# CHAPTER 1

# Executive Function and Learning



## WHAT ARE EXECUTIVE FUNCTIONS?

Before we delve into a formal definition of EFs, we would like to place you firmly in your classroom. Think about your students. Recall the creative ones, the funny ones, the talented ones, and the ones who surprise you. They all, from time to time, have trouble setting and meeting goals. It may be Theo who struggles to *shift* from one activity to another or Juan who cannot help but *blurt* out while others are speaking. Consider Joanie who constantly *underestimates* how long a task is going to take or Samia who *forgets* there was even a plan to follow in the first place. These are just some of the many students we want you to hold in mind as you read this chapter. Every student you have worked with probably taught you something different about the way EFs affect performance. As an experienced teacher, you are the real expert on EFs in the classroom.

EFs are cognitive processes that work alongside our intellect and creativity to allow us to respond to challenges. They develop naturally throughout childhood and adolescence, maturing in our mid-20s. These skills are controlled by the prefrontal cortex in our brains and are the very reason we are able to remain focused, organize our time *and* follow through with a plan, meet challenges with flexibility and persistence, hold and quickly access information stored in memory, and retain self-control when the going gets tough.

If you look up "executive functioning" on the Internet, you will find a range of differing opinions. Experts hotly debate fundamental matters such as how many EFs there are, how to refer to them individually, and how to properly group them. Dr. Adele Diamond believes there are three core EFs (2013), George McCloskey's developmental model mentions 32 different capacities that support self-regulation (2013), while Dawson and Guare (2018) speak of 11. In 2012, Dr. Russell Barkley threw up his hands and pointed out that this lack of a common model among researchers had delayed a generally accepted definition of EF. Consensus continues to elude the top experts.

This focus on the details is important. Researchers are trying to understand how closely aligned EF weakness is with attention deficit disorder, for example, and how individual EFs, such as working memory, can be fostered in infancy. They wonder if certain EFs are disproportionately impaired by learning disabilities or if early intervention to support others could circumvent reading problems. They wonder if there are subsets of EFs that function differently from the others.

Despite the confusion among researchers, experts focused on mobilizing EF knowledge for classroom use have pushed forward with general definitions. If nothing else is perfectly clear, we can agree that EF is a good "umbrella term" to describe the processes involved in "purposeful, goal-directed, and flexible behavior" (Meltzer, Dunstan-Brewer, & Krishnan, 2018, p. 111). We take our lead from the list of 11 proposed by Dawson and Guare (2018), found in Table 1.1. After many consultations with teachers, we believe this is the most useful set of concepts for students to learn if they are to discuss their learning fluently.

**TABLE 1.1. 11 Key Executive Functions**

*Response inhibition*

The capacity to think before you act. The ability to resist the urge to say or do something allows us the time to evaluate the situation and how our behavior might affect it.

*Working memory*

The ability to hold information in mind and work with it when 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.

*Emotional control*

The ability to manage emotions in order to achieve goals, complete tasks, or control and direct behavior.

*Cognitive flexibility*

The ability to revise plans in the face of obstacles, setbacks, new information and possibilities, or mistakes. It involves adaptability to changing conditions.

*Sustained attention*

The capacity to attend to a situation or task in spite of distractions, fatigue, or boredom.

*Task initiation*

The ability to begin a task without undue procrastination, in a timely fashion.

*Planning and prioritizing*

The ability to create a roadmap to reach a goal or to compete a task. It also involves being able to make decisions about what's important to focus on and what's less important.

*Organization*

The ability to design and maintain systems for keeping track of information or materials.

*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.

*Goal-directed persistence*

The capacity to follow through to the completion of a goal, even when it seems to take a long time, without being deterred by setbacks, mistakes, frustration, boredom, other demands, or competing interests.

*Metacognition*

The ability to stand back, take a bird's-eye view of oneself in a situation, or observe one's own problem solving. It also includes self-monitoring and self-evaluative skills.

*Note.* Adapted from *Executive Skills in Children and Adolescents, Third Edition,* by Peg Dawson and Richard Guare. Copyright © 2018 The Guilford Press. Reprinted with permission.

