope**

The more dopamine that is released in the brain, the more the reward circuits are activated, and the more those circuits are activated, the bigger the craving. It doesn’t matter if the craving is at the dinner table or the card table. For instance, scientists know that high-calorie foods produce more dopamine in the brain. Why? Because higher calories increase our chances of survival. When we crave ice cream or gambling, we may not be craving sweets or money. We’re craving dopamine.

**Chapter 4: Learning (A Job for the Teen Brain)**

Parents quickly blame themselves for a teen’s poor behavior, even though they’re not exactly sure how or why they’re to blame. With biological parents, the guilt may come from passing on flawed DNA; and with biological and nonbiological parents or guardians, the guilt comes from questioning how they raised their child. In either case, you, the parent, are to blame, right? Yes, the two scenarios are different, but no, it’s not because of the genes or anything you did or didn’t do or because the teenager was somehow struck on the head and woke up as an alien species from the planet Adolescence.

Teenagers are different because of their brains and specifically because of the two unusual aspects of their brains at this stage of their development. Their brains are both more powerful and more vulnerable than at virtually any other time in their lives.

In neuroscience, we refer to the human brain’s unique ability to mold itself as plasticity. Thinking, planning, learning, acting- all influence the brain’s physical structure and functional organization, according to the theory of neuroplasticity.

It’s important to remember that even though their brains are learning at peak efficiency, much else is inefficient, including attention, self-discipline, task completion, and emotions. So the mantra “one thing at a time” is useful to repeat to yourself. Try not to overwhelm your teenagers with instructions. Remember, although they look as though they can multitask, in truth they're not very good at it. Even just encouraging them to stop and think about what they need to do and when they need to do it will help increase blood flow to the areas of the brain involved in multitasking and slowly strengthen them. This goes for giving instructions and directions, too. Write them down for your teens in addition to giving them orally, and limit the instructions to one or two points, not three, four, or five. You can also help your teenagers better manage and organize tasks by giving them calendars and suggesting they write down their daily schedules. By doing so on a regular basis, they can train their own brains.

Perhaps most important of all, set limits- with everything. This is what their overexuberant brains can't do for themselves. So be clear about the amount of time you will allow your teenager to socialize “virtually,” or on the Internet or through texting. Best-case scenario: limit the digital socializing to just one to two hours a day. And if your teenager fails to comply, take away the phone or their electronic devices, or limit computer use to homework. Also, insist on knowing their usernames and passwords for all their accounts.

None of this means your kids are going to immediately go along with the program. In fact, it's virtually a certainty that there will at least be occasional slip-ups, perhaps a lot of them. That's why it's up to you to keep tabs, to check on teenagers as they do their homework and spend time on the computer. The more on top of it you are, the fewer the temptations for your adolescents, and the fewer the temptations, the more their brains will learn how to do the constant distractions.

In dealing with those unexpected emotional outbursts from your teenage son and daughters, something as simple as counting to ten before responding can help you stay calm. Being angry, or treating the meltdowns like a childish tantrum, is not advisable. Adolescents believe they’re adults, and though we know better, the more you treat them that way, the greater the chance they'll actually try to act that way, too. Because I'm a doctor and a scientist, I could sit my kids down and tell them, Look, you don't believe me when I say that you are being irrational or impulsive or overly sensitive but let me tell you why it's your brain's “fault.” By the time you finish reading this book, you’ll be able to do the same thing. And trust me, it works. I've seen it not only with my sons but also in talking to teenagers after I've given presentations in high schools. They're actually fascinated by the neuroscience and that there’s a logic, or rationale, behind what otherwise seem like inexplicable upheavals in their lives. You do run the risk, however, that these “brain explanations” become a kind of adolescent ammunition.

“My brain made me do it.” Your teenage son might be tempted to say when he decides to drive off with Dad’s car and not tell anyone until he comes home after midnight.

“Well, no,” you have to say, “your brain is sometimes an explanation; it’s never an excuse.”

Your teenagers are knowledgeable and self-aware enough to know that they are not automatons, and this means they have the capacity to modify and the responsibility for modifying their own behavior. This is what you must remind them- and then remind them again and again and again. The brain science isn’t an excuse for crazy, stupid, illegal, or immoral behavior.

