

# Toxic Stress and its Impact on Early Learning and Health: Building a Formula for Human Capital Development

by Pat Levitt

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**D**ecades of research reveal how the brain develops and the ways that children's early experiences are built into the architecture of the brain. The challenge that policymakers face is how to capitalize on this exciting new science and its potential to build a solid foundation for economic productivity, responsible citizenship, and a prosperous society. The environments children grow up in shape how the brain develops with one powerful influence being toxic stress. Even among children as young as infants, toxic stress can damage the brain's response to stress making it difficult to correctly interpret the world, function at a high level, and avoid problems later in life. Children's ability to cope with stress depends in part, upon stable and caring relationships with parents and the adults who care for them. Healthy development is threatened, not only by bad things that happen to children, but also by the absence of good things. One prevalent threat to children's healthy development is severe neglect, a form of toxic stress more common than physical or sexual abuse. Children who have been neglected have the capacity to recover with promising interventions that target both the child and their parents/caregivers. In evaluations, programs that build supportive relationships produce biological changes in children's response to stress that can have lifetime benefits.

The path to a sound economy and the state's future prosperity depend on the well-being of our children.<sup>1</sup> One of the state's most important responsibilities is building a formula for developing human capital. Burgeoning research in the fields of neuroscience, molecular biology, genomics, and epigenetics reveals why early child development—particularly from birth to five years—is the foundation for a prosperous society. Decades of research reveal how the brain develops and the ways that children's early experiences are built into the architecture of the brain.

The challenge policymakers face is how to capitalize on this exciting new science. Policies that build a strong foundation for children's early learning and behavior can improve school success, economic productivity, and responsible citizenship.<sup>2</sup> This chapter reviews the science of how the architecture of the brain develops, the ways that stress differs in its nature and severity, how toxic stress disrupts the architecture of the brain, what role children's relationships and experiences play in buffering toxic stress, how neglect contributes to toxic stress, and what policies and programs can improve children's response to stress. Implications will be given for public policy decisions that can ensure children get a great start in life.

**Policies that build a strong foundation for children's early learning and behavior can improve school success, economic productivity, and responsible citizenship.**

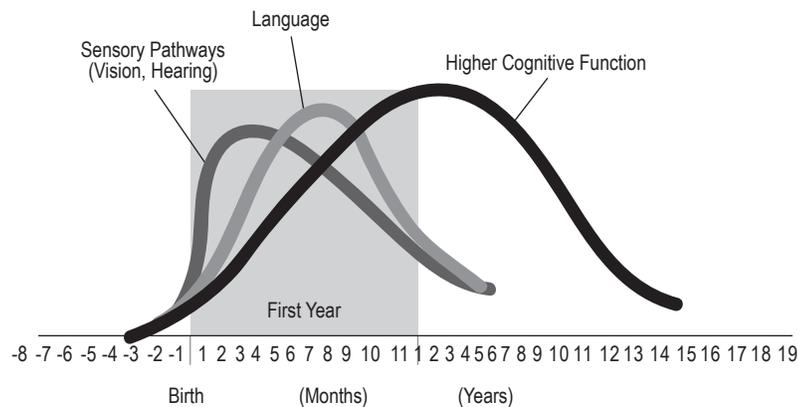
Pat Levitt

## The Science of Early Brain Development

***Just like a home,  
the brain is built  
sequentially by  
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Decades of research reveal many ways that the brain develops, four that are mentioned here: (1) the biology of how the brain develops, (2) what factors influence it, (3) when it is most malleable, and (4) the ways in which the brain operates. First, research tells us that “brains are built over time from the bottom up (p. 1).”<sup>3</sup> Simple circuits and skills are formed first providing the foundation for more advanced circuits and skills to emerge later in life. When the brain is built on a strong foundation, it increases the odds of healthy development; when the foundation is weak, it increases the chances of later difficulties. Just like constructing a home, the brain is built following a predictable sequence—laying the foundation, framing the rooms, and wiring the electrical system.<sup>4</sup> The “wiring” of the brain cells occurs rapidly in the first few years of life; an amazing 700 new neural connections (synapses among brain cells) are formed every second.<sup>5</sup> As illustrated in Figure 1, the neural connections that develop first are the pathways for basic sensory functions like vision and hearing. This provides a critical foundation for the infant to begin to interact with the environment. Next, the pathways for early language develop followed by those for higher cognitive functions that form over the years.

