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Executive Skills and the Teen Brain

It is Tuesday morning at 6:30 A.M. in the Smith household. There is no indication to Mr. or Mrs. Smith that Jesse, their 15-year-old son, is stirring, although he was supposed to be up at 6:15, since his bus comes at 7:00. His mother knocks loudly on his door to remind him that he needs to get up immediately or he will be late. In a voice muffled by his pillow, Jesse mumbles, "Relax, Mom, I'll get there on time." Mrs. Smith sighs. If Jesse misses the bus, she will need to drive him and won't be able to get to work early as planned. Jesse emerges from his room at 6:40, grabs a bowl of cereal, and casually leafs through the sports pages. Every few minutes, his mother reminds him of the time, and he in turn reminds her that she needs to relax. Jesse does manage to get out the door and make the bus but calls 15 minutes later to tell his mother he forgot his lunch and his algebra book, which has his homework in it. He thinks it's on his desk. Could she drop it off on her way to work, before the end of his first period? His mother agrees because she knows Jesse already has missing assignments.

In the last 2 weeks, Jesse has missed his bus twice, forgotten his soccer equipment once, and been late with a major English paper. His teachers have said that Jesse needs to be more responsible for himself and more motivated and conscientious if he expects to go to college. They know he can do the work if he makes the effort, and they have recommended that his parents consider letting him suffer the consequences of low grades and detention to help motivate him. His parents aren't convinced. Over the past year and a half, since he entered high school, "natural consequences" have not had a significant impact on Jesse's time management, sense of time urgency, or organization.

Jesse did well in elementary school. He was a bit disorganized but typically got good grades, and his teachers noted how creative he was. In middle school, his parents had to provide increased support, but he still managed good marks, although his grades for study skills were weaker. Since starting high school, however, Jesse has struggled more. Whereas in middle school teachers used agenda books and checked them at regular intervals, in high school the student is expected to manage these tasks more independently, and Jesse seems increasingly overwhelmed.

Mr. and Mrs. Smith are realizing that while Jesse expresses a desire to be more independent (he said he set an alarm for this morning), they need to provide continuing and in some cases increased support. They don't mind doing that as long as there is some end in sight, but Jesse doesn't seem to be developing the skills he needs to manage the increasing demands of high school. Nor does he welcome their help as he used to. The more irritably he responds, the more conflict seems to characterize their relationship. Now his parents are losing sleep over what will happen when he turns 16 and can drive. And how about after that, when he's ready for college? He has the academic ability, but will he succeed without the parental and teacher support he's getting now? Like many parents, Mr. and Mrs. Smith have a sense that the clock is ticking. How can a young man who is bright and who expresses a desire and an intention to go to college be so scattered?

The problem for Jesse, as for many adolescents, is not one of intelligence. During elementary and even middle school, Jesse demonstrated the ability to do well in school. Around the house, his parents can see that he's bright and engaging, and they, like his teachers, have seen the spark of creativity. When it comes to smarts, adolescents like Jesse have plenty. What they lack, however, are some of the brain-based skills that we all need to plan and direct activities, to regulate behavior, and to make efficient and effective use of these smarts. The trouble does not show up in math or reading; rather, it shows up when they need to regulate their behavior to respond to the demands of a specific situation. Despite their good intentions, these adolescents can struggle with time management and organization. They can say things in conversation or take risks in situations where it seems like they should know better. They do not lack the intelligence to know better, but they may well lack the *executive skills* to help them use that intelligence to regulate their behavior.

What Are Executive Skills?

When people hear the term *executive skills,* they sometimes assume it refers to a set of skills required of good business executives—skills like strategic planning, decision making, and information management. There is some overlap—executive skills definitely include decision making, planning, and management of information, and, like the skills used by a business executive, executive skills help kids get done what needs to get done. But in fact, the term as we use it comes from the neurosciences literature and refers to brain-based skills required for humans to effectively execute, or perform, tasks and solve problems.

By the time your child has reached adolescence, she (like you) needs executive skills to manage the range of tasks and problems she will confront on a daily basis, as well as to regulate her behavior in the face of the temptations and distractions that will arise from the presence of peers. From activities as simple as getting up in the morning or remembering to take a homework assignment to school, to the complexity of managing school and extracurricular activities or driving in a car with a group of peers, executive skills are essential. For 15-year-old Jesse, managing his morning routine requires a number of executive skills. If the morning is to go smoothly and without the nagging of his parents, he needs to plan how much time he will need in the morning, remember to set his alarm clock, organize his homework and get it into his backpack, and get to sleep at a decent hour, inhibiting the urge to respond to the nearly continuous flow of text messages from his friends. If he does manage to remember to set his alarm, when it goes off in the morning he needs to initiate getting himself out of bed instead of opting for the immediate pleasure of additional sleep and then run through a mental checklist of what he needs to get together before he gets on the bus.

Let's be clear here. In general, many teens will have wake-up issues. These come with the territory of adolescence. From a biological perspective, the "wake–sleep clock" in adolescents' bodies changes so that they are naturally awake later but still need a good night's sleep. Unfortunately they live in a school world that does not accommodate these changes. School starts early, and even if nothing else were going on, waking up would be somewhat of a struggle. Add to that a day crammed with school, extracurricular activities, and socializing, and you get some idea of what keeps them up late at night. So even teens with good executive skills are going to struggle at times. Biology and busy lives conspire to ensure this.

Our point about Jesse is that when the system is taxed further by a weakness

in executive skills, the struggle begins to take a significant toll on the teen's and parents' lives and threatens to impact school performance in a student who is more than academically capable.

For teenagers who struggle with these skills, more trouble lies ahead as the tasks in life become more complicated and more demanding of their ability to plan, sustain attention, organize information, and regulate feelings and how to act on them.

Executive skills are, in fact, what your teenager needs to make any of your hopes and dreams for her future—or her hopes and dreams—come true. By late adolescence, our children must meet one fundamental condition: they must function with a reasonable degree of independence. That does not mean that they do not ask for help and seek advice at times, but it does mean that they no longer rely on us to plan or organize their day for them, tell them when to start tasks, bring them items they've forgotten, or remind them to pay attention at school. When our children reach this point, for most of us our parenting role is coming to an end. We begin to speak of our children as being "on their own" and hopefully accept this at some level of comfort, as well as hoping for the best for them. Social institutions do the same, defining them as "adult" for most legal purposes.

