The Science of Trauma

Together, behavioral psychology and neuroscience are reshaping our understanding of the damage caused by trauma in early childhood—and how good parenting heals the wounds.

BY ABIGAIL KRAMER

Fifteen years ago, a clinical psychologist named Philip Fisher and his wife applied to the State of Oregon to adopt a 2-year-old boy. Fisher had been working with older kids for many years, mostly in psychiatric treatment programs for youth whose behavior problems had gotten them into serious trouble. Fisher believed in his work—he’d seen that, in the right environment, kids could begin to exorcise demons that had plagued them, in some cases, since before their conscious memories began. But he was disturbed by the feeling that more could have been done if the children had been treated at a younger age. “There aren’t many late starters in juvenile delinquency,” he says. “Parents always said things would have been different if they had gotten help early.”
AS HE WADED through the bureaucracy of his own son’s adoption, Fisher’s professional concerns collided with his personal life. The proceedings dragged on for nine months—a developmental lifetime compared to the speed at which a toddler grows and learns, adapting to the turbulence that is inherently part of foster care. Fisher worried that he was missing a crucial window of opportunity to impact the course of his child’s life.

As it turned out, the nature of that developmental window (how it works, why it matters, how to influence it for the best) was the central concern of a newly burgeoning field of science—one that was, back in the late 1990s, just beginning to unroll one of the fundamental mysteries of childhood: how the things we experience when we’re very young—even when we’re too young to remember—affect who we become later in life.

Child psychologists (along with most of the rest of us) have long understood that there’s a connection between traumatic childhood experiences and poor life outcomes. “There’s been a recognition for at least a century that children who are neglected or abandoned are at risk of problems,” says Jack P. Shonkoff, M.D., director of the Center on the Developing Child at Harvard University. By the time Fisher filed his adoption request, studies had documented enduring links between stress and trauma in childhood and a long list of problems later in life, ranging from mental illness to obesity to cancer.

Until recently, however, scientists had little insight into how those links worked—or how early in life they can form. “The predominant belief,” Shonkoff says, “was that if really bad things happen when children are very young, if you can get them out of those situations early, either they won’t really know what’s going on or they won’t remember. There was a general belief that things that happen to very young children can’t affect them years later.”

Over the past decade and a half, Shonkoff, Fisher and a scattered constellation of researchers across the country have proven that belief wrong, engendering a very new understanding of what children need and how they grow. They have begun to look under the hood at the mechanics of development, revealing how early experiences—especially those involving trauma and chaos—get built not just into children’s minds but their brains and bodies. It’s a relatively young line of inquiry, but its breakthroughs have come about, in large part, through the crossbreeding of two long-established strains of thought: that of behavioral psychology—a field that accumulates its knowledge mainly through observation and self-reporting—with the bloodier science of animal brain development.

For several decades, neurobiologists have subjected animals like rats and rhesus monkeys—mammals whose brains grow in patterns remarkably similar to our own—to experiments designed to trace the impacts of psychological trauma early in life. One frequently repeated experiment has been to traumatize baby rats by separating them from their mothers and siblings for significant periods each day. After weaning, the rats are not only likely to be cognitively impaired—less able to learn, remember and solve problems than other rats—but they exhibit behaviors that mirror mental illness in humans, like anxiety, depression and an unhealthy penchant for ethanol.

When scientists examine the rats through adolescence and adulthood, they find that the psychological problems are matched by an array of physiological abnormalities, the sum of which converge on a rather astonishing finding: The rats’ experience of trauma early in life literally changes the way their brains develop, altering hormone function and stunting growth in areas that are essential, in humans, to thinking, remembering and controlling emotions.

Scientists at Shonkoff’s research center explain the phenomenon through the metaphor of architecture: Infant brains (whether they belong to rats, monkeys or people) are genetically programmed to grow and make connections in response to experience. When babies’ environments are healthy, their neural connections grow sturdy and effective, providing a strong foundation for future learning and development. When they are exposed to repeated stress, the effect is toxic, weakening brain growth in ways that can do permanent damage.

