A simple marshmallow test can tell us a lot about brain development. The test goes like this: An adult seats a young child at a table with one marshmallow on a plate and says, “Sit here with the marshmallow for a few minutes, and when I return I will bring another marshmallow and you can have both to eat.”

Each child is observed using a variety of cute and inventive strategies to cope with the command. Some children smell the marshmallow, many hold it, a few dance in their chairs and some just eat it. The older the child, the greater variety of strategies he or she demonstrates to resist the temptation.

What does this test tell us? According to neuroscientists, the marshmallow test illustrates how well-developed a child’s self-control is—one of a set of “executive function” skills that include the ability to focus, filter distractions, remember and use information, plan ahead, adjust, resist temptation, delay gratification and persevere for long-term goals.

“Having executive function in the brain is like having an air traffic control system at a busy airport to manage the arrivals and departures of dozens of planes on multiple runways,” is how the Center on the Developing Child at Harvard University describes it.

Research into how the brain develops has produced new evidence that these skills are “essential for school achievement, for preparation and adaptability of our future workforce, and for avoiding a wide range of population health problems,” according to a 2012 report by the Harvard center. A growing body of research indicates that the more developed these skills are, the more likely the child is able to process what he or she reads, writes or computes, and thus succeed at school.

In fact, these skills are a greater predictor for school achievement than “a child’s IQ score or social class,” says Deb Leong, a child researcher and retired professor of psychology at Metropolitan State University of Denver.

Increasing evidence of what works and how much money can be saved in the long term, coupled with this recent neuroscience research on how the brain develops, have combined to capture the attention of policymakers around the country.

State lawmakers are beginning to ask how this new knowledge can (or even if it should) influence policy decisions in early childhood development, spurring a growing interest in programs such as high-quality child care, pre-kindergarten and home visiting.

The Developing Brain

Scientists have discovered that the most rapid period of brain development occurs in the first few years of life. During this time the basic architecture of our brain is being constructed through an ongoing process that begins at birth and continues into adulthood.

To illustrate what is meant by brain architecture, think in terms of building a house. First the foundation is laid, then the basic frame goes up, followed by more complicated electrical wiring and plumbing. The construction goes from the basic to the complex. But it begins with the foundation; if it is unsteady, the entire structure is weak. The same goes for the brain.

According to Jack P. Shonkoff, director of Harvard’s Center on the Developing Child, the quality of the foundation built in early childhood, whether it is strong or fragile, affects future development, health, learning and economic success. With a strong foundation, babies move easily through more and more complex learning stages. And “although it’s never too late to learn new skills since the brain never stops developing, it’s just harder and less effective to build on a weak foundation than it is to get development right the first time,” says Shonkoff.

From birth, babies’ brains require responsive and caring relationships with adults in nurturing, stimulating environments. The type and quality of interactions a child has—from the earliest years of life—with his or her parents and other caregivers is one of the most important factors in building the brain’s foundation.

Scientists call these “serve and return” interactions. Like a game of tennis, babies “serve” opportunities to interact through
How Does Executive Function Affect Behavior?

If nurtured, the brain develops all-important “executive function skills,” which include the ability to focus, filter distractions, self-regulate, plan ahead, adjust to changes, control impulsivity, resist temptation, delay gratification, and remember, organize and use information. These skills are essential in several areas of life by helping children and adults to:

**School**—remember and follow complicated instructions, avoid distractions and control rash responses.

**Behavior**—develop teamwork, leadership, decision-making and critical thinking skills.

**Health**—make good choices about nutrition and exercise, resist the pressure to engage in risky behavior and be conscious of others, including their children’s safety.

**Employment**—acquire good organizational and problem-solving skills and adjust to changes in circumstances.


Practical Application

Washington has taken the lead in incorporating brain science and the importance of executive function into its policies. The Washington Legislature, the governor and state agency department heads are now using a “science-based” perspective and approach when legislating or adopting early learning policies and laws. Guidelines were changed to incorporate the importance of promoting the development of executive function and self-regulatory skills in very young learners.

For example, some of the guidelines look specifically at how turn-taking games and certain kinds of directions given from early childhood teachers can encourage children to develop self-control mechanisms.

Washington also developed an online training program as part of its professional development requirements for early childhood teachers that includes an explanation of the brain’s executive function and describes the effects of trauma on child development. The online videos show preschool teachers in classrooms demonstrating the kinds of lessons that help develop self-regulation skills.

In addition, the Washington Health Care Authority incorporated executive function information into training materials for managed-care organizations that serve Medicaid patients. And to lessen the stress on families, the state’s Department of Social and Health Services has shifted to a greater focus on helping welfare families find a viable way out of poverty.