To reach this stage of independence, a child must develop executive skills. You have probably seen an infant watch his mother leave the room, wait for a short time, and then begin to cry for his mother's return. Or maybe you have listened to your own 3-year-old telling herself (in a voice that sounds suspiciously like your own) not to do something. Or how about watching a 9-year-old who actually stops and looks before he races into the street after a ball? Or maybe you've watched your teenage son secure a job and take care of his work schedule without your assistance. In all of these cases, you are witnessing the development of executive skills.

Our Model

Our initial work in executive skills dates to the 1980s. While evaluating and treating children with traumatic brain injuries, we found deficits in executive skills to be the source of many cognitive, behavioral, and academic problems. In our clinic we also noted similar, although less severe, types of problems in children with attention disorders. From these origins, we began investigating the development of executive skills for a broad range of children and adults. While there are other systems for developing executive skills (the Resources section at

the back of the book includes references for these systems), our model has been designed to achieve a specific goal: to help us come up with ways that parents and teachers can promote the development of executive skills in kids who have demonstrated weaknesses.

We based our model on two assumptions:

1. *Most individuals have an array of executive skills strengths as well as executive skills weaknesses.* In fact, we found that there seem to be common profiles of strengths and weaknesses. These patterns apply across the board to children and adults, for those who are developing typically as well as those who have been diagnosed with cognitive, behavioral, or academic difficulties. We wanted a model that would enable people to identify those patterns so that kids could be encouraged to draw on their strengths and work to overcome or bypass their weaknesses to improve overall functioning. We also found that it made sense to help parents identify their own strengths and weaknesses so they could be of the greatest help to their kids.

2. *The primary purpose of identifying areas of weakness is to be able to design and implement interventions to address those weaknesses.* We wanted to be able to help children build the skills they need or find ways to manipulate the environment to minimize or prevent the problems associated with the skill weaknesses. The more discrete the skills are, the easier it is to develop specific definitions of them. When the skills can be defined specifically, it is easier to create interventions to improve those skills. For example, let's take the term *scattered*. It is great for a book title because as parents we read the word and know immediately that it describes our child. But "scattered" could mean forgetful, disorganized, lacking persistence, or distracted. Each one of these problems would call for a different solution. So the more specific we can be in our problem definition, the more likely we are to come up with a strategy that actually solves the problem.

The scheme we arrived at consists of 11 skills:

- Response inhibition
- Working memory
- Emotional control
- Flexibility
- Sustained attention
- Task initiation
- Planning/prioritization
- Organization
- Time management
- Goal-directed persistence
- Metacognition

These skills can be organized in two different ways: developmentally (the order in which they develop in kids) and functionally (what they help the child do). Knowing the order in which these skills emerge during infancy, toddlerhood, and beyond, as mentioned earlier, can help you understand how your teenager arrived at the point where she is, as well as what you can expect from her as she moves through adolescence. While all executive skills are important, when it comes to teenagers, parents are likely to be particularly aware of the impact of specific skills. For example, in managing the demands of school, sports, work, and an active social life, the skills of planning/prioritization, organization, task initiation, and time management are particularly important. In terms of the types of activities that teenagers engage in that keep parents awake at night, they will want to know that their children have the capacity for response inhibition so that they do not routinely engage in impulsive and risky behaviors. And as driving comes into play, sustained attention becomes a critical skill. This is especially true since sustained attention can easily be affected negatively by one of the most important elements in a teenager's life, the presence of peers, as well as the constant availability of devices to maintain contact with those peers.

In the table on pages 15–17 are listed executive skills in the order of emergence, definitions of each skill, and examples of how they are manifested in teens.

When Do the Different Executive Skills Begin to Develop?

Infant research tells us that response inhibition, working memory, emotional control, and attention all develop early, in the first 6–12 months of life. We see the beginnings of planning a little later, when the child figures out a way to get a desired object. Flexibility shows in the child's reaction to change and can be seen between 12 and 24 months. The other skills, such as task initiation, organization, time management, and goal-directed persistence, come later, ranging from preschool to elementary school, with metacognition coming latest, at 10 or 11 years of age.

In some cases, parents know well before adolescence that their children have weaknesses in executive skills. A problem with flexibility might show up in preschool as regular tantrums in response to unexpected change. You might have learned early on that it was important to maintain predictable routines for your child. As time went on, the foot-stomping tantrums may have subsided, but you still recognize the burst of anger in your teen when you present an agenda

Definition and Examples of Executive Skills

Executive skill	Definition	Examples
Response inhibition	The capacity to think before you act—this ability to resist the urge to say or do something allows your child the time to evaluate the situation and how his behavior might impact it.	Some teenagers think about the consequences before they do something. Other kids just act—they don't waste time thinking about the consequences.
Working memory	The ability to hold information in memory while performing complex tasks. It incorporates the ability to draw on past learning or experience to apply to the situation at hand or to project into the future.	Some kids keep track of their belongings, like coats, keys, or sports equipment, or are really good at remembering what they have to do. Other kids forget where they have left stuff and misplace things a lot or say, "I'll do it later," but then forget about it. Some kids seem to learn from experience; others don't.
Emotional control	The ability to manage emotions to achieve goals, complete tasks, or control and direct behavior.	Some teenagers have a short fuse and get easily frustrated by little things or get stressed out if something doesn't go right. Other teenagers can stay cool despite irritation and take unexpected events in stride.
Flexibility	The ability to revise plans in the face of obstacles, setbacks, new information, or mistakes. It relates to an adaptability to changing conditions.	Some teenagers can "go with the flow" and adjust fairly easily to a change in plans. Others plan out in their head in advance how something will go and get upset if it doesn't happen as planned.
Sustained attention	The capacity to keep paying attention to a situation or task in spite of distractibility, fatigue, or boredom.	Some kids complete homework or chores without having to be hassled by their parents, while other kids start but don't finish unless someone is on their case.