The ongoing challenge for child development researchers is to decipher the blueprints—to find out which experiences matter and trace the pathways by which they do harm. It’s a project with tantalizing prospects—a kind of neurological treasure hunt that promises clues not just to further our understanding of brain development but, in its furthest extrapolation, to decode the enigmatic connection between biology and character. If we could better understand the physiological legacies of our experiences, might it be possible to map our personalities—even, to some extent, our destinies—onto a network of chemical pathways and neural wiring? How does adversity change who we are? How do our environments mark and define us? To what extent are we trapped by our pasts, and how do we understand the potential to overcome?

It’s a body of questions with profound implications for our approach to early childhood. In the longstanding debate over nature versus nurture, says Jack Shonkoff, “the ‘versus’ is scientifically dead.” In its place, he argues, these investigations charge us with a renewed imperative to fulfill one of the basic obligations of a social contract: improving the conditions in which children and their families live. “You put up a brain scan and people get excited,” Shonkoff says. “Oh my god, this is real!”

Human babies are born with approximately 100 billion neurons, each connected to thousands of others through an
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An immensely intricate network of chemical pathways called synapses. Each experience a baby is exposed to—everything she sees, every song she’s sung, every time she’s held or fed or smiled at—sends a series of electrical impulses shooting through the developing circuits of her brain, strengthening pathways and inciting new synapses to grow. During the first few years of life, that growth happens exponentially. At its peak, the cerebral cortex region of an infant’s brain can produce two million new synapses every second—a warp-speed neural spider web that sets the parameters of a person’s capacity to think, learn and process emotion. Connections that are stimulated consistently over time will grow stronger. Others will weaken and die.

The raw materials of brain development are predetermined, encoded in the 23,000 genes we inherit from our parents. But the way those genes behave—whether they live up to their potential—is determined in large part by the inputs we get during the first few years of life.

Since the 1970s, psychologists have posited that the key ingredient to a child’s development is her emotional attachment to her caregivers. As babies, the idea goes, we depend on adults not just to make sure we’re fed and clothed, but to respond to our cries, our facial expressions, our inquiries about the world and our attempts to connect. Behavioral researchers are fond of quoting the psychologist Urie Bronfenbrenner, famous for founding the Head Start program for low-income preschoolers. “In order to develop normally,” Bronfenbrenner wrote, a child needs to interact with “one or more adults who have an irrational emotional relationship with the child. Somebody’s got to be crazy about that kid.”

Attachment theory has reigned as the dominant philosophy of child wellbeing for close to half a century. The trouble with hypotheses about behavioral psychology, however, is that they are difficult to test. In order to isolate the impacts of nurturing parenting, researchers needed the chance to study a control group—in other words, a large group of kids who never got to be nurtured. That opportunity arose with the fall of the Socialist Republic of Romania, when Western scientists discovered Romanian orphans.

In the mid-1960s, Nicolai Ceausescu, the Stalinist leader of Romania, invoked a series of laws designed to increase his country’s human capital by forcing up its birthrate. He outlawed contraception and abortion, subjected women to compulsory fertility tests and taxed families that produced fewer than five children. Childbirth shot up, as did poverty. The state was obligated to create hundreds of institutional orphanages to care for babies whose parents didn’t want or couldn’t care for them.

When Ceausescu was deposed in the 1989 Romanian Revolution, nearly 170,000 children were living in state institutions that Western reporters, newly allowed into the country, described as being more like warehouses than orphanages. Babies and toddlers spent day and night in rows of cribs, removed only to sit on pots they used as toilets. They were rarely held and had almost no one-on-one interaction. The buildings were mostly silent.

