When trauma hinders learning

What's a teacher to do when difficult experiences in early childhood prevent children from entering kindergarten with the executive functions they need?

By Donald A. Barr

In the fall of 2015, a front-page story in the New York Times reported on the challenge a kindergarten teacher in Brooklyn faced in dealing with a difficult new student (Taylor, 2015). From the time the six-year-old girl started kindergarten, she "struggled to adjust to its strict rules. She racked up demerits for not following directions or not keeping her hands folded in her lap. Sometimes, after being chastised, she threw tantrums. She was repeatedly suspended for screaming, throwing pencils, running away from school staff members or refusing to go to another classroom for a time-out."

Many kindergarten teachers have had similar experiences with children who simply don't seem ready for kindergarten. But they may not understand the complex developmental processes that can contribute to the troublesome, and no doubt disruptive, behaviors this child exhibited. How do social and biological factors interact to affect children's behavior, and what are the brain structures and functions involved?

Is disruptive behavior willful?

Salvatore Terrasi and Patricia Crain de Galarce (2017) have described how important it is for teachers to understand the potential impact of childhood emotional trauma on classroom behavior. They suggest that "teachers who are unaware of the dynamics of complex trauma can easily mistake its manifestations as willful disobedience, defiance, or inattention, leading them to respond to it as though it were mere 'misbehavior'" (p. 36). The child in the New York Times story does not appear to be exerting conscious control when responding to the teacher defiantly. She was more likely responding to emotional impulses she did not have the capacity to control.

The girl was the child of a single mother living in a low-income neighborhood in Brooklyn. Children from low-income communities who live in single-parent households are at greater risk of exhibiting these types of disruptive behaviors when entering kindergarten. As Clancy Blair and C. Cybele Raver (2015) explain, "The neurocognitive and social emotional skills integral to self-regulation undergird early learning and are likely to be compromised for children growing up in poverty and other adverse circumstances" (p. 713).

What might have impaired this six-year-old's emotional self-regulation and, as a consequence, impeded her capacity to develop the basic skills expected of most kindergartners? What should teachers know about the possible underlying causes of a child's lack of self-control? If early emotional trauma has affected a child's neural development, what steps can educators take to provide a learning environment that will enhance that development?

The importance of executive function in school readiness

Research in psychology and neuroscience has provided an increasingly clear answer to these questions. The central issue is the extent to which children have been able to develop executive function (EF) before starting kindergarten. EF includes three principal components:

- Inhibitory control — the capacity to inhibit or regulate strong emotional or impulsive behavioral responses voluntarily;
- Cognitive flexibility — the ability to think about multiple concepts simultaneously or to switch quickly between concepts;
- Working memory — the ability to hold new information in the mind, process it, and store it as a learned memory.

Together these capacities enable children to exert conscious control over their behavior to achieve a goal.

A report published by the U.S. Department of Education defined EF skills as:

the attention-regulation skills that make it possible to sustain attention, keep goals and information in mind, refrain from responding immediately, resist distraction, tolerate frustration, consider the consequences of different behaviors, reflect on past experiences, and plan for the future. (Zelazo, Blair, & Willoughby, 2016, p. 1)