Once someone is out of adolescence, synaptic plasticity, and learning, require more effort. In the same way that a young adult eventually settles down into a life and a routine, so, too, does the brain. The middle-aged man who played electric guitar in a rock band in high school would have trouble picking up the instrument again at forty-five. Twenty-five years ago, those guitar-playing neurons were in constant use, but by the time he reaches adulthood they’ve been dormant for so long they were essentially left behind, just like the electric guitar in the attic. Adults also have less glutamate and dopamine and fewer receptors available; therefore they are less cognitively flexible.

**Chapter 5: Sleep**

One of the chief complaints I hear from parents of teenagers is their frustration at not being able to get their kids to go to bed at a decent hour every night, and then not being able to coax them out of bed in the morning.

Teenagers who refuse to go to bed at night are not slothful, nor do they lack discipline, and refusing to heed your pleas to wake up is also not a sign of rebelliousness. The infuriating behavior of teens when it comes to sleep is actually completely normal.

Sleep patterns, or chronotypes, change across the life cycle and in the same way in all species. Infants and children are “larks”; that is, they wake up early and go to sleep early. Adolescents are “owls,” waking late and staying up until the wee hours of the morning.

Teenagers can be, and are, forced to abide by the adult chronotype, with early rising for school. However, this early rising does not result in an early bedtime: the teen brain doesn’t adjust at the other end of the day, and instead has a tendency to hold on to that part of its pattern. The result is a shrunken sleep period. However, on weekends, one sees teenagers immediately slip back into late-morning awakenings, as their internal clock prefers. If they are allowed to sleep as long as they like, teenagers will get around 9 to 10 hours of sleep per night. But if they are made to wake up for school, they are chronically losing 2.75 hours of sleep daily. This is thought to contribute to a chronic sleep deprivation syndrome.

Because so much is going on in adolescents’ brains, and they are learning so much and at such a fast pace, teenagers need more sleep than either their parents or their much younger siblings.

Scientists have calculated that the average adolescent actually requires nine and a quarter hours of sleep. Only about 15 percent of all American teenagers actually get that much on a regular basis.

Studies have shown that teenagers who report sleep disturbances have more often consumed soft drinks, fried food, sweets, and caffeine. They also report less physical activity and more time in front of the TV and computers.

One in five teenagers actually interrupts his or sleep in order to text.

One unfortunate consequence of sleep deprivation in everyone, but especially in teenagers, is that increasingly insomniacs are turning to artificial stimulants to keep themselves awake during the day. Some of those stimulants, such as Ritalin or Adderall, which are normally given for attention deficit hyperactivity disorder, are illicit, but the most popular and completely legal ones are energy drinks. While the US Food and Drug Administration restricts the amount of caffeine in soft drinks to a maximum of seventy-one milligrams of caffeine per twelve-ounce can, it does not restrict the amount of caffeine in energy drinks, because they are classified as dietary supplements. The amount of caffeine in an energy drink varies from eighty milligrams to as much as five hundred milligrams.

As critical a role as sleep plays in the learning process of teenagers, so do parents and guardians, and there are things you can do to encourage your teenage sons and daughters to get enough sleep, begin with taking the TV and computer out of the bedroom.

Another obstacle to sleep that you should be aware of is the bright LED light of a computer screen, which should be turned off about an hour before bedtime to relax the overstimulated eyes and brain.

As for your teenagers, suggest they do nontech activities before bed and do the same activities at the same time every night, not only to avoid melatonin suppression from the artificial light of computers, iPads, and smartphone screens but also to habituate the body to winding down at the same time every night.

**Chapter 6: Taking Risks**

Left to their own devices, adolescents frequently access stressful, inappropriate, even dangerous information on the Internet. It is likely that information has led to copycat self-harm behaviors such as cutting and even suicide in depressed kids. Teens are very vulnerable to the power of suggestion, and there are a lot more suggestions now at their fingertips via the computer. Similarly, statistics show that substances of abuse are more readily available than they have been in the past, and unlike other generations, today’s teens only have to send a text on a smartphone to gain instant access to a source of illicit drugs.

No matter the evidence of their peculiar, sometimes infuriating behavior, teenagers are not irrational. Contrary to that popular misconception, a person’s reasoning abilities are more or less fully developed by the age of fifteen. In fact, adolescents, appear to be just as adept as adults in their ability to logically access whether a certain activity is dangerous or not. This is why teens can, in fact, get very high scores on aptitude tests, such as the SAT, which relies wholly on logic and rational deduction.