Executive skill	Definition	Examples
Task initiation	The ability to begin projects without undue procrastination, in an efficient or timely fashion.	Some kids are good at making themselves set aside fun stuff to do their homework or to start on their homework right away. Other kids have a hard time pulling themselves away from fun things (texting, Facebook) to do work and put off homework as long as possible.
Planning/ prioritization	The ability to create a road map to reach a goal or to complete a task. It also involves being able to make decisions about what is important to focus on and what is not important.	Some kids are good at figuring out the steps needed to do a project or figuring ways to save money for something they want. Others don't know where to start or how to make a plan, or want expensive things but don't know how to go about saving money for them.
Organization	The ability to create and maintain systems to keep track of information or materials.	Some kids keep notebooks and backpacks organized to find things easily or put things back in a specific place as soon as they have finished using them. Other kids can't find things in their notebooks or backpacks because they are a mess, or they leave their belongings around the house (or even at other people's houses!).
Time management	The capacity to estimate how much time one has, how to allocate it, and how to stay within time limits and deadlines. It also involves a sense that time is important.	Some kids are reliably on time for school or can finish their homework in the time that they have available. Other kids are chronically late or routinely scrambling to make a deadline, or always seem to run out of time for the homework they have to do.

Executive skill	Definition	Examples
Goal-directed persistence	The capacity to have a goal, follow through to the completion of that goal, and not be put off or distracted by competing interests.	Some kids are willing to set aside fun stuff to achieve a long-term goal or find ways around the obstacles that might stand in the way of getting what they want. Other kids live by the precept "You're only young once" or give up working toward a goal if something blocks them.
Metacognition	The ability to stand back and take a bird's-eye view of yourself in a situation, to observe how you problem-solve. It also includes self-monitoring and self-evaluative skills (for example, asking yourself, "How am I doing?" or "How did I do?").	Some kids are good at sensing how others are reacting to their behavior or ideas. Other kids focus more on getting their point across and may not pick up on feedback from others.

different from the one he was planning. If your child's kindergarten teacher reported that your child couldn't wait his turn, was constantly out of his seat, and spoke without raising his hand, you might have been observing weak response inhibition. In adolescence, this weakness might evolve into fooling around and talking out in class and, on the home front, risk taking, particularly behind the wheel. (This is Dick talking:) When I volunteered in my son's first-grade class, I saw him regularly daydream through teacher directions, and throughout elementary school I was a regular visitor to lost and found. Interestingly, I often saw the other parents whose kids struggled with these skills there, and we came to recognize the belongings of one another's children, at times dropping them off for each other. Car keys, books, cell phones, and articles of clothing all fell victim to his weaknesses with attention and organization when he was a teenager.

If you've been seeing problems like these since your teen was younger, chances are you've developed some strategies and probably teaching techniques

so you and your child could cope better with these situations. Interventions like maintaining predictable routines, designating when he could have his turn, and establishing a place for belongings and cues to put them there are all strategies that parents can use effectively. During adolescence, the principles that guide the earlier interventions (change the environment, teach the skill, motivate the teen to use the skill) don't change. What does change is the approach (moving from giving a direction to conducting a negotiation) and the situations around which the negotiations occur. Much of the remainder of this book is devoted to spelling out the details of these interventions for you.

On the other hand, your experience could have been with a teen more like Jesse. That is, perhaps you haven't seen significant problems before now. This is likely because the supports provided by you and by the school were sufficient to prop up your teen's weak skills. With time, as a child ages and moves into middle and then high school, expectations change ("They need to be more responsible for themselves"), and family and institutional supports gradually fall away. For these children, increasing demands on executive skills coupled with a decrease in naturally occurring supports expose a problem that may not have required significant intervention in the past.

Thinking Skills versus Doing Skills

Knowing how each skill functions—whether it contributes to teenagers' thinking or doing—tells you whether the goal of your intervention is to help your child think differently or to help your child behave differently. If your adolescent has weak working memory, for instance, you will be working with her on strategies to help her retrieve critical information (such as what she has for specific homework assignments). If your teenager has weak emotional control, you will be working with him on strategies to control his temper when he finds out that his little brother has removed something from his room. In fact, though, thinking and doing go hand in hand. Very often, we are teaching kids how to use their thoughts to control their behaviors.

Thinking skills are designed to select and achieve goals or to develop solutions to problems. They are especially important skills for teenagers because they help them create a picture of a goal and a path to that goal, and they give them the resources they will need to access along the way to achieve that goal. They also help the teenager remember the picture, even though the goal may be far away, when other events come along to occupy his attention and take up space in his memory. But to reach the goal, your teenager needs to

use the second set of skills, ones that enable him to do what he needs to do to accomplish the tasks he sets for himself. This second set of skills incorporates behaviors that guide the teenager's actions as he moves along the path. The organizing scheme is depicted in the table below.

When all goes as planned, beginning in early childhood, we come up with ideas for things we want or need to do, plan or organize the task, squelch the thoughts or feelings that interfere with our plans, cheer ourselves on, keep the goal in mind even when obstacles, distractions, or temptations arise, change course as the situation requires, and persist with our efforts until the goal is achieved. This may be as time-limited as completing a 10-piece puzzle or as extensive as remodeling our house. Whether we are 3 years old or 30, we rely on the same set of brain-based skills to help us reach our goal.

Developmental Trends

As you've watched your child grow and develop, you've seen changes and improvements in your child's ability to regulate her behavior, in other words, in her executive skills. While at 2 years old you wouldn't have thought of letting go of your child's hand in a busy parking lot, by age 7 you may well have been comfortable with her walking independently, relying only occasionally on verbal reminders. From the time of our children's first independent movements, in the first year of life, we are increasingly aware of their ability and desire for

Two Dimensions of Executive Skills: Thinking and Doing

Executive skills involving *thinking* (cognition)	**Executive skills involving *doing* (behavior)**
Working memory	Response inhibition
Planning/prioritization	Emotional control
Organization	Sustained attention
Time management	Task initiation
Metacognition	Goal-directed persistence
	Flexibility