## WHAT IS YOUR EF PROFILE?

We all have a variety of strength and weakness in our EFs; even the most capable students, and most adults, have one or two weak EFs that will impair performance to some extent. For example, think about the teachers at your school. We're pretty certain you have a great organizer, a task initiator who gets everyone started on new projects, or a super flexible teacher who always goes with the flow. You might also know someone who occasionally interrupts faculty meetings, or who, once a plan is made, needs plenty of reminders to refer to it again. You can bet that these individuals are, perhaps unknowingly, using strategies to manage the more critical impacts of these tendencies in their lives. Through experience, and some cringe-worthy mistakes, we smooth the roughest edges of our EF challenges so they don't wreak havoc in our lives. Our students are several years of maturity and many life experiences away from this adult level of self-management.

The children in our classrooms have much weaker EFs than we do for many reasons. We can easily understand that they are less cognitively mature, but there are other less obvious factors that put their EFs on unstable ground. Figure 1.1 shows the way modern life, a variety of different learning disabilities, and adverse childhood experiences can stack up to weaken EFs. Can you recall teaching a student who may have been affected by several or even all of these compounding factors?

We don't want to paint a picture of unrelenting doom and gloom. It is critical, however, for educators to understand the reason behind the variation in school behavior and performance. It is important to remember that, for some children, it is more mentally challenging to resist temptation, hold multiple ideas in mind, control emotions, or stay focused. While they may be able to demonstrate all of these skills for a few moments, or throughout first period, or when they are especially interested in something, managing them over the course of a long, demanding school day is a different matter entirely.

## HOW DO EFs AFFECT LEARNING AT SCHOOL?

We all have a unique spectrum of EF strength and weakness, and we all have good days and bad days. Experts estimate that the individual differences in EFs explain over half of all the variation in school performance (Visu-Petra, Cheie, Benga, & Miclea, 2011). Take a moment to consider how EFs might affect a typical day in a teacher's life.

### *Bad EF Day*

Imagine that you are at an interactive workshop on a topic you know little to nothing about. There are all sorts of interesting people attending. You should be excited, but you had a terrible night's sleep; you were up all night with a sick child whom you had to leave at home with a babysitter. This caused you to run late. Then, you missed the train, which meant you missed the breakfast, coffee, and chatter before the conference began. You look around and feel embarrassed. Everyone else seems to be happy, enjoying themselves, and on track. You start to think about the coffee and breakfast that you missed, and then the urge to check in on your son springs to mind. You look at the clock and realize the session is almost over. How will you report back to the staff at your school?