So why do teens do some of the crazy things they do? In general, teen brains get more of a sense of award than adult brains and the release of, and response to, dopamine is enhanced in the teen brain. This is why sensation-seeking is correlated with puberty, a time when the neural systems that control arousal and reward are particularly sensitive. But because the frontal lobes are still only loosely connected to other parts of the teen brain, adolescents have a harder time exerting cognitive control overly potentially dangerous situations. Adults also are better able to access a network of frontal brain areas than adolescents, whose brain regions engage in more “connectivity” to access risks, rewards, and consequences.

The chief predictor of adolescent behavior, studies show, is not the perception of risk, but the anticipation of the reward *despite* the risk. In other words, gratification is at the heart of an adolescent’s impulsivity, and adolescents who engage in risky behavior and who have never, or rarely, experienced negative consequences are more likely to keep repeating that reckless behavior in search of further gratification.

One thing you can do as a parent, guardian, or educator to help adolescents avoid giving in to the immediacy and the emotion of rewards is to talk to them about different kinds of risky behavior. Whether it’s drug experimentation or car racing, help them visualize the costs versus the benefits through an analogy.

So here’s the paradox: Adolescence is a stage of development in which teens have superb cognitive abilities and high rates of learning and memory because they are still riding on the heightened synaptic plasticity of childhood. These abilities give them a distinct advantage over adults, but because they are so primed to learn, they are also exceedingly vulnerable to learning the wrong things. How does this happen? It all goes back to the brain’s craving for rewards, and the fact that anything that is learned, good or bad, that stimulates the production of dopamine is construed by the brain as an award. This means a little bit of stimulation to a teenage brain whose synapses are firing all over the place leads to a craving for more stimulation that can, in certain situations, result in a kind of overlearning. The more commonly known name for this overlearning is addiction.

**Chapter 7: Tobacco**

In adults, we naturally think the physiological consequences of tobacco use, chiefly cancer and emphysema, and then simply, apply those fears to our adolescents. But what we keep learning is that the adult and adolescent brains are two different things and therefore the influence of behaviors such as smoking on the teenage brain is more complex and the consequences are particularly pernicious. One of the surprising things about sleep deprivation and teenagers is that it can lead to increased cigarette use. More surprisingly still, cigarette smoking can cause a variety of cognitive and behavioral problems, including ADHD and memory loss, and it has been associated with lower IQ in teenagers.

The fact is, teenagers get addicted to every substance faster than adults, and once addicted have much greater difficulty ridding themselves of the habit- and not just in their teen years but throughout the rest of their lives. It’s as if addiction hard-wires itself into the brain when adolescents are exposed to substances of abuse. Smoking is just one example, and sadly the health toll it’s taken on past generations is proof positive of the consequences. Because teenage brains are more plastic and primed for learning, they are, unfortunately, also more prone to addictions.

Those that begin smoking in adolescence are three times more likely to begin using alcohol, and long-term ingestion of nicotine has been shown to increase tolerance to alcohol, meaning it takes more alcohol to produce the same effect. Not surprisingly, smokers are ten times more likely than nonsmokers to develop alcoholism.

It’s difficult for teenagers to look into the future because their brains are not yet wired to consider distant consequences, but that shouldn’t stop you from bringing up those consequences and drilling them into your teens. They may dismiss you or turn and walk away, but I promise you, it will register. Remember, they don’t miss a thing at this age.

**Chapter 8: Alcohol**

Each year approximately five thousand people under the age of 21 die as a result of drinking. In 1965 the average age when a person first used alcohol was 17.5. Now it’s 14. Alcohol saturates American culture. Even when adolescents are not taking a drink, they are being exposed to it.

Alcohol dependence has two common effects during withdrawal: a sluggish prefrontal cortex and the decrease in dopamine receptors, which leads to tolerance, meaning it takes increasingly larger amounts of alcohol to produce the same high. Moreover, it is likely, say researchers, that the effect of alcohol abuse on a teens still-maturing prefrontal cortex will increase the desire for more alcohol. In fact, children and adolescents who begin drinking before the age of fifteen are four times more likely to develop alcohol dependence later in life than those who begin drinking at a legal minimum age of twenty-one.