Thousands of Romanian orphans were taken into homes in the United States, where adoptive parents discovered that, despite the drastic change in their circumstances, many suffered from severe and persistent problems. A significant number had stunted growth or abnormally small heads. Many were cognitively impaired or had behavior disorders and extreme difficulty engaging in relationships. For some kids, some of the problems dissipated over time; others proved more stubborn.

In 2000, a team of American neuroscientists traveled to Romania’s capital, Bucharest, to study children in its orphanages, which remained the country’s default form of care for orphans and unwanted kids. Starting with a group of 136 children, aged 5 months to 2.5 years, the scientists ran tests to measure cognitive and emotional development, then compared the results to a group of same-aged Romanian children who lived at home.

In every domain, the researchers found evidence that institutionalization had done tremendous damage. Kids in the orphanages showed diminished electrical activity in their brains, slower neural reactions and weaker connections between areas of the brain that integrate information. Their
cognitive scores were at a level associated with mental retardation. They demonstrated almost no attachment to their caregivers and, when researchers tried to engage them with activities like peek-a-boo or puppet shows, no ability to experience amusement or joy.

The researchers assigned half the children to specially trained Romanian foster parents, leaving the other half in institutions. Over the next several years, they ran developmental tests aimed at finding out if, when and how the children’s trajectories diverged. What would change when terribly neglected babies began receiving individualized care? Could the damage be undone?

The answer turned out to be both yes and no. At 30 months, the children who had been moved into foster homes showed a capacity to express positive emotions that was indistinguishable from children who had never been institutionalized. After a year of foster care, they matched the expressive and receptive language skills of children in the community control group, though their grammatical abilities remained low. By 54 months, their average IQ score had risen by about seven points—still much lower than that of kids who had never been in orphanages, but an improvement over children who had remained there. The latter group’s average score dropped by one.

There was one area, however, in which foster care made almost no difference. All of the institutionalized kids—those who had been moved into homes as well as those who remained—were diagnosed with drastically higher rates of depression, anxiety, ADHD and conduct disorders than children in the community control group. At 54 months old, more than half were found to have a diagnosable psychiatric illness.

In a 2009 paper on their findings, the Bucharest Study researchers noted that the children’s impairments—and improvements—were not evenly distributed: Kids who had been moved into families before the age of two made significantly more progress than those who moved when they were older. “Our results,” the researchers wrote, “strongly support intervention at earlier ages.”

The lesson of the Bucharest study was rare in its lack of ambiguity: The absence of parenting is disastrous to babies’ development.

But it’s also a finding that begs to be turned upside down. For people who work with traumatized children and their families—especially in the child welfare system, with its mandate to decide the slippery question of when caregivers are good enough—the most relevant question is the degree to which good parenting can help. To what extent can the presence of an involved caregiver protect a child’s brain from the harm caused by early stress and trauma? Which practices help children develop, and which don’t?

An important clue seems to be hidden in the function of a stress-related steroid hormone called cortisol. When human beings encounter a threat, our brains launch an intricately choreographed, nearly instantaneous response designed to muster our metabolic resources to fight or to flee. Jolts of electricity shoot from the sensory organs, through the limbic system to the hypothalamus, a cluster of neurons nestled near the root of the brain stem. The hypothalamus triggers the pituitary and adrenal glands, which deluge the bloodstream with chemical signals that incite our hearts to pump faster, our airways to open and our glucose levels to rise. Cortisol is both the end product and the regulatory agent of the stress-response cascade, instructing the body either to relax or remain vigilant to danger.

Cortisol is indispensable, should you find yourself facing a stranger in a dark alley or the more abstract menace of a looming deadline at work. But it is markedly less useful for coping with the grinding, long-term stress that results, for example, when a child’s family falls apart. “These systems were designed by evolution to deal with much more immediate situations,” says Philip Fisher, the University of Oregon psychologist. “We’re not well adapted for the kind of chronic, persistent stress that can happen when parents are drug abusing or mentally ill. In evolutionary terms, there wasn’t a lot of survival… somebody takes over the parenting or the infant dies.”