**Figure 1.** Human Brain Development: Neural Connections for Different Functions Develop Sequentially



*Note:* In the proliferation and pruning process, simpler neural connections form first, followed by more complex circuits. The timing is genetic, but early experiences determine whether the circuits are strong or weak. Graphic courtesy of the Center on the Developing Child at Harvard University. Data source: C. A. Nelson (2000). <http://developingchild.harvard.edu>

Second, the developing brain is shaped by both genes and experience. Genes provide the blueprint, but early experiences determine how strong or weak the neural circuits will be. In part, this occurs through a process termed “epigenetics,” in which experiences promote chemical signatures on a child’s DNA that finely control when and how genes will be used during development. These changes to the genes that we inherit may be permanent.<sup>6</sup> Brain architecture is fueled by baby’s inborn drive to use their senses to master their world. Babies babble, coo, and reach out to people, who respond with their own words and gestures, much like the “serve and return” in a game of tennis. The developing brain is also shaped

by children’s relationships, first with members of their family but also their peers, primary caregivers, and other adults who play important roles in their lives. Thus, children grow up in an environment of relationships, and if these relationships are not reliable and responsive, the developing architecture of the brain may be disrupted in ways that impair future learning, behavior, and development.<sup>7</sup>

Third, the brain is most plastic early in life. This allows babies to adapt to a wide range of environments and relationships. As the brain becomes more specialized, it is less able to adapt to new or unexpected challenges. For example, as early as the first year of life, the baby’s brain is becoming specialized to the sounds that it hears and is already losing its ability to respond to sounds in other languages.<sup>8</sup> When neural circuits are not formed properly from the beginning, it takes more physiological energy to compensate later. This means that influencing a baby’s brain early in life is easier than rewiring it later, and less expensive than the subsequent costs of remedial education, clinical treatment, public assistance, incarceration, and so forth.<sup>9</sup>

Fourth, the brain operates in a highly interconnected fashion, not in silos. Children’s emotional, social, and cognitive competence do not operate in isolation, but depend upon each other for proper functioning. Together they form the “bricks and mortar” that are the foundation for human development.<sup>10</sup>

***If relationships with family and caregivers are not responsive, the architecture of children’s brains may be disrupted in ways that impair future development.***

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### **Stress Differs in its Nature and Severity**

The environment has a powerful impact on brain architecture and child development. One particular type of experience that has received a lot of attention is stress. There are different kinds of stress; it can be harmful (what we call “toxic”), tolerable, or beneficial (positive) depending on the severity of the stress, a child’s ability to cope, and how long the stress response lasts. Most adults have had the experience of facing a threat, being gripped by fear and anxiety, and having trouble thinking. Most of us have learned how to adapt to stress through early experiences that tune our circuits to be resilient to challenges. But when children live in highly threatening, chaotic, or severely neglectful environments, these continuous experiences impact negatively on the circuits that control how well they will adapt to stress later in life. These types of toxic stress cause significant difficulties for young children to perform well cognitively, even when they are in a safe place like school.<sup>11</sup> Understanding the differences between stress that is harmful, tolerable, or even beneficial can help policymakers determine what prevention strategies are appropriate and when interventions are needed.<sup>12</sup>