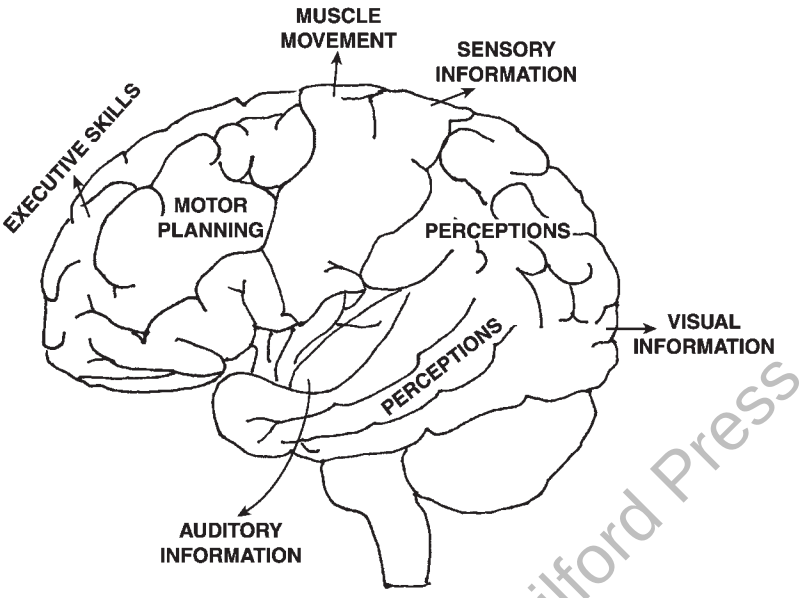
independence. At the same time, we are aware that their executive skills are not well enough developed for the children to manage their behaviors or solve problems without direction or guidance from us. Everything we teach our children reflects our understanding of how we are using our executive skills to help them develop and refine their executive skills.

Now, as our children enter adolescence, we become acutely aware of how important this skill development has been and will continue to be if our children are to safely negotiate the challenges of adolescence and emerge in 4 to 6 years with sufficient ability to manage on their own. Understanding their skills and the support that we need to provide during this period is especially critical for a number of reasons. As a natural part of development, teenagers want to establish their own identity. From the teen's perspective, a key feature of establishing one's identity is the ability to make decisions independently. A second significant feature of adolescence is the increased influence of peers on the teenager's decision making and the corresponding decrease in parents' influence. The third critical element in this period is the fact that there are real challenges and potential risks associated with these decisions in the teenager's world. These challenges include managing school demands, establishing positive social interactions with peers, and maintaining safety in the context of driving, availability of alcohol and drugs, and the beginning of sexual relationships.

Parents of teenagers, particularly of those children with weak executive skills, face their own set of challenges during this period. On the one hand, most parents recognize that they must continue to provide guidance for their children to avoid serious, if not catastrophic, mistakes. On the other hand, they recognize that their children will show various degrees of resistance to this guidance. For those parents who attempt to control their child's decision making, there is likely to be frequent conflict. When parents avoid providing this guidance, the likelihood of poor decision making on the part of the teen is increased significantly. Before we get into how parents and teens can negotiate these challenges, it will be helpful for you to understand how children come by executive skills.

How Executive Skills Develop in the Brain: Biology and Experience

As is the case with many of our abilities, there are two main contributors to the development of executive skills—biology and experience. In terms of the



The human brain, with the approximate location of major functions.

biological or neurological contribution, the potential for executive skills is essentially innate, already a part of the brain's wiring at birth. This is similar to the manner in which language develops. Naturally at birth, executive skills, like language, exist only as potential. That means that the brain has within it the basic biological equipment for these skills to develop, but a number of factors can influence how these skills develop. Any type of major trauma or physical insult to the child's brain, particularly if this involves the frontal lobes, will adversely affect executive skill development. Genes also can play a major role, and therefore the genes that the child inherits from you can also impact these skills. If you don't have good organizational skills or attention, there is a better chance that your child will have problems in these areas as well. As far as the environment is concerned, if it is biologically or physically toxic, there is an increased likelihood that the child's executive skills will suffer as a result. Environmental toxins can include anything from lead exposure to child abuse. And there is growing evidence that severe psychosocial stress can adversely impact executive skills development. However, if we assume reasonably normal biological equipment and the absence of genetic or environmental traumas, brain development will proceed as it is supposed to.

Biology: Growth + Pruning + Experience = Executive Skills

At birth, the child's brain weighs about 13 ounces. By the late teenage years, brain weight has increased to nearly 3 pounds. A number of changes account for this increase in size and weight. First, there is rapid growth in the number of nerve cells in the brain. These nerve cells must communicate if the child is to think, feel, or act. So they can "talk" to each other, the nerve cells develop branches that allow them to send and receive information from other nerve cells. The growth of these branches, called axons and dendrites, is especially fast during the infant and toddler years. They are connected to one another by synapses, which along with the axons and dendrites, are the wiring that allows our brains to send and receive information. In a newborn baby, each neuron, the cell that sends electrical signals, has about 2,500 synapses. Over the next 3 years or so, that number increases to around 15,000 synapses.

Also during these earliest stages of development, a substance known as myelin begins to form a fatty sheath around the axons. This process of myelination insulates the branches that carry the nerve impulses, making the "conversations" between nerve cells faster and more efficient. Myelination continues well into the late stages of adolescence and early adulthood and is responsible for the development of what is often called the white matter of the brain. The white matter consists of bundles of axons that connect different brain regions and allow them to communicate. Then there is gray matter. This is a term often used as a metaphor for the learning, thinking part of the brain itself. The reason for this is that gray matter is made up of nerve cells, or neurons, as well as synapses, the connections between them discussed above. The development of this type of brain matter is a bit more complex. At the fifth month of pregnancy, the brain of the unborn child is estimated to have about one hundred billion neurons. This is actually comparable to what the average adult brain has. Early in childhood, the total number of synapses in the brain (about a quadrillion) greatly exceeds the number there will be in the adult brain. If the development of neurons and gray matter continued at this pace, the adult brain would be enormous. Instead, a different phenomenon occurs. The increase in gray matter—neurons and particularly synapses—peaks before the age of 5 and is followed by a gradual reduction or "pruning" of the neuron connections. The initial increase happens during a period of rapid learning and experience in early childhood. Recent brain research suggests that as this learning and skill developmental become more efficient, additional increases in gray matter could actually undermine the learning.