One of the biggest contributing risk factors for adolescents who drink is a family history of alcohol abuse. Some seven million youths under the age of eighteen are children of alcoholic parents, and researchers have found that about fifty percent of the risk of developing alcohol dependence is genetically influenced. Environment, however, counts for much of the other fifty percent. social learning experts have found that children, especially teenagers, model their behaviors on the adults who are most important to them and with whom they most frequently interact. Those who are monitored closely by their parents or guardians and who are given clear rules are less likely to abuse alcohol. Teens with lax parents are more likely to surround themselves with friends who abuse alcohol.

Parents’ mistake, say researchers, is buying into the belief that allowing teenagers to drink at home with friends will lead the teens to drink responsibly. According to research, the more teenagers drink at home, the more they will drink at other places, and the higher the risk for problematic alcohol use three years later.

Every weekend, thousands of teenagers across the country will consume alcohol. Many of them will drink way too much; some may even pass out. All are likely to suffer some form of damage to their brains that may well be permanent. Many of those teens will also get into cars that are driven by other alcohol-impaired teens. Almost all of them will make it home again. A few, like seventeen-year-old Taylor Meyer, who drowned in a muddy puddle at the edge of an abandoned airfield, will not. A month after the Massachusetts teen’s death in 2009, police arrested a dozen intoxicated adolescents at a party not far from the airfield where they had once gathered to drink with Taylor Meyer and where the young girl had died. Many of them were wearing pink bracelets in honor of their dead friend- and drinking to her memory.

**Chapter 9: Pot**

There are studies that show that smoking pot can lead to the use of harder drugs and even stunt one's intellect. Scientific breakthroughs showing how certain chemicals work on the brain have reaffirmed the risks that marijuana poses, especially for adolescents.

Pot is now regarded by many experts as a “gateway drug” leading to the use of more dangerous illicit substances. It impairs mental functioning and coordination and poses a threat to public safety when, for instance, individuals who are high get behind the wheel of a car.

In fact, marijuana is outpacing alcohol as a public health problem in teenagers. In the last several years, marijuana abuse has been responsible for almost two-thirds of admissions of teenagers, ages fifteen to nineteen, two rehabilitation centers, compared with less than a third for alcohol.

Teen users are twice as likely to become addicted, and those who indulge in pot before the age of sixteen have more trouble with focus and attention and make twice as many mistakes on tests involving planning, flexibility, and abstract thinking. Also, the younger a pot smoker is, the more he or she smokes. Bottom line: The earlier the use, the greater the abuse.

Adolescent brains are not as resilient as adult brains when it comes to marijuana. Teenagers are especially vulnerable to the drug because they are at a critical stage in the development of two of the most sophisticated parts of the brains- the frontal and prefrontal cortex- and these are precisely the parts most affected by marijuana. This is not minor or incidental. These brain regions are used every day for basic cognitive tasks whether it's abstract thinking, the ability to change one's behavior in relation to changing demands in the environment, or the inhibition of inappropriate responses.

Recent research shows that fear of losing their parents’ trust and respect is the greatest deterrent to adolescents’ drug use. They won't tell you this, of course, but when asked by researchers what prevents them from experimenting, a majority of non-drug-using teenagers say it's because their parents expected them not to and that their parents would be disappointed in them if they did. So take advantage of this power, however unacknowledged by your sons and your daughters. Whenever possible, be concrete and practical when talking about drug use. What are their goals? What are the things they value most? Reiterate to them that college, scholarship, making varsity, or passing drivers education- all those things will become more difficult to achieve if they use pot. To be convincing, of course, you also need to be knowledgeable about what marijuana does to the brain. That's where this book comes in handy. You need to know what to say when your teenagers try to argue that pot is harmless, that it makes them feel good, that it doesn't affect them negatively. For instance, if your son says that smoking pot helps him to relax and relieve him of his anxiety, then you have to remind him that he'll always feel anxiety throughout his life and he can't always turn to pot to find relief. It's important to figure out what's causing the anxiety and deal with the source rather than try to “medicate” it away.

Repetition is good for the adolescent soul (even though teens complain about it), don't think that bringing up the subject or asking your son or daughter about pot smoking just once is enough, because it isn't. That's why whenever I can, I use the news or story of a neighbors teenager or a new scientific study as a “teachable moment,” a chance to talk to my boys about what pot and cigarettes and alcohol and hard drugs have done to others and are capable of doing to them. Don't avoid talking to your kids, even if you think they aren't listening, because they are.