**Toxic stress** refers to events that produce strong, frequent, or prolonged activation of the body’s stress management system. Stress can physically damage brain architecture when it is chronic, uncontrollable, or experienced without a caring adult. In extreme circumstances, certain parts of the brain that are necessary for emotional control, memory and learning, and problem-solving may actually be smaller. In less extreme circumstances, the stress system may change, reacting to events that might not be stressful to others.<sup>13</sup> Over time, the “wear and tear” of this excessive stress response and the chemicals it releases can lead to academic problems, difficulties in social adjustment, mental illness (e.g., depression, anxiety disorders, alcoholism, drug abuse), and chronic physical disease (e.g., heart problems, diabetes, stroke).<sup>14</sup>

*Tolerable stress* could affect brain architecture, but generally it occurs for briefer periods that allow the brain to recover and reverse any potentially harmful effects. For example, when supportive adults are available, children can recover from major adverse experiences such as a natural disaster, death or serious illness of a loved one, parental divorce, or a serious accident.<sup>15</sup>

*Positive stress* is what many of us experience as children—a moderate, short-lived stress that is a normal part of child development. For example, meeting new people, starting a new child care arrangement, speaking in front of a class, or getting an immunization can be positive stressors if the child has the support to deal with them.<sup>16</sup>

### **How Toxic Stress Disrupts the Architecture of the Brain**

***Even among children as young as infants, toxic stress can damage the architecture of the developing brain.***

Even among children as young as infants, their response to toxic stress in their family and caregiving environments can damage the architecture of their developing brains. A child’s ability to deal with stress depends upon highly interrelated brain circuits and hormone systems. When a child is threatened, stress hormones are produced that send chemical signals to the brain and throughout the body. The neural circuits for dealing with stress are particularly malleable during the fetal and early childhood periods. Toxic stress during this early period can lead to stress response systems that turn on too quickly or shut down too slowly. A poor response to stress can be damaging to a child’s health and well-being if it is turned on too often or for too long.<sup>17</sup> Toxic stress can actually tune a child’s sensory and cognitive systems in ways that make it challenging to correctly interpret the world around them. This can make it difficult to function at a high level and to avoid problems later in life.

When the body responds to stress, a variety of hormone and neurochemical systems are activated. For example, acute stress produces adrenalin that mobilizes energy stores and alters blood flow. Cortisol is also produced because it helps the body cope with many forms of stress; when acutely released, cortisol mobilizes energy stores and suppresses the body’s immune system.<sup>18</sup>

Frequent or sustained activation of the hormone system can have serious developmental consequences that can persist long past the time of stress exposure. For example, when cortisol levels are elevated intermittently for a long time, it can change the architecture of the regions of the brain that are essential to learning and memory. Sustained activation also results in novel “epigenetic” modifications that can result in permanent disturbances in a child’s physiology.<sup>19</sup> Thus, even how a child responds to stress during the important years of schooling and later in adult life can be changed. In animal studies, the offspring of pregnant females who experience exceptionally high levels of stress are more fearful and more reactive to stress themselves. They experience impaired memory and learning abilities along with more aging-related cognitive deficits in adulthood.<sup>20</sup>

### **The Role of Children’s Relationships and Experiences in Buffering Toxic Stress**

The impact of toxic stress on the developing brain is determined by the child’s response to it. Stable and caring relationships with adults can help children cope

with stress and will contribute to healthy brain development in a number of ways. Parents and caregivers promote children’s physical health by assuring proper nutrition, providing preventive health check-ups, and protecting children from toxins and preventable injuries. Sound adult relationships with children also can increase the predictability of daily routines and decrease exposure to toxic stress.<sup>21</sup>

The quality of the caregiving—its sensitivity and responsiveness—can serve as a powerful buffer against stress, even among children who may be highly vulnerable to its effects. It is a surprise to many that the absence of “serve and return” interactions is the most common form of toxic stress. For example, a mother’s clinical depression during her child’s early years interferes with her responsiveness, which can increase the child’s cortisol reaction to adverse family conditions later in childhood. From the earliest times after birth, therefore, parents’ availability and responsiveness literally shape the architecture of the emerging brain by building the neural circuits that are the foundation for the child’s emerging capabilities and the roots of their physical and mental health. Stable and high-quality child care environments also contribute powerfully to building healthy brain architecture. The absence of these responsive relationships activates the body’s stress response system in ways that can have lifelong mental and physical health consequences.<sup>22</sup>