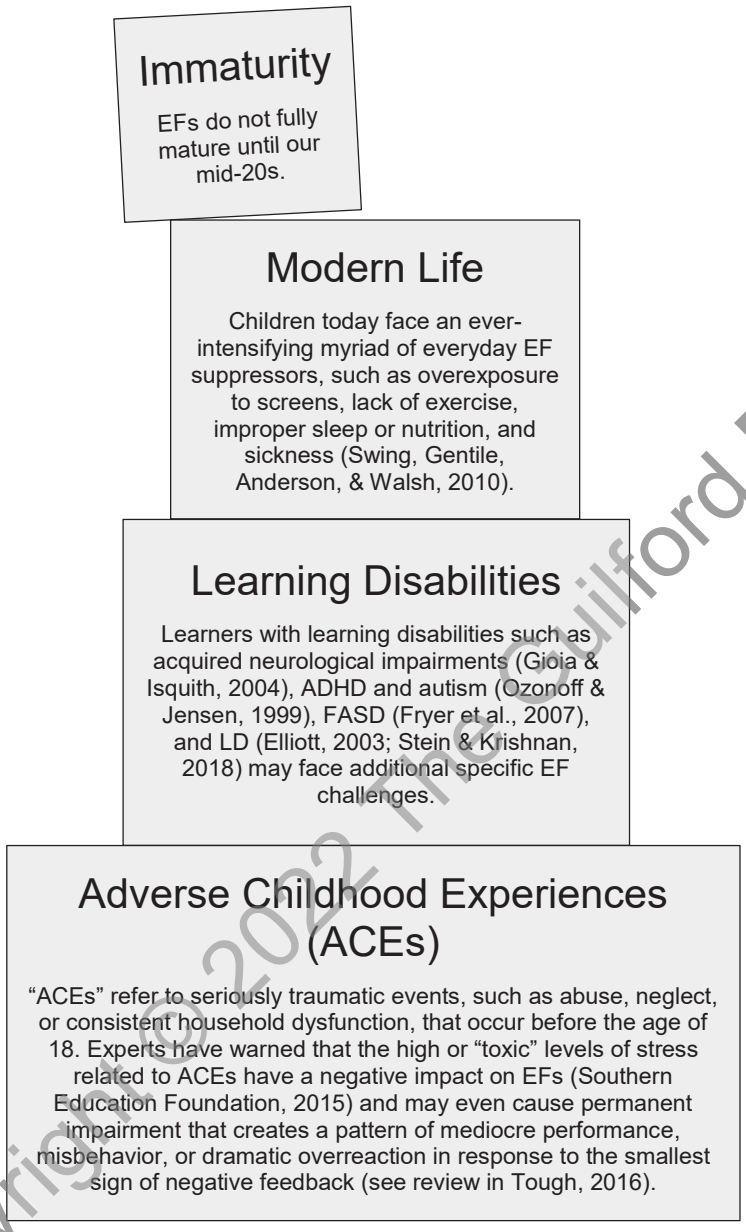


**FIGURE 1.1.** Additional challenges to EF.



### *Good EF Day*

Attending a workshop in a neighboring city, you have a late dinner with a colleague and discover at midnight that your accommodations have no shampoo. You grudgingly set an alarm and plan to run to the store in the morning. When the alarm goes off you throw on sneakers and head to the store. Finding it closed, you end up jogging four blocks to the next one. The sun is rising, it's a lovely morning, and you take the long way home, jogging all the way. You get back, quickly shower,

and feel surprisingly great, despite your poor sleep. Arriving at the conference, you're a bit late, but you feel energized, social, and optimistic. You feel deeply focused, and your mind quickly assimilates and extends the information you hear. You connect with another participant from your city. Though his school is slightly different than yours, you continue chatting during the coffee break about ways to start a project together.

Consider the impact of these good and bad EF days on the overall learning and performance of each teacher. The teacher having a bad EF day will not be able to give a good report to her colleagues. Organization, time management, attention, and emotional control impaired her ability to be successful. This failure may have a negative impact on her career, because she may not be chosen to attend the next conference. The teacher having a good EF day, however, through her emotional control, flexibility, attention, working memory, and goal-directed persistence, has shown leadership and will return to school with impressive news. Do you suspect that the teacher having a good EF day might just be more naturally curious, innovative, and generally successful? In fact, both of these stories are based on Laurie's (author) personal diary. They represent one and the same person. Can you appreciate how much our EFs, despite our intellect and creativity, can affect our learning and performance?

Students experiencing a "bad EF day" often do it in a very public forum, with no way to retreat or regroup, in front of peers and teachers who have become exasperated by them. If these bad days cause them to feel frustrated, depressed, and embarrassed, the situation becomes even worse. Stress is a disastrous condition for EFs. It floods our prefrontal cortex with cortisol and scrambles our ability to remember things, exercise discipline, and reason our way through problems. The feeling might be similar to experiencing stage fright, or being the new guy at a challenging job, or being lost in a big city during rush hour.

EF weakness has a greater impact on academic success than language or intellectual ability (Blair & Razza, 2007; Duckworth & Seligman, 2005; Espy et al., 2004). Forgive the harsh language, but EF challenges can make children look *and feel* lazy, naughty, or as if they simply aren't very smart. Below, we will characterize each of these types. At the end of Chapter 3 we provide even more detailed information about the impact of EFs on performance.

Students who drift off task, stall, or become disorganized are the ones who may appear "lazy." These are students with challenges in attention, task initiation, goal-directed persistence, and time management. Often these students have big ideas but are just so utterly overwhelmed by details that they don't know how or where to start. They might even be your gifted students but will often end a classroom period with nothing accomplished. Think of them as your "consultants"—you may notice them dropping in on other students' conversations with amazing ideas, enjoying a chance to do some thinking without having to manage any of the EF challenges. We wonder, why doesn't this student just start his own assignment if he has so much to say? In time, these students may become passive, discouraged, or even angry. Without an understanding of EFs and support to be strategic, they internalize the criticism that they are terribly wasting their potential or they decide they are destined to fail.

The "naughty" students are the hardest to ignore. These are the ones whose interruptions, rule breaking, stubbornness, and short fuse most likely caused you to buy this book in the first place. They can be very disruptive to other students and to your ability to conduct your teaching, and as a result may suffer the most severe consequences. For example, we know a student who spent March, April, May, and June working in a solitary wooden study carrel in the hallway

of his school. Trust that we see this situation with compassion—no teacher begins their career hoping to exclude students, just as no student begins school hoping to become the enemy of his whole class. This unfortunate and unacceptable situation, instead, is a sure sign that a teacher and student are undersupported, out of ideas, and burnt out. These "naughty" students might like to know that, actually, they struggle a little more than usual with response inhibition, flexibility, and metacognition. Furthermore, they might like to know that emotional triggers are unusually powerful for them and cause all of their other EFs to fall apart. Research tells us that students with weak EFs are *often* subject to harsh misattribution from peers, teachers, and themselves because their challenges are mistaken for symptoms of poor character (Gaier, 2015) that seem intentional (Elik, Wiener, & Corkum, 2010). Unfortunately, because childhood includes plenty of intentional mischief and boundary testing, only the most well informed and sensitized can discriminate an EF weakness from layers of other typical behaviors.