Through pruning, the child consolidates mental skills, and the gray matter connections that are not needed or used drop away. Until recently, scientists thought this surge in neuron and synapse growth, followed by pruning, happened only once during child development, when children were young. However, recent research has demonstrated that there is another major surge in growth of neurons and synapses just before adolescence, followed by a process of pruning that extends throughout adolescence.

In terms of what we know about the development of executive skills, research shows that this growth spurt in the brain prior to adolescence occurs primarily in the frontal lobes. Scientists now generally agree that the frontal brain systems play a key, though not exclusive, role in the development of executive skills. Therefore, we can safely say that these areas, which include the frontal and prefrontal cortex, along with connections to adjacent areas, in large part make up the brain base for executive skills. As far as the growth spurt is concerned, it is as if during the preteen years the brain is preparing itself for the development of executive skills and the significant demands that will be made on those executive skills during adolescence. The diagram on page 21 shows the human brain with the approximate location of major functions, including executive skills, in the prefrontal cortex.

As part of this research looking at brain development during adolescence, scientists at the National Institute of Mental Health have also suggested that a "use it or lose it" process may be occurring in the frontal lobes during this time. Neural connections, including synapses, that are used are retained, while those that are not exercised are lost. If this is in fact the case, it means that the practice of executive skills is critical. Teenagers who practice executive skills are not only learning self-management and independence, but in the process are also developing brain structures that will support their executive skills into later adolescence and adulthood.

As noted earlier, you may have noticed executive skills weaknesses in your child early on and have been practicing these skills with her for some years. Does that put you ahead of the game? In the sense that you understand how the weaknesses manifest themselves and what strategies might work to help your teen be more successful, the answer is yes. Is your child in better shape to enter adolescence than the one whose parents are just now recognizing a weakness? Maybe. While earlier practice may have helped, you might have become aware of the problem earlier because the skill deficit was more significant. In that case challenges will still be significant in adolescence. Earlier practice has probably promoted the development of neural pathways underlying these skills, but

continued practice will be essential if your teen is to manage the new executive skills demands that inevitably come with adolescence.

What about the teen who is showing problems for the first time? Is it too late to intervene? The answer is an emphatic no! In fact, the developing teen brain presents an excellent opportunity for you to influence executive skills in your teen. But to take full advantage of that opportunity you should be aware of certain reactions you and your teen may have that could throw up a roadblock. The realization that your teen is struggling and may need increased support can feel discouraging. For your teen, this struggle may feel humiliating—or at least acknowledging it probably feels like an impediment to the teen's desire for autonomy.

The key is understanding these factors, understanding the issue of weak or lagging executive skills, and knowing how to intervene using the resources we've provided here. This time period represents a critical window of opportunity for the practice and development of executive skills, so it's worth trying to overcome obstacles. To help you in this process, we have provided detailed guidelines for gauging how your teen responds to the problem and what approach will be most effective.

Practice is important to the acquisition of executive skills for another reason. Researchers who studied the brain using fMRI (functional magnetic resonance imaging) have found that when children and teenagers perform tasks that require executive skills, they rely on the prefrontal cortex to do nearly all of the work rather than distributing that workload to other specialized regions of the brain. Two of these other regions, the amygdala and the insula, are parts of the brain that are activated when making quick decisions that affect safety and survival (the fight-or-flight response). In contrast to children and teenagers, adults can spread out the workload in part because they have had years of practice to develop the neural pathways to make this possible. Activating executive skills takes more conscious effort with children and teenagers than it does with adults, which may help explain why they are less inclined to engage their executive skills to perform tasks of daily living. Related to this, recent research has demonstrated that when risky situations are described to adults, the risk is so obvious to them and they are so practiced at understanding the risks that they don't have to engage large areas of their frontal lobes. In contrast, the riskiness of a situation is significantly less obvious to adolescents, and they have to make an effort to engage the frontal lobes to determine if in fact the situation does represent a significant risk. Considering this, it is not hard to imagine that a group of teenagers challenging or encouraging one another to engage in a risky behavior can readily lead to bypassing this effortful thinking and impulsively

engaging in the behavior. To highlight these issues of development in the adolescent brain, a recent article in *Parade* magazine compared the teenage brain to a Ferrari. It is fast, shiny, sleek, and it handles well. The problem is it has lousy brakes.

This is where you and your teenager's teachers, coaches, and employers come in. Adolescence offers parents and other adults in their lives a critical opportunity to enhance the development of executive skills in the teen. In the adolescent brain, the huge surge in brain wiring and the process of pruning these connections will extend into young adulthood. The biological changes occurring during this period represent the last significant alterations in the brain before it achieves mature adult status in the mid- to late 20s.

The Mystery of the Adolescent Brain—and Teenage Behavior

In one sense, the adolescent brain is well suited for the task at hand—learning the skills that will be required for adult living. Through practice and experience, the pruning process will continue and the brain will gradually shed unused synapses and dendritic branches, strengthen other synapses, and increase the efficiency of nerve transmission through myelination of axons. Over a period of 10 to 12 years, beginning around puberty, the plasticity of the adolescent brain allows for rewiring. What the final wiring diagram looks like depends on two factors: what teens bring with them up to puberty and what experiences they have over the next 10 years or so. While on the one hand adolescents have a brain that is primed for learning through experience, they also have a brain that is ill suited for fully independent decision making about what those experiences should be. Why? Let's consider some other characteristics of the adolescent brain. Above, we mentioned risk taking and noted that teens take more effort to engage their frontal lobes when considering risk. Nonetheless, when they do, their assessment of the degree of risk in a hypothetical situation is comparable to that of adults. Why is it, then, that they still engage in risky behavior more often than adults? It's because of what neuroscientists refer to as "hot" versus "cool" cognition. "Hot" cognition means that teens are thinking under conditions of intense emotion and high arousal (like when you and your teen disagree about an overnight beach party). You see the risk, but your teen sees the reward. For teens, anything that arouses emotion—fear of social rejection, the need to look cool, disappointing someone, disagreements with parents—can lead to "hot" (and less rational) thinking. This helps us understand why at times our children seem like mature, reasonable teens

and at other times like moody, demanding 5-year-olds. It also explains why it is important for parents to maintain their "cool" in discussions and disagreements with teens. Strong emotional reactions from parents fuel the emotional reactions of teens.