Primary caregivers who provide inadequate care may experience a number of predisposing factors such as economic hardship, social isolation, and/or chronic disease. Adults who provide inadequate care may have a number of mental health impairments including depression, anxiety, post-traumatic stress disorder, serious personality disorders, or substance abuse involving the use of alcohol or illicit drugs. Those caregivers at highest risk often experience several of these problems simultaneously. Research finds that inadequate or neglectful caregiving occurs in every culture, at all income levels, and in all racial, ethnic, and religious groups.<sup>23</sup>

The quality of early care and education programs can also influence whether and the extent to which young brains are exposed to elevated stress hormones early in life. For example, compared to their peers in higher quality child care, young children in poorer quality care show disrupted daily cortisol levels.<sup>24</sup>

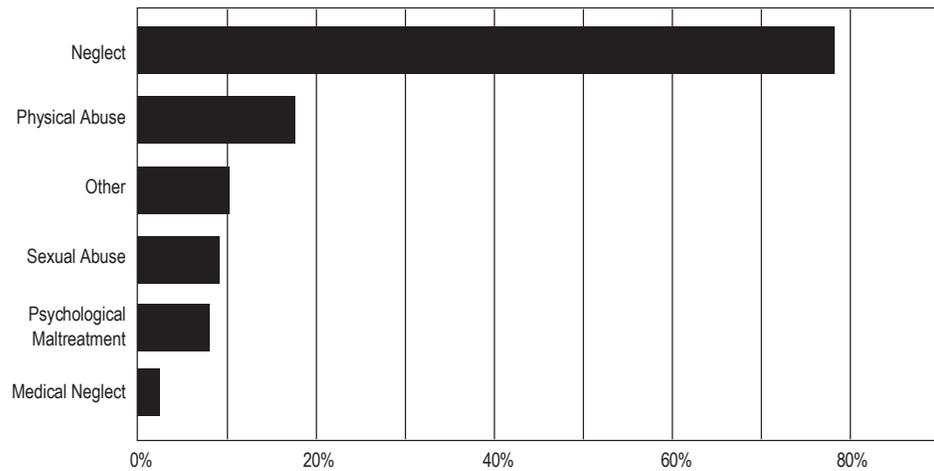
### **How Neglect Contributes to Toxic Stress**

Extensive research over the last 30 years has shown that healthy development can be threatened, not only by bad things that happen to children (e.g., physical abuse, sexual exploitation), but also by the absence of good things (e.g., responsive caregiving, positive experiences). In fact, deprivation or neglect can damage a young child’s development more than physical abuse. To researchers, neglect refers to the “absence of sufficient attention, responsiveness, and protection that are appropriate to the age and needs of a child” (p. 2).<sup>25</sup> The earliest studies of neglect were of children who experienced extreme deprivation in state-run institutions in Romania, China, and other places outside North America.

Neglect is by far the most prevalent form of child maltreatment in the United States, yet it receives far less public attention than physical or sexual abuse. In 2010, neglect comprised 78% of all reported cases of maltreatment nationwide.<sup>26</sup>

***Compared to their peers in higher quality child care, young children in poorer quality care show disrupted daily cortisol levels.***

**Figure 2. Neglect is the Most Prevalent Form of Child Maltreatment**



*Note:* Each state defines the types of child abuse and neglect in its own statute and policy, guided by federal standards, and establishes the level of evidence needed to substantiate a report of maltreatment. The data above, from the National Child Abuse and Neglect Data System (NCANDS), reflects the total number of victims (defined as a child for whom the state determined at least one report of maltreatment was found to be substantiated or indicated) as reported