The implication of current marijuana research for teenagers is profound. Manipulating or interrupting this important stage of development with cannabis could change the entire trajectory of their brain development, with some deficits not appearing until much later in life. Yes, as parents, teachers, and guardians, we ignore the science, we do so at the peril of our own children.

**Chapter 10: Hard-Core Drugs**

It takes only a single bad decision to result in a catastrophic consequences, as it did for Irma Perez, a fourteen-year-old California girl, on April 23, 2004. According to her sister Imelda, Irma was at a party where she was offered a single pill of MDMA (3,4-methylenedioxymethamphetamine), a synthetic stimulant and mild hallucinogen also known as Ecstasy. Immediately after swallowing the drug, she became sick, “vomiting and writhing in pain,” but her friends, afraid of getting into trouble, delayed calling 911 or taking her to an emergency room for hours. Instead, as Imelda wrote on [www.nationalparentvigil.com](http://www.nationalparentvigil.com), the website she helped found, that made the situation worse:

They tried to give her marijuana, thinking it would relax her and possibly help her because they had heard it had medical qualities. Irma suffered for hours and when she was finally taken to the hospital the next morning, she was in terrible shape. Five days later she was taken off life support and died…. How did Irma actually die? Dr. Leslie Avery and Dr. Peter Benson, a forensic medical expert, say that Irma’s brain swelled from a lack of oxygen. “Her cerebellum dissolved as her brain tried to escape its confined space” Benson said.

The research into how and why drugs like Ecstasy and cocaine are so dangerous for adolescents in turning up new findings every day. The basis of many of these findings is that with a still-maturing brain, teens are especially vulnerable to drugs that work directly on the brain’s chemistry.

Adolescents process cocaine differently from adults. First and foremost, cocaine is a stimulant, but it stimulates a greater release of dopamine in the adolescent brain than in the adult brain.

Like cocaine, amphetamines and methamphetamines both increase the concentration of dopamine in the brain, and like cocaine both produce a euphoric high. Medications used to treat ADHD, are also increasingly being abused by teenagers. Typically, teens use the pills for nonprescription purposes, most often to stay awake late at night studying or for a boost of energy or concentration when doing homework or writing a paper. But because Ritalin and Adderall and Concerta- drugs used to treat ADHD- are stimulants, they are also capable of trapping adolescents in a cycle of habitual use and addiction.

Prescription drug abuse has been on the rise nearly every year for the past decade, with 15 percent of all high school seniors reporting nonmedical use of sedatives, especially the prescription drugs Valium, Activan, Klonopin, and Xanax. Researches at Rockefeller University found that adolescents exposed to Oxycontin (the narcotic oxycodone) can suffer lifelong damage to their brains because of permanent changes in the reward system. As the adolescent brain prunes itself, OxyContin appears to make dopamine receptors more sensitive to it. Painkillers like OxyContin activate the brain’s opioid receptors and release more dopamine in the brain’s reward system.

The chilling realization about drug use and adolescence is this: The same brain processes that make negotiating the teen years so difficult make substance abuse more likely. An immature prefrontal cortex means less control over impulsive behavior, less understanding of the consequences, and fewer tools to stop the behavior.

**Chapter 11: Stress**

Barely a day goes by when parents and teachers of teens don't witness an outburst of anger, tears, poutiness, withdrawal, irritability, even hostility from there mercurial kids. On the other hand, adolescence are prone to overexcitement and bursts of enthusiasm. The question often is, how do we know when things have become too extreme? How do we distinguish between episodes of normal teenage angst and something darker, more troubling?

Emotions are the barometer of mental well-being. It isn’t hard to remember the devastation I felt when a boyfriend broke up with me in high school or I didn't get the grade I wanted in a class in college. Nor can I forget my euphoria when I learned I'd been accepted into medical school. A world without emotion is, frankly, difficult to imagine. During adolescence, more than any other time, emotions rule our lives. Teenagers are usually up or they’re down, and they are very rarely something in between. As parents we sometimes experience our teenagers’ emotional highs and lows as frighteningly out of control, and because our teenagers are yet unable to smooth things out using their frontal lobes, it's up to us to be the filter, the regulator, to provide the sense of calm their brains can't yet provide.