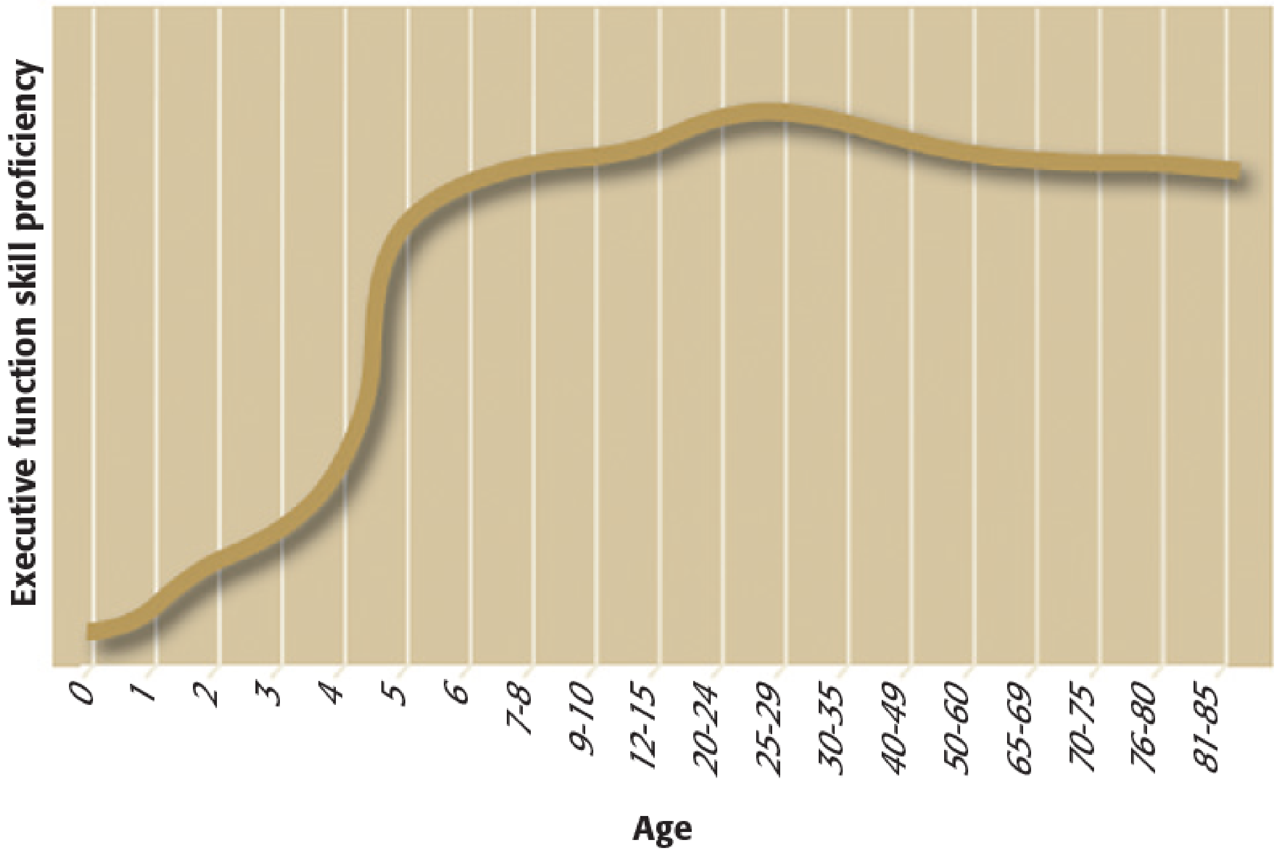
It seems clear that this six-year-old had not yet developed an adequate level of EF for the classroom. It also seems apparent that the teacher had dealt with similar children before. A report published by the Center on the Developing Child at Harvard University (2011) indicated that:

It is often within the group setting of a classroom and the demands of schoolwork that delays or deficits in the development of age-expected executive function skills are first noted. Teachers identify problems with paying attention, managing emotions, completing tasks, and communicating wants and needs verbally as major determinants of whether a child is ready to succeed in the school setting . . . Scientists who study executive function skills refer to them as the biological foundation for school readiness. (pp. 3-4)

> *While it is neither unusual nor unexpected for a three-year-old child to have an emotional tantrum, it is expected that five-year-old children entering kindergarten will have gained the capacity to control their emotional impulses and avoid tantrums.*

It is important for teachers, especially those in the early elementary years, to understand how the development of EF reflects an underlying biological process. As with other biological processes (for example, the development of language), children often develop their capacities at different rates. While it is neither unusual nor unexpected for a three-year-old child to have an emotional tantrum, it is expected that five-year-old children entering kindergarten will have gained the capacity to control their emotional impulses and avoid tantrums.

FIGURE 1.
Executive function skills build throughout childhood and adolescence



Note: A range of tests measuring different forms of executive function skills indicates that they begin to develop shortly after birth, with ages three to five providing a window of opportunity for dramatic growth in these skills. Growth continues throughout adolescence and early adulthood; proficiency begins to decline in later life.

Source: Center on the Developing Child at Harvard University. (2011). *Building the brain's "air traffic control" system: How early experiences shape the development of executive function: Working paper No. 11.* Cambridge, MA: Author. http://developingchild.harvard.edu. Used with permission.

The neural basis of executive function

The development of EF proceeds relatively slowly from birth through age three and then accelerates rapidly between ages three and six. Figure 1 shows the average or modal (most common) developmental pattern. In some children, the development curve will be shifted to the left, with more rapid development. In other children, it will be shifted to the right, with delayed development.

To appreciate the neurobiological processes underlying this development, it is important to have a basic understanding of brain structure and the neural connections among different regions of the brain, as illustrated in Figure 2.