“We needed to recognize the damage toxic stress can have on children,” says Washington Representative Ruth Kagi (D), chair of the Early Learning and Human Services Committee. “We pay dearly when children are not ready to learn.”

Washington is also one of 17 states with a federal waiver to test innovative child welfare programs. Washington’s waiver allows the use of an alternative response to families

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**Levels of Stress**

<table>
<thead>
<tr>
<th>Toxic</th>
<th>Prolonged activation of stress response systems in the absence of protective relationships</th>
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<tbody>
<tr>
<td>Tolerable</td>
<td>Serious, temporary stress responses, buffered by supportive relationships</td>
</tr>
<tr>
<td>Positive</td>
<td>Brief increases in heart rate, mild elevations in stress hormone levels</td>
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*Source: The Center on the Developing Child at Harvard University*
at-risk of entering the child welfare system. Instead of having to follow a strict protocol when responding to reports of child abuse or neglect, the new procedures allow child protective services to respond more appropriately depending on the specific circumstances of each family.

Families determined to be at a low risk for child abuse or neglect, for example, are allowed to keep their children with them at home, but are offered alternatives to a traditional child welfare investigation such as treatment for drug or alcohol abuse.

“As our state legislature focuses on school readiness and achievement, plus workforce development, it is important that we consider what science tells us about how children’s brains develop,” says Kagi. She sponsored legislation in 2011 that put together a planning group that included the governor, state legislative leaders and agency directors to focus on policies and investments that would lessen the effects of harmful childhood experiences.

Legislative Interest Grows

Other states are beginning to follow Washington’s lead, acknowledging the sensitivity of early brain development and the harm that toxic stress can have on children’s development.

In 2010, Vermont lawmakers established the Building Bright Futures Council to act as an early childhood advisory body and promote policies based on research from the Center on the Developing Child.

Hawaii passed legislation that cites scientific research to support intensive home visiting services for at-risk families and hospital-based screening and assessments. And last year, Texas lawmakers as well created a home visiting program to help children at risk for abuse and neglect and other family difficulties. The program sends trained workers regularly to homes to provide support, guidance and training in good parenting skills, among other things.

Minnesota lawmakers considered reforms last year to the state’s Family Investment Program and the child care assistance program. The proposed changes were based on research that brain development during the first five years of life is critically important and that traumatic experiences can harm the way a child’s brain develops.

And most recently, Wisconsin lawmakers passed a joint resolution to base future policy decisions on the research findings of early childhood brain development and the effect of toxic stress on child development.

Investing in What Works

Improving the lives of children can also save states money down the road. Several rigorous studies have found that high quality early childhood programs for low-income families have the potential to produce long-term savings by reducing the demands for special education services and welfare benefits, preventing future criminal behavior and increasing future incomes. All this can amount to savings ranging from as low as $4 to a high of $9 for every $1 invested.

Nobel Laureate James Heckman, professor of economics at the University of Chicago, stresses that nurturing, positive early development is as important to children’s futures as is a good education. He claims that investing early in children’s lives increases productivity and personal incomes, improves health, supports greater upward mobility and reduces social costs.

All this brain development “science provides hard data to help shape the decisions we make in Olympia,” says Washington Senator Steve Litzow (R), chairman of the Early Learning & K-12 Education Committee.

“We know that children do not begin learning when they enter kindergarten—it really starts at birth. If we want students to be successful in school, they need to be engaged and actively learning at an early age,” he says.

The ability to develop executive function skills is dependent on healthy brain development and the presence of caring responsive adults. How well children learn depends on their ability to pay attention, follow directions and manage their impulses.

“The longer a child can resist the marshmallow, the greater chance he or she has at succeeding in school, and leading a healthy, happy, successful life,” says Representative Kagi.

“And that is good for us all.”

““This scientific evidence has transformed both the conversation and the players around early learning.”

—WASHINGTON REPRESENTATIVE RUTH KAGI (D)

Early Childhood Brain Development

By the Numbers

700

The number of new neural connections made every second during the first few years of life

18 months

Age when disparities in vocabulary first appear in children; differences correlate with parents’ educational level and income.

90% – 100%

Chance of developmental delays in children with at least six toxic stresses, such as poverty, maltreatment, single parent, mental illness of caregiver, etc.

$4 – $9

The range of savings for every dollar invested in early childhood programs for low-income families

Source: The Center on the Developing Child at Harvard University

“We know that children do not begin learning when they enter kindergarten—it really starts at birth.”

—WASHINGTON SENATOR STEVE LITZOW (R)

For more information on how brain research is driving early childhood policies, go to www.ncsl.org/magazine.