So when and how we know whether an emotional outburst or mood swing, an impulsive act or even a severe disappointment, is normal teenage behavior or something we should worry about, like the first sign of depression or an anxiety disorder? There are signposts and degrees and ways of making these distinctions, but before we dive into them, you first need to understand what emotions are- and or not- when it comes to adolescent development.

In large part what makes adolescence so difficult is that much of a teenager's response to the world is driven by emotion, not reason. Adults aren't the only ones who know this; teenagers do, too. Often they describe their lives as a “drama” that can be either “two awful” for “two wonderful” depending on the circumstances. The emotional lives of all human beings are closely tied to the working of the amygdala, from which arise our most primal feelings and reactions- fear, anger, panic, grief. Emotionally, the main difference between adults and adolescents is that there is much less activity in the frontal lobes of adolescents, making it harder for them to handle their emotions, especially in crisis situations.

The threats to immediate survival are far fewer today than when our primitive ancestors roamed the earth, but the fight-or-flight response remains encoded in our genes. Adolescents, whose amygdala are less under control by their frontal lobes, are prone to responding to situations of stress with more extreme emotions than adults, who can rely on their prefrontal cortex within the frontal lobes to control their anger and fear.

Studies have found that in mid-to late adolescence, and especially in girls, cortisol levels are slightly higher than in the normal adult population. Negative emotions- stress, worry, anxiety, anger- have all been significantly associated with higher levels of cortisol. So, too, has loneliness; and this is why in adolescents being alone is also associated with increased anxiety and stress.

The effect of stressful experiences and emotional trauma on adolescents can have serious consequences for mental and emotional health later in life. Stress in adolescence works differently from stress in adults, and the effects of stress on learning and memory in teenagers can predispose them to mental health problems, including depression and post-traumatic stress disorder (PTSD). Substance abuse also often develops, when stressed kids start self-medicating by taking stimulants or anti-anxiety drugs they sneak out of the bottles in their parents’ medicine cabinets. Anxiety is astronomically high in kids today, with a host of societal issues, less consistent family life, and exposure to all sorts of stimuli on the Internet, not to mention the vagaries of social networking. These are otherwise good, normal kids, but stress can seriously strain their ability to cope.

Stress is a big player when it comes to emotional trauma. Adolescents are at especially high risk for experiencing emotional trauma compared with the rest of the population, and the consequences for their brain development can be devastating.

When trauma is severe or prolonged, an adolescent is more prone than an adult to developing PTSD. Normally, PTSD develops when someone is exposed to an incident or event that threatens his or her personal safety or survival. One thing to remember is that normal adolescents, even without any abnormal stress, have exaggerated amygdala function and therefore increased stress responses.

So stress on top of an already overactive stress-response system can create havoc in the teen brain. Without treatment, those who suffer PTSD can become susceptible to crippling fear and anxiety throughout the remainder of their lives. The symptoms and problems associated with adolescent PTSD include not only fear and anxiety but also sadness, anger, loneliness, low self-esteem, and an inability to trust others. Behavior problems associated with adolescent PTSD also run the gamut from social isolation and poor academic performance to aggression, hypersexuality, self-harm, and abuse of drugs or alcohol.

Most people associate post-traumatic stress disorder with war veterans. In war, most combatants are men and women in their late teens and early twenties, and so their brains pay an even heavier price than those of older adults.

For adolescents in general the two strongest predictors of PTSD are exposure to violence and the sudden death of a loved one, according to the American Psychiatric Association. And of the two, the unexpected death of a loved one is the more common. Nonetheless, researchers have found that health care professionals often overlook the potential for PTSD in adolescents, perhaps because this developmental stage is already marked by emotional highs and lows and other behaviors typical of adolescence, like rebelliousness, withdrawal, acting out, and depression. All of these, however, can also be indicators of PTSD. An important difference between adolescent depression and PTSD is that fear and agitation are more characteristic of PTSD than moodiness and withdrawal. Not surprisingly, anxiety disorders are more likely to develop in children and teens exposed to trauma.