The front part of the brain, or the prefrontal cortex (PFC), is where many different components of memory are stored. For example, when we were children, we first learned the concept of "2 plus 2 equals 4." If I were to ask you, "What is 2 plus 2?" you would rapidly respond "4." In doing so, you would not actually have performed a mathematical computation. You would simply have retrieved the conceptual memory stored since childhood in the PFC.

This process — of taking new bits of information and storing them in the PFC as memory — is largely under the control of the hippocampus, which sits at the bottom, central portion of the brain. The better our hippocampus works, the better it is able to store new memories and associations in the PFC. This process involves creating multiple nerve connections (or axonal connections) from the hippocampus, looping up and over the central portions of the brain to the PFC.

A second form of memory follows a similar pathway. These are the emotional memories we have stored — and which we often recall unconsciously. Many of these memories come from early childhood. Some are positive memories of the warmth and security derived from a caring parent or other adult figure. Some are negative, reflecting the fear or anger of feeling threatened or experiencing punishment or abuse. These memories are transmitted through the amygdala to a separate area of the frontal cortex referred to as the orbital frontal cortex (OFC), shown in Figure 2 at the base of the frontal cortex.

If a child develops a feeling of intense anger in response to a stimulus, that anger may represent an emotional memory of an earlier experience stored in the OFC. The child may only have conscious control over their response to that memory if they have developed an adequate level of executive function. In severe cases, the stored emotional memory will be in response to a single incident that was so powerful it repeatedly disrupts normal interactions with others. This may represent post-traumatic stress disorder (PTSD). For example, Terrasi and de Galarce (2017) describe a case of PTSD in a 2nd-grade student who previously got along well with his friends and was succeeding in school but who, after witnessing his mother being hit in the arm by a stray bullet while they were walking together in their neighborhood, became "defiant with his teachers . . . often hiding under a desk, knocking things down, hitting other children, and running out of the classroom" (p. 35).

Not all negative emotions stored in the OFC that trigger emotional outbursts in children are of the type associated with PTSD. These emotions can also reflect the accumulation of chronic and recurrent stressful experiences during early development, especially if they are the result of toxic stress. According to the National Scientific Council on the Developing Child (2014):

Toxic stress refers to strong, frequent, or prolonged activation of the body's stress management system. Stressful events that are chronic, uncontrollable, and/or experienced without children having access to support from caring adults tend to provoke these types of toxic stress responses. Studies indicate that toxic stress can have an adverse impact on brain architecture. (p. 2)

Children growing up in poverty and in high-stress circumstances are at increased risk of developing these changes in brain architecture. Jack Shonkoff and his coauthors (2012) have reported that chronic toxic stress "is associated with hypertrophy and overactivity in the amygdala and orbitofrontal cortex, whereas comparable levels of adversity can lead to loss of neurons and neural connections in the hippocampus and medial PFC" (p. e236).

Chronic stress in early childhood not only results in an overly active amygdala-OFC response system, it can also result in delayed development of the hippocampus and reduced nerve connections between the hippocampus and the PFC. As Shonkoff and colleagues (2012) go on to explain:

The functional consequences of these structural changes include more anxiety related to both hyperactivation of the amygdala and less top-down control as a result of PFC atrophy as well as impaired memory and mood control as a consequence of hippocampal reduction. (p. e236)