A second characteristic of adolescent brains that can help us understand their behavior has to do with neurotransmitters. Neurotransmitters are chemical-like substances that travel between nerve cells across a synapse and determine whether a nerve signal keeps going or halts. Levels of two of these neurotransmitters, dopamine and serotonin, decrease during adolescence. The decrease in dopamine results in mood changes and problems with emotional control. The decrease in serotonin results in decreased impulse control. A third neurotransmitter, melatonin, increases in adolescence. Melatonin is responsible for circadian rhythms and the sleep–wake cycle. Its increase results in a need for greater sleep. This helps to explain how teens can sleep for extended periods on weekends. The increase also means that teens will be sleep deprived through the combination of staying up later, leading busy lives, and attending the early classes that we noted above. So we have "hot" thinking, increased moodiness, decreased emotional and impulse control, and fatigue, all of which come with the territory of adolescence.

A third facet of the adolescent brain involves a part of the brain called the limbic system, which is referred to as the more primitive or emotional part of the brain. As adults, we still experience the emotions and drives that originate from the limbic system, but the prefrontal cortex helps to regulate and "damp down" these emotions and drives. For teens, the incomplete development of the frontal lobes and prefrontal cortex, along with the changes noted above, means that they will rely more on the emotional parts of their brain in decision making. The result? They will be quicker to anger, show more intense mood swings, and make choices based on gut feelings rather than logic.

The final factor involves sensation seeking. The nucleus accumbens has been identified as one of the "reward centers" in the brain. This area of the brain is highly sensitive in teens, and it sends them powerful signals to pursue a desirable activity or situation. The neurotransmitter dopamine produces pleasurable feelings, but because teens have less dopamine available they will need more intense levels of stimulation to produce the same feelings of pleasure and reward. The result is that they will seek the excitement associated with new, more intense experiences and the thrill associated with risks.

How these four factors play out with any particular teen depends on his or her emotional makeup and vulnerabilities, state of frontal lobe development (in behavioral terms, how mature the teen is), and experience (does the teen

feel competent in some area—social, academics, work, sports, arts?). Think of changes in the adolescent brain as "turning up the volume," particularly on whatever executive skills weaknesses and emotional vulnerabilities the teen brings into adolescence.

The All-Important Prefrontal Brain System

As we have noted above, the prefrontal brain systems play a key role in the development and application of executive skills. The prefrontal systems are among the last areas of the brain to develop fully, in young adulthood, and are the final, common pathway for how we manage information and how we regulate our behavior. As the frontal lobes develop, if they are working well, they help us manage our behavior and use our executive skills in the following ways:

1. The frontal lobes direct our behavior, helping us decide what we should pay attention to and what actions we should take. *Example:* A 17-year-old gets a text message from his friend inviting him to play an online video game that is starting in a few minutes. He wants to play but decides to finish his math homework, which he knows his mom will ask him about when she gets home.

2. The frontal lobes link our behaviors together so that we can use past experience to guide our behavior and help us make future decisions. *Example:* A 16-year-old remembers that when she has a plan to stay over with friends, her parents want details about the plan, including who will be there, what parent will be there, and contact information and a time when they can speak to that parent. Prior to asking her parents' permission, she prepares all of this information, including when and at what number they can contact her friend's parent.

3. The frontal lobes help us control our emotions and our behavior, taking into account external and internal constraints as we work to satisfy our needs and desires. By regulating our emotions and social interactions, the frontal lobes help us meet our needs without causing problems for ourselves or others. *Example:* A 15-year-old wants to attend a beach party with some new kids he has met at school. His 17-year-old brother informs his parents that there will likely be alcohol and drugs at the party. Although upset, the 15-year-old does not get into a fight with his parents or brother about the decision that he cannot go.

4. The frontal lobes help us observe, assess, and fine-tune, allowing us to correct our behavior or to choose a new strategy based on feedback. *Example:* A 16-year-old forgets her basketball jersey for a game and, as a result, is not allowed to play. She remembers to organize all of her equipment and check it before she leaves for school in the morning so that this will not happen again.

So in terms of biology and brain development, what does this mean for your teenager? First, we know that executive skills are critical to successfully negotiating the challenges of adolescence, including risk assessment and independent living. As parents, these are basic goals that we have for our children. Second, we know that at birth, executive skills exist only as potential; a newborn has no actual executive skills. Third, frontal brain systems, and therefore executive skills, will require approximately 25 years to develop fully. Given these factors, children and adolescents cannot rely solely on their own frontal lobes and executive skills to regulate behavior. What's the solution? We lend them our frontal lobes, acting as surrogate frontal lobes for our children. Although we might not think of it in these terms, parenting is, among other things, a process of providing executive skills support and coaching for our children. As we will see, for parents and their teenagers this is both critical and challenging.

Experience: Lending Your Child Your Frontal Lobes

In the earliest stages of your child's life, you simply were the frontal lobes for your child, and your child had little to contribute. Your own executive skills planned and organized your child's environment to ensure safety and comfort, monitoring of basic behaviors such as sleeping and eating, social interactions, and problem solving when your child was upset or distressed. Your child, as a newborn, had very few behaviors—sleeping, eating, crying—with which to manage her world and was totally dependent on your responses to her needs. But at about 5 or 6 months of age, your infant began to develop some of the skills that would eventually lead to self-management and independence. The first of these skills to develop, at about 5 or 6 months, was response inhibition. This ability to respond or not respond to a person or to a situation is at the heart of behavioral self-regulation. We are well aware of the trouble that our children can get into if they act before thinking. You may have been impressed in the past by the self-control of a child who could see a tempting object and not immediately touch

or take it, and you'd be impressed now if you saw your teenager forgo meeting with friends to work on a school project. When your child began to develop this skill at about 6 months, you wouldn't have initially seen any striking changes. What you probably did note was that the infant was somewhat more active and interactive. Between 6 and 12 months, the baby's ability to inhibit or initiate responses grew significantly. For example, you might have seen your 9-month-old crawling toward her mom in the next room. Whereas a month or two earlier she might have been distracted by finding a favorite toy along the way, by 9 months she was crawling right past the toy on her way to her mother. You may also have noticed that your baby could now withhold some kinds of expression and show others depending on the situation. We have probably all had the experience of trying to engage a baby at this age who then doesn't respond at all or even turns away. It feels like rejection, doesn't it? Even at this young age, a baby is beginning to learn the powerful effect of responding or not responding to a particular person or situation. The 3- or 4-year-old shows this skill by "using his words" instead of hitting a playmate who tries to grab his toy. The 9-year-old is using the same response inhibition skill when he looks before running into the street to get a ball, and the 17-year-old shows response inhibition by staying near the speed limit instead of responding to his friend's suggestion "Let's see what this thing can do."