**Chapter 12: Mental Illness**

Because adolescence is already a time of mood swings and behavioral irregularities, it is even more important for parents, guardians, and teachers to be aware of the emotional needs of adolescents, especially in times of crisis and stress, when adolescents’ vulnerability to mental disorders is at its highest. There are two rules of thumb parents should remember: Number one, behavioral changes that seem to cluster or are associated with other symptoms should raise your level of suspicion that you might be dealing with something more than just a difficult teenager going through a phase. And number two, it is better to be safe than sorry. If you have *any c*oncern that radical or progressive changes are happening to your adolescent, then you must seek help for your child.

Difficult or irregular behavior in teenagers can be expressed by a variety of emotional states, from moodiness and sadness to oppositional behavior, rage, and aggression. The line between these highly charged but normal adolescent states and “real” mental illness can be difficult to determine. That’s because these behavior traits (which are common in kids this age), can be seen both in teens without a diagnosable personality or mood disorder *and* in teens with one of the more severe mental illnesses, such as major depression, bipolar disorder, or schizophrenia. Signs of depression, for instance, are hard enough to detect in teenagers you're around all the time. With digital devices as their constant companions, normal teens seem withdrawn compared with teens twenty years ago, making it much harder to distinguish between a shy, introverted adolescent and a seriously depressed one. Adolescents don't engage in as many group activities as they did years ago. All this makes figuring out whether your teenage son or daughter is mentally troubled more vexing. “Real” mental illness must be diagnosed and is usually treatable, but how do you tell? When is it time to worry?

There are two general characterizations of adolescent behavior that can help in making this distinction: severity of mood and change in function. Any exaggeration or deepening of a teenager's mood swings or a predominance of one mood over another- especially anger, sadness, or irritability, and especially if it lasts longer than two weeks- is a sign of possible psychiatric problems. Changes in sleeping or eating habits, a tendency to act out more than usual, taking more risks, and spending less time with friends and family are also warning signs. So are failed friendships and an absence from extracurricular activities.

With major mood and affective disorders, however, there is rarely just one “thing” wrong. For instance, major depression is usually accompanied not only by tearfulness but also by changes in eating habits (and consequent weight gain or loss) or withdrawal from family life. Self-mutilation, alcohol or drug abuse, expressions of self-loathing, violence, and of course, suicide attempts also often accompany major depression.

Severe mental health problems are more common in adolescence then either asthma or diabetes. One in five teens will suffer a mental or behavioral disorder serious enough to affect his or her daily life. Even more alarming: roughly half of all adult mental health disorders begin during adolescence. Among youths twelve to sixteen years of age, up to twenty of girls and ten percent of boys have considered suicide. After motor vehicle accidents, suicide is the leading cause of death for teenagers and young adults.

Anxiety and eating disorders show a surge in adolescence. The adolescent brain is more affected by stress, and hence it is no surprise that anxiety is prevalent in this age window. In fact, recent reports suggest we have an epidemic of anxiety and related disorders such as anorexia in teens these days.

Depression is increasingly recognized as a growing problem in teenagers. The overall prevalence of depression during adolescence is higher than in childhood. Mood disorders in general, including depression and bipolar disorder as well as anxiety disorders, are the most frequently diagnosed psychiatric conditions in teens.

The chief difference between teens and adults who suffer from an anxiety disorder is the source of the anxiety. For adults, anxiety emanates from problems with health or money, difficulties at work, and family issues. For adolescents, it often has to do with friends and school- social acceptance, academic performance, etc.

The vulnerability of a teen to emotional and psychiatric issues cannot be overemphasized. The teenage years are a developmental stage whose by-products are a hypersensitivity to stress, a membership in a peer group equally unable to interpret warning signs or to offer adequate empathy. Here is a major opportunity for the adults around teenagers: Be vigilant, exercise your own well- developed skill set to ask questions, probe, stay connected, and, most important, have a low threshold to seek medical advice or counseling for symptoms that appear to change from the ordinary. Also, as kids these days spend so much time online, isolated, warning signs could be harder to detect. Kids sit alone in their rooms on the Internet and the phone. Years ago, social isolation was quite easy to notice: a kid sitting alone in the cafeteria, on the school bus, or on the top bench of the bleachers. Now moderate physical isolation is a natural consequence of online social interaction, making it much more difficult to detect. But, as a parent, you don't know until you check. Be part of your kids’ lives at home. Don't count on your teenager- or his or her friends- to sound the alarm.