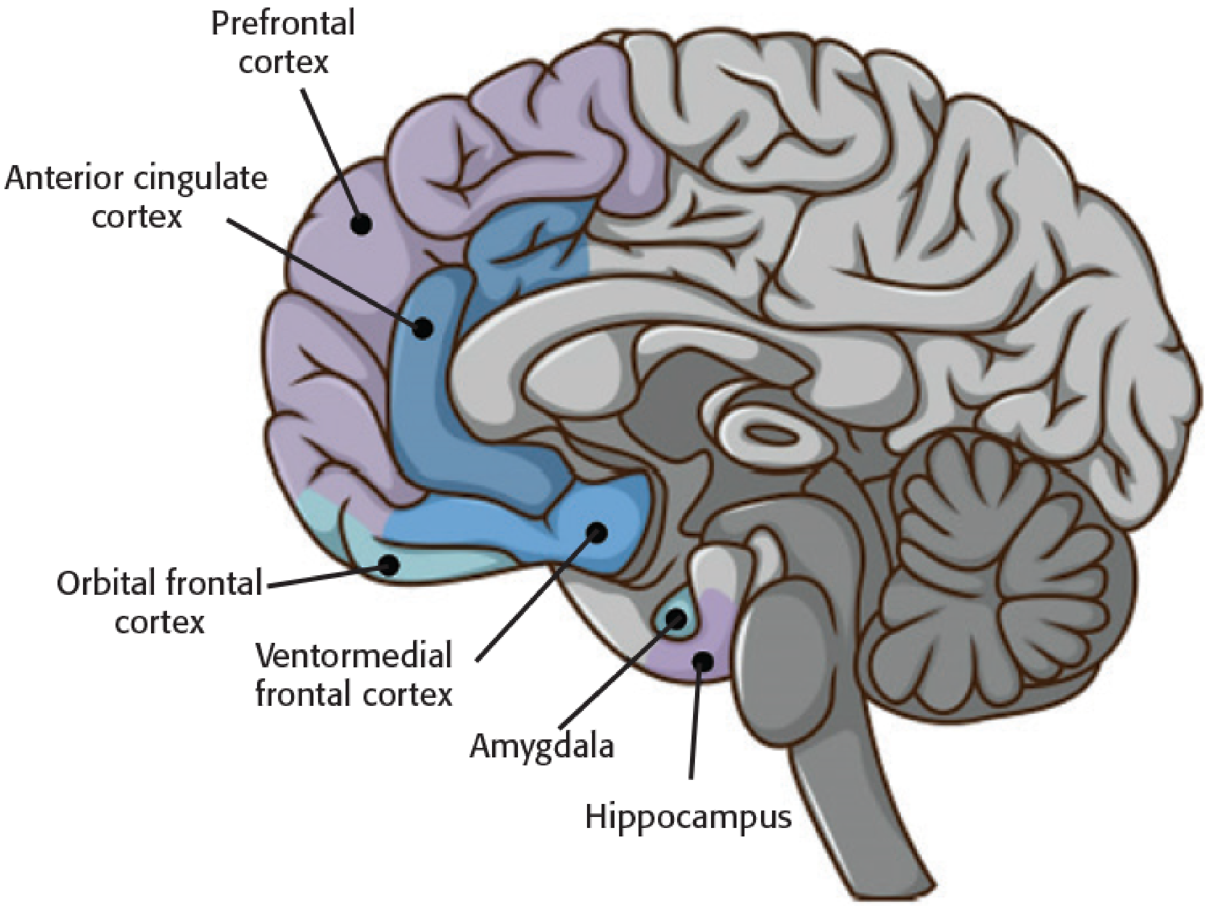
Joan Luby and colleagues (2013) followed 145 children from age three through age six, assessing their emotional and behavioral development and examining data on their family circumstances. After the children were six years old, the authors administered an MRI brain scan to each child, measuring the size of their hippocampus, PFC, and the axonal nerve connections between them. Preliminary analysis found that children from families living in poverty tended to have a smaller, less-developed hippocampus with fewer axonal connections with the PFC. On further analysis, the authors determined that it wasn't poverty itself that was associated with a less-functional hippocampus. Rather, it was the presence of hostile parenting style, low levels of emotional support from parents, and repeated exposure to stressful life events.

Might the six-year-old girl who had such trouble controlling her emotional outbursts in the Brooklyn charter school be an example of the behavioral impacts of chronic, toxic levels of stress experienced during the period when most children are developing the neural capacity for EF? The Shonkoff report suggests that this may have been the case:

Hence, altered brain architecture in response to toxic stress in early childhood could explain, at least in part, the strong association between early adverse experiences and subsequent problems in the development of linguistic, cognitive, and social-emotional skills, all of which are inextricably intertwined in the wiring of the developing brain. (p. e236)

FIGURE 2.

Medial view of select brain regions relevant to executive function



Source: Zelazo, P.D., Blair, C.B., & Willoughby, M.T. (2016). *Executive function: Implications for education.* Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Research.

Teacher reactions to children's behavior

Ximena Portilla and colleagues (2014) followed an ethnically diverse sample of 338 five-year-old children through their first year of kindergarten. They assessed each child's level of inattention and impulsive behavior in class, as well as the teacher's perception of the level of teacher/student conflict the student's behavior caused. They found that (a) teachers reported having more conflictual relationships with children exhibiting repeated impulsive behavior and (b) greater levels of conflict perceived by the teacher were associated with decreases in school engagement on the part of the child, as well as reduced academic competence in 1st grade. The way a kindergarten teacher responds to a child who exhibits poor EF and disruptive behavior can have a powerful, negative impact on the child's own investment in the educational process.