Many other students struggle with EF challenges that directly affect deep thinking and reasoning skills. These are the ones who may look and feel as if they simply aren't very smart. Working memory and response inhibition, in particular, have tremendous impacts on math and reading ability (see review in Diamond, 2014). A weak working memory makes it difficult to hold the main idea of a story in mind while decoding difficult words. You've undoubtedly worked with students who have struggled like this; they get to the end of a paragraph and have no idea what they've read. Weak response inhibition, on the other hand, makes it very challenging to select only relevant information when making meaning in text. These are students who, when asked to summarize a chapter from their novel, will tell you every single detail from the first paragraph. Or this phenomenon may be due to weak metacognition, whereby these students have trouble connecting the dots and noticing the overall patterns and meaning in the material they read. Sometimes this "simply not very smart" type will have a cluster of strong EFs, so even though they seem organized, attentive, and disciplined, they just can't manage to nail their academic work. Though the EF challenges for these students are deep in their thought process, the situation is far from hopeless. We know many students who, through EF literacy and a strategic approach, have learned to manage working memory and response inhibition challenges.

How many "bad EF days" are taking place in your classroom? How will you know if the unexpected performance you're seeing really *is* due to EF challenges? It is easy to suspect that poor performance is intentional. For example, what if your class struggles to complete your mapping activity and then heads outside to recess and works away happily for 30 minutes, drawing elaborate maps all over the playground? Or can't understand a scientific concept but has no problem mastering the latest video game? It is important to remember that individual capacity for EF is heavily influenced by familiarity, experience, interest, comfort, and mood, not to mention sleep, nutrition, and illness. This is why the art teacher and the math teacher often have vastly different impressions of a specific student's abilities. American psychologist Ross Greene (2008) reminds us *kids do well if they can,* and he's right: When our students' EFs are working well, they tend to use them. Sometimes, however, EFs are mysterious, unpredictable, and conspicuously absent.

As you read and think more about EFs, you will find your senses become keener to their clues and you will learn to spot them. We sometimes refer to this as developing an "EF lens." It's like wearing a pair of glasses that gives you a different perspective on your learners. With this lens in place you may feel more compassion and understanding toward your students, and you might find your teaching muscles flexing as they haven't flexed in a long time. Finally, *seeing* the EFs in your classroom presents an exciting new range of responses, supports, and teaching opportunities.

## HOW TEACHERS ALREADY SUPPORT EFs

Can you remember when the term "executive function" first hit your radar? Teachers are often exposed to this regrettably scientific-sounding label for the first time on the pages of a psychoeducational report. Given a few examples, however, they realize that EFs are very simple. By "EF" we mean, well, almost everything you notice about your *students' performance.* When we refer to "EF-supportive teaching," we are essentially talking about *everything a teacher says and does all day long.* Consider how your work with students is already so oriented toward EF support. We provide charts, planning webs, and tables to help students with organization. We give 10-, 5-, and 2-minute warnings to support time management. We create calming spaces to support emotional regulation. If you took a moment to jot down the 10 routine teaching moves that take the most time in your day, odds are you could connect each one to a lagging EF in your students.

For this reason, it often feels ridiculous to lecture classroom teachers on EFs. Much of what experts know in a theoretical, categorical, or statistical way is understood in a deep, practical, and dynamic way in the field. This contrast in approach makes teachers and researchers excellent partners. Working together, we can use the scientific names of different EFs to sort the behaviors we see and the approaches we use. Sorted into EF categories, both our students' performance and our teaching responses become easier to understand, compare, anticipate, and control. As with any messy, complex situation, a little bit of order goes a long way.

There are a wide range of styles of classroom teaching, but the most effective for building EFs strike a sensitive balance between support and demands. Experts agree that incremental, rigorous challenge in a calm, structured, stimulating, social, and joyful environment will best support EF development (Diamond & Ling, 2020). It's a bit like Goldilocks and her porridge, so let's explore the different flavors, textures, and presentations that make up a "just right" recipe.