In studies of children’s stress-response systems, cortisol is often used as a marker of things gone awry. Under normal circumstances, both children and adults have regular, predictable patterns of cortisol production: We wake up in the morning with high levels, which decrease steadily throughout the day. When we encounter a stressful situation, our cortisol levels spike, then—if our systems are healthy—quickly return to baseline. When children’s brains are exposed to cortisol too of-
ten and for too long—either because of traumatic experiences like neglect and abuse or simply because they absorb the atmospheric stress that so often tailgates intractable poverty—it can alter the structure of the genes that control hormone production, disrupting the stress-response system in one of two ways: Either children’s cortisol production becomes hypersensitive (quick to turn on and stubbornly resistant to being shut down), or it becomes chronically dampened, producing abnormally low levels of cortisol to start the day.

In a particularly damaging corollary, prolonged stress seems to stunt growth in parts of the brain that have large numbers of cortisol receptors. This includes the prefrontal cortex—a region most closely associated with a set of skills known collectively as ‘executive function.’

Executive function is not the same as intelligence, but it encompasses abilities that are crucial to learning, such as the power to control impulses, to shift attention from task to task, and to manipulate information in the short-term. Children living in poverty regularly score lower on tests of executive function than wealthier kids. Many scientists think the cause is exposure to ambient stress.

In 2002, a team of researchers in Pennsylvania and North Carolina launched a study designed to untangle the relationship between poverty, stress and brain function. Starting with a cohort of nearly 1,300 babies, they ran periodic tests until the children were 3 years old. First, they measured stressful conditions such as family crowding and the noise level and safety of babies’ homes and neighborhoods. Then they subjected the babies to briefly stressful situations, such as taking away a toy or repeating the child’s name while wearing a strange mask. Before and after each experience, the researchers took saliva samples to measure the babies’ production of cortisol.

As with previous studies, the researchers found that kids who lived amid greater levels of poverty and chaos were likely to have disrupted cortisol patterns, and that these kids did worse than other kids on measures of executive function. But the study also tested a potential mitigating factor: the relationships between babies and their mothers.

At each visit, researchers videotaped mothers interacting with their children. They then coded the videotape, rating mothers on qualities such as sensitivity, animation and the positive regard they expressed for their babies. What they found was that when mothers were rated as being particularly responsive and nurturing, their babies’ cortisol patterns were much more likely to be normal, regardless of whether they lived in poverty or chaos. Even in the cases where babies’ cortisol patterns were irregular, those with responsive mothers were likely to score higher on tests of executive function. In other words, having a nurturing mother almost completely mitigated the developmental damage that, in other children, correlated with stress.

In a 2011 journal article, the study’s authors posed a series of questions about their findings. “It is not clear,” they wrote, whether particularly responsive mothers were affecting their babies “through a tactile and kinesthetic nurturing process” or through more contextual practices “such as structuring of opportunities and appropriate levels of stimulation.” It’s even possible, they suggested, that the behaviors they measured simply coincided with other markers of involved parenting, like exposing children to new situations.

Whatever the operative mechanism, the study was among a growing number that point to the good-news flipside of this research on trauma and development: Stressful environments are damaging to children’s growth, but committed caregivers have the power to protect them. Damage, in other words, is not a foregone conclusion.

... The question, for Philip Fisher, is how to make that good news relevant to kids whose relationships with their parents have already been disrupted.

Once his toddler’s adoption finally went through, Fisher found himself in the disorienting position of a service provider who has become in need of services. “Although the placement process was difficult,” he says, “the adoption went really well initially and we were very happy.” As his son approached adolescence, however, he started to struggle. Fisher realized that his family fell into a kind of social services hinterland. Few of the people traditionally designated to help troubled kids and families (grateful though he was for their support) understood the needs of children who had experienced the displacement of foster care or adoption. On the other hand, people who worked with families in the child welfare system—those in the best position to impact foster children’s developmental health—largely reserved their attention for older kids.