A second key skill developing in the same time frame is working memory. During the first 5 or 6 months of life, your infant lived perpetually in the present. If she couldn't immediately taste it, touch it, smell it, hear it, or see it, it did not exist. For the young infant, out of sight is out of mind. At about 6 months of age, your baby developed a very basic capacity to hold visual information (objects, places, people) in mind when not in its presence. This was the beginning of the child's being able to carry part of her world and her experience with her. This allowed for the chance to make choices and "decisions." For example, if Mom left and did not come back immediately, the baby could look to the last place where she saw her and cry. Mom might have returned. If this happened, the baby "understood" at some level that "If Mom leaves and I want her back, she will come if I cry."

As information and experience grew, working memory allowed your child to recall a past event, apply it to a present situation, and predict what might happen in the future. For example, suppose your child is now 15 years old. She might say to herself, "Last Saturday, after I helped with cleaning the house, Mom and I went shopping. I'll ask her if we can do something like that again after I help her with chores today." Or the 17-year-old could say, "My boss asked me to work tomorrow night. I need to tell her that I can't. The last time I

worked before a test, I didn't leave enough time to study and got a bad grade." It is obvious that the baby's recall of Mom leaving the room was a far cry from her skills at age 15 or 17, but with her ability to hold a picture of Mom in mind, we can see the beginning of this control. To help our children develop a skill like working memory, we provide them with certain types of experience. For example, we provide manipulative "cause–effect" toys such that when the baby performs an action, like banging it, the toy does something, like move or make a noise, or we make toys "disappear" and have our children look for them. Once the child can move, we might have him retrieve or search for objects. As he gains language, the child begins to manage his behavior by remembering directions and rules repeated and displayed by you, and then later again, you can ask questions like "What do you need for this activity?" or "What did you do the last time this happened?"

In combination with response inhibition, we can begin to see how experience stored in working memory can influence the child's decision to respond or not respond to a situation.

Throughout childhood, we see first these and then the other executive skills beginning to emerge and develop so that by the time our children reach adolescence, they are using all of these skills. At the same time, we are acutely aware that these skills are not fully developed and that our children need the continuing support of our frontal lobes to negotiate turbulence and manage risks. Maybe you have a daughter who habitually leaves lit candles in her room when she goes out for the night. Or your son has a penchant for lighting small fires without a permit or a whole lot of common sense. Perhaps you know a teen who never puts money in the meter and shoves parking tickets under the front passenger seat. We know one teen who, on three separate occasions, has gotten out of his car only to have it roll away, later blaming the fact that he left it in gear while on an important phone call. We also know a high school sophomore who tried to arrange a nighttime beach party with no chaperones.

As we have noted, these risks loom large for parents: driving, availability of alcohol and drugs, and sexual relationships. In addition, we understand the implications of poor school performance and the limits this can place on the adolescent's options and choices at the end of high school. We can see the challenges, and we understand that our children do not always appreciate the longer-term consequences of their actions. In their day-to-day activities, they are often what Russell Barkley describes as "context-dependent." By this he means that their behavior is influenced largely by what they experience right here, right now. Therefore, they are attracted to situations and activities that are fun, interesting to them, and immediately rewarding (TV, video games, computer,

etc.). This characteristic of context-dependent behavior, along with the importance and influence of peers, keeps their focus in the present and makes it much more difficult for them to see what their behavior might mean for their future.

It is a Sunday morning in November. After working a double shift on Saturday, I am looking forward to a day of relaxation and personal time. But there is a problem. Sitting on the dining table in front of my breakfast is an assignment for a six-page U.S. History paper, which is due on Monday. Although I would prefer not to have to do the assignment, it is relatively painless. U.S. History is a subject I like and am good at. This essay should be a piece of cake for me.

My dilemma is that there is a football game today. The Patriots play the Jets at one o'clock. I am confident that I will easily write my paper, but the research and writing will occupy a large part of my day. I know that in the past things like this have been difficult for me to focus on for long periods of time. I decide to create a schedule. Over the past few months, my parents and teachers have tried to impress on me the value of creating and adhering to time tables in order to help me work on pace and finish on time. I decide, from considering a number of factors (familiarity with the subject, past performance, availability of research information), that this paper will take me 6 hours, start to finish. I allot 2 hours for researching the topic. The remaining 4 hours are for the actual writing. Normally I would allow for 1 hour of writing per page, but since I like history and because the last 2 pages will be opinion-based writing, I decide 4 hours is feasible. But then I get clever with my plan. I know that I am prone to distraction for assignments like this. So instead of the above pace, which assumes I am focusing fully on the task at hand, I double the time allotted for the writing portion of the assignment. By giving myself 8 hours to do a task that I am capable of doing in 4, I've successfully anticipated and dealt with my problems before they even arise. Now I've created a plan to follow and am more likely to be successful in writing my paper, and am also using a teacher- and parent-suggested technique for dealing with my focus problems. Satisfied and optimistic, I sit down in front of the TV with my laptop at 10 A.M., confident that by 8 P.M. I will be closing the laptop, having achieved both of my goals: a relaxing, stress-free day and a completed paper.

I work for 3 hours, finishing my research and getting through the introduction. So far I am on pace and have achieved my goal of working both casually and uninterrupted. My father comes into the living room at 1 to watch the opening of the game and check my progress. He knows about the

paper, but I don't tell him about my schedule, just that I have everything under control. It is my plan, after all, and I am afraid that if I tell him about it he will criticize it before it even has a chance to work.