**Chapter 13: The Digital Invasion of the Teenage Brain**

The cascade of neuroprocesses that kicks off the brain's reward circuitry and the rush of the pleasure chemical dopamine can be triggered just as easily by the release of the latest iPhone as by alcohol, marijuana, or a fast car. In some ways, technology is a drug.

There is increasing evidence of the effect of excessive Internet use on mood in adolescents, and several studies have shown a connection between depression, poor academic performance, and the inability to curb time spent online.

The compulsive need to be digitally connected happens on two levels, behaviorally and biochemically. Every ring, ping, beep, and burst of song from a smartphone results in an “Oh, wow” moment in the brain. When the new text message or post is opened, the discovery is like a digital gift; it releases a pleasurable rush of dopamine in the brain. In fact, there is mounting evidence that Internet addiction has much in common with substance addiction.

Average young people, especially boys, we will have played about ten thousand hours of video games by age twenty-one. This is a lot of time honing a skill that is not directly linked to any monetary or educational gain. In his book *Outliers*, Malcolm Gladwell says ten thousand hours is generally the amount of time required to become an expert in any field. This means that as a sideline, our youth are becoming experts in a skill set that has limited use outside itself, except of course for those who go into professions related to the gaming industry or whose job involves a lot of computer simulations. It also has been pointed out that ten thousand hours are more than it takes to get a bachelor’s degree!

It seems that a modest amount of gaming, like any form of learning, can actually be good for the brain. There is a difference between the hard-core gamers and casual gamers.

Obsessive gaming in the adolescent, to the exclusion of most other activities, appears, like addiction, to have both immediate negative effects and long-term negative effects on the brain. Limiting a teenager's use of the Internet isn't easy, but one way to better control it is moving the computer out of your high schooler’s bedroom and into a common area where you can check more readily on what your son or daughter is up to. Software programs can help you monitor what sites your kids visit and block access to others, but the main responsibility is for you to communicate with your teenagers.

**Chapter 14: Gender Matters**

Scientists and psychologists have long known that there are differences in development between girls and boys and that girls’ language development, specifically reading and writing, is generally about one to one and a half years ahead of a boys’.

When we think about gender differences, we often think about emotion. However, there are other ways that the different rates of brain development manifest themselves. An obvious one is organizational skills. Many learning specialists will testify that boys take longer to develop their organizational and attention skills, and the practical implications for educators can be profound.

Given the current statistics- that more girls have higher average SAT scores than boys and girls are more likely to complete high school and to enroll in both undergraduate and graduate educational programs- things are definitely changing from prior generations.

Even today, many people will site apparently scientific evidence for how good men are at visualizing space; they are logical and linear. Women are good at intuiting; they are more creative and empathic and see things holistically. My personal observations is that these black-and-white stereotypes are inaccurate, And there is an ever-increasing amount of data to back that up.

**Chapter 15: Sports and Concussions**

Concussions have gotten increased attention in recent years, but mostly as they relate to men and professional sports. According to the American Academy of Pediatrics, however, the second highest rate of sports-related concussions in high school after boys’ football is girls’ soccer.

There are many myths about concussions I want to dispel right off the bat. First of all, concussions do not affect everyone the same way, and some people may even have a genetic predisposition to them. Also, concussions are a problem not just in contact sports but elsewhere; they can occur in noncontact sports, in car accidents, falls, and even from a severe jostling. The medical community now realizes that concussions can happen without a clear episode of blackout.

More than a decade ago the American Medical Association linked sports-related concussions to lower scores on several tests of cognitive function, but only recently has research helped us realize the complex and frightening truth about the dangers of these concussions on still-maturing brains. Among high school sports with male/female participation- soccer, lacrosse, basketball, baseball, softball, and gymnastics- girls sustained concussions nearly 70 percent more often than boys, Even though boys participate in these sports at a rate slightly higher than girls. Moreover, in soccer in particular, female concussion rates are three times the rate as male players. In a study based on a survey of more than four hundred high school athletic trainers, researchers found it took girls substantially longer than boys to recover from their symptoms and return to action. After a concussion, adolescent girls score significantly worse on visual memory tasks than boys and show greater reductions in reaction times on mental tests.

Although it's not understood why, adolescent athletes take longer to recover from mild traumatic brain injury than adults do. The younger the athlete, the longer it takes. On average, adults need three to five days to recover to baseline on cognitive tests; college athletes need five to seven days, and high school athletes ten days to two weeks.