Working with researchers at the Oregon Social Learning Center, a think tank that develops service programs for kids...
and families, Fisher set out to create a new model for providing foster care to preschool-aged children—one that would protect them, at least in part, from the long-term damage caused by trauma and stress. The goal was to isolate what scientists had learned about the benefits of responsive parenting—those practices that had proved most likely to protect children from developmental harm—and inject them into relationships that are, by definition, temporary.

The better we understand how children grow, the more possible it will become to sever the link between traumatic childhoods and chaotic adulthoods.

Under Fisher’s program, which goes by the unwieldy name of Multidimensional Treatment Foster Care for Preschoolers, or MTFC-P, foster parents undertook a training program that emphasized a preschooler’s need for structure, consistency and nurturing. They learned strategies to address negative behaviors, but were instructed to mete out approval much more frequently than punishment, and to respond readily to children’s attempts to connect. The program also provided a great deal more assistance than is typically available to foster parents, including weekly support groups and home visits from a child development consultant. Kids in the program attended weekly therapeutic playgroups and worked one-on-one with a therapist if they showed evidence of developmental delays. Program staff were available 24 hours a day to troubleshoot any problems.

Fisher and his team tested the model with a group of 117 foster children in rural Oregon. Half were placed in standard foster homes; half went to foster parents who had been trained in Fisher’s program. The researchers compared their outcomes to a community control group of low-income, preschool-aged kids who lived with their parents.

Over time, as might be expected in a program with so many supports, kids in the MTFC-P homes did better than kids in regular foster care by all the standard measures of child welfare success. They moved between foster placements less frequently. When they went home to their parents, they were less likely to come back into the system. And when they were adopted, the adoptions were more likely to last.

Far more revelatory was what happened when researchers measured the children’s stress-response systems. At the beginning of the study (and like foster kids in previous experiments), children in care were much more likely than other kids to have abnormal cortisol production. Nearly one-third came into the study with what Fisher describes as a ‘blunted’ pattern, starting off with low cortisol in the morning and experiencing a much smaller than normal decrease through the day.

As the study progressed, cortisol production among the children in traditional foster homes became even more abnormal. Their mean level of morning cortisol dropped by close to 30 percent, so the pattern became significantly more blunted over time. Meanwhile, morning cortisol levels among the children in the MTFC-P homes rose. By the end of the study, their cortisol production was indistinguishable from children in the community control group.

Fisher explains that much of what happened during the study remains mysterious. Scientists don’t fully understand how or why cortisol patterns change, or even precisely what the changes mean for a child’s long-term development. What was clear, however, was that something about the MTFC-P foster homes allowed very young children to reverse damage that had been caused by turmoil in their lives. Given the right training and support, caregivers were able to nurture children who then regained a measure of health. “It shows that plasticity works both ways,” Fisher says. “It’s not just that we say, ‘bad things produce bad outcomes.’ If we can maintain the right circumstances, things can get back on track.”

In that sense, the premise of the model reflects that of the science that informs it. It rests on the hope that the better we understand how children grow, the more possible it will become to sever the link between traumatic childhoods and chaotic adulthoods. For the most part, chronically stressed children don’t grow in isolation. They develop in the context of overtaxed families and of communities made unstable by poverty, violence, illness and incarceration. The science of infant development promises hope that we can wipe the slate a little bit cleaner—that if we are willing to build the skills of children’s caregivers and to ease some of the burdens that limit their ability to provide responsive, nurturing care, it might be possible to loosen the grip of the past on the future. Fortunes can be reversed; children freed to reach their potential.

“Obviously there are going to be limits depending on how severe a child’s experiences were,” says Fisher. “You can’t take a child that’s experienced extreme deprivation and make everything hunky dory for them, but you can improve their trajectory. And for children who’ve experienced less severe adversity, there’s potential to make things move in a really solid direction.”