I watch the Patriots game and fall behind my pace, but with the padding I have given myself I have more than ample time to catch up. The four o'clock football game starts and I linger on it, thinking intermittently about how to begin my third paragraph.

My father returns, and when he sees how little progress I have made he gets agitated. We argue, me telling him that I have a plan and that how I choose to spend my time is my business. He says that I am putting my free time before my work and that mixing the two is counterproductive. He says that this isn't what he or the teachers had in mind—this isn't the plan they wanted. We yell and he finally leaves, saying that I am foolish for trying to have my cake and eat it too.

I finish the paper at 11 at night, writing the last three pages in an hour, after my dad came in and ordered me to shut the TV off. He told me that he knew this plan wouldn't work and that next time I should just do the work. Maybe he is right, but I won't admit it openly. In fact I insist that he distracted me from my work by criticizing my efforts to address my own problems. I tell him that he is being counterproductive by not allowing me to experiment with different methods for dealing with my responsibilities. He tells me that if he didn't put his foot down, I'd never get any work done.

(This is Dick talking:) This vignette, written by my son, Colin, depicts a situation that played out dozens of times between us when he was in high school. At the time, I saw his behavior as just one more example of context-dependent and task-avoidant behavior. Since I was focused only on the outcome (the paper), it took a long time for me to realize that I had missed an opportunity to help him develop and use his own problem-solving skills. Perhaps Colin would have finished the paper. If not, it might have been an opportunity for us to discuss his plan and make changes.

For parents of teens with executive skills weaknesses, when to risk short-term failure for a longer-term gain is an ongoing dilemma. The opportunity to fail is critical to learning, and parents need to be able to assess the potential costs versus the benefits of giving their teen the opportunity to fail. We are not advocates of a full-blown "tough-love" approach that says that teens will always learn from their mistakes. For adolescents with significant executive skills weaknesses, the proverbial "throw them off the dock to teach them how to swim" is likely to result in a string of failures, some of which may be catastrophic.

Instead, the goal of parents is to "keep them in the game" by providing enough frontal lobe support to help them evade major failures while at the same time giving them the chance to take risks and experience the consequences. We will provide guidelines for parents to assess risk versus reward—when it makes sense to give the teen some leeway and when it is time for the parent to step in and make a decision. Adolescents, fortunately, are somewhat ambivalent about their independence. While there are times when they resent their dependence and the meddling of their parents in their lives, there are other times when they seek out their parents for advice and support.

Our goal in writing this book is threefold: First, we want to help you understand what executive skills are and how these skills are the foundation for your teen's ability to live independently. Second, we want to provide tools to help you evaluate your teenager's specific executive skills as a way to understand where the teen may need support. And third, we want to provide specific and concrete information about how you can continue to act as "surrogate frontal lobes" for your teenager while at the same time respecting and fostering your teen's desire for independence.

We see adolescence as a time of great opportunity for parents. As we have noted, the brain is primed to acquire new abilities, and learning and practicing executive skills is key among these. Because of your changing relationship with your child during adolescence, you also have a unique opportunity to partner with your teenager in a way that provides guidance and at the same time provides direction for independence.

Why Does Your Teen Have Executive Skills Weaknesses?

There are at least three different sources of executive skills weaknesses in teens. The first is conditions or diagnoses characterized by deficits in executive skills. These include attention-deficit/hyperactivity disorder (ADHD), autism spectrum disorders, and traumatic brain injuries. The second source involves situations or conditions that are related indirectly to executive skills weaknesses. These include sleep disorders, mood disorders such as depression and anxiety, and habit disorders such as drug or alcohol abuse. The third source has to do with normal variations in executive skills.

Let's take the diagnoses first. Russell Barkley has made a compelling case that ADHD is first and foremost a disorder characterized by weaknesses in

executive skills. Subsequent work by a number of researchers and clinicians in the field has added to the strength of this theory and helped to identify the executive skills typically affected. These routinely include response inhibition, attention, time management, planning and organization, and working memory and often involve the others we have discussed. The prototype for the "scattered teen" is the one who has ADHD. Since even conservative estimates conclude that 3 to 5% of the childhood population has ADHD, scattered teens exist in significant numbers.

Children on the autism spectrum, including those with Asperger syndrome, are also identified as having executive skills weaknesses. In our experience, problems with flexibility and emotional control are typical, as is difficulty with metacognition in the sense of being able to self-monitor and adjust behavior to the demands of a situation, particularly a social situation. Parents and teachers also report a range of other executive skills deficits.

In the case of traumatic brain injury, including multiple concussion injuries, impairments in executive skills are well documented and fairly common as a result of the susceptibility of the frontal lobes to acceleration/deceleration injuries where the head rapidly snaps back and forth. Weaknesses often include difficulty with response inhibition, flexibility, planning, working memory and, in teens, emotional control.

This doesn't cover all the populations for whom there is evidence of deficits in executive skills but does indicate some of the more common disorders associated with these weaknesses.

We recognize conditions indirectly related to executive skills deficits because these can be fairly common in adolescence. As we have noted, sleep deprivation adversely affects executive skills, and teens routinely suffer from sleep deprivation. Certainly we can see the impact of this on their attention or moodiness. As we also have seen, changes in the teen brain contribute to emotional highs and lows, including anxiety and depression, both of which can negatively impact executive skills. Changes in executive skills, among other behaviors, can also signal use of drugs or alcohol. In each of these circumstances, it is more recent or sudden changes that should lead parents to consider one of these causes.

We also recognize that executive skills weaknesses occur in the absence of a recognized disorder, diagnosis, or condition. Strengths and weaknesses are common among us. Do you know a person who is routinely late and seems to lack a sense of time urgency? How about the acquaintance who is disorganized and can't find belongings? Do you know someone who routinely "opens mouth, inserts foot"? These and other examples are quite familiar to us. In and

of themselves, these weaknesses are no big deal unless they interfere with our ability to successfully negotiate problem situations, task demands, and social interactions.

It is for the population of teens whose executive skills weaknesses (regardless of their origin) interfere with successful problem solving and independent living that we have written this book.

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