First, let's discuss the rough quantities of support in classroom teaching. On one hand, we shouldn't aim to scaffold and support our learners every step of the way. Imagine second-grade students who have had the same "jobs" for 6 months, who require classical music playing softly in the background and an adult "hush" in the air all day, and who barely interact with one another because they are so comfortable in their routines. While this feels relaxing, and you may want to incorporate short periods of respite during your teaching day, a classroom that is comfortable all day is too mushy and bland. It will not be stimulating and challenging enough to promote the normal, healthy growth of EFs in your classroom. On the other hand, neither is it advisable to create an EF war zone by removing all structure, rules, predictability, and order. This is too extreme, and just isn't conducive to learning.

Japanese classrooms might provide an example of a good balance. In studies comparing Japanese teaching to that in the United States and Germany, Stigler and Hiebert (1999) noticed a big difference. In Japan, teachers delivered a new mathematical concept and wrote a problem on the board. No other instructions were given; the students struggled, strained, and stressed as they attempted to figure it out. After a generous period of time, students were gathered up for a supportive discussion about their process, ideas, and strategies. In the United States, a very different situation was observed. The teachers went over a few problems on the overhead, made sure everyone understood the new concept, and gave the students a number of similar problems to solve. They provided guidance all the way, ensuring little to no confusion or frustration. While there is a time and place for structured, fail-proof teaching, it should not be the only approach happening in your classroom.

Apart from core instruction, teachers do many other things at school that either build EFs directly or provide the type of context in which children are most receptive to the direct builders. All of the little extras we do at school are important. As it turns out, our commitment and generosity are not for entertainment, or babysitting, and nor are they cute examples of the eccentricity of experienced teachers—they are powerful factors in the support and development of EF. Consider the research-based direct and indirect builders of EF presented in the left column of Table 1.2. When we ask teachers how they already tap into these builders in their classrooms and schools, they respond heartily. The right column lists just a few of their examples.

There is one additional important factor in the support and development of EFs in your students: you. Remember how EFs are optimized with good sleep, nutrition, health, and regular exercise? This is true for teachers too. The end of Chapter 3 describes how EFs can affect your work, but seriously, have you ever attempted a day of teaching on 2 hours of sleep, or without eating all day, or with a migraine? We don't recommend it, but it's a great way to understand what an EF blackout feels like. You may be short tempered, disorganized, constantly missing the point, firing off ill-advised emails, or terribly inflexible with your class. You can do a lot of damage to your relationships, self-esteem, and reputation on days like these, so if you find yourself in this position, it's best to lay low. Trust us, we've been there. Over the long term, exhausted teachers can experience *burnout cascades* whereby student behavior problems lead to teacher stress, which leads to suboptimal teaching, which leads to further student behavior problems, and on it goes (Maslach & Jackson, 1981). Research suggests, however, that teachers with better EFs experience less stress, tending to report feeling less irritated by children and more in control (Friedman-Krauss, Raver, Neuspiel, & Kinsel, 2014). Optimizing your EFs may protect you from a downward spiral at work.

Conversely, you might remember days when you've managed really well. Perhaps you put your phone away at 9:00 P.M. and got a brilliant night's sleep, or you managed to make breakfast and pack a good lunch. Sometimes it's the simplest things, such as having walked part of the way to school, or having stumbled into a funny conversation with a student that lifted your mood. On days like these you might feel a little magical. You might feel highly attentive, emotionally tuned in, able to handle multiple demands, and capable of exercising good judgment. You might project calm and happiness. For your students, this professionalism and maturity will be an inspiring, and, for some, life-changing source of security. Students who go home to a chaotic environment will benefit especially from the stability and nurturing you provide. Think of yourself as the fifth wall of your classroom. Your health and happiness are so important to your own EF. Don't forget to make time to nourish your own body, mind, and soul.

Teachers, through their support of EF development, play a crucial role in the success of their students. On a day-to-day basis we set a tone of good self-control; perceive many different intellectual, emotional, and social needs; and respond with a "just right" balance of challenge and support. This is heavy-duty work, and why teachers are often exhausted at 3:30. Have you ever had the frustrating experience of having a non-teaching partner or friend explain to you all the ways you should make your work easier? "You're so tired because you do all that extra stuff! Stop taking on so much. Keep it simple. Just get your work done and get out of there." The next time this happens, maybe you'll feel a deeper sense of satisfaction knowing that the extra effort you put in really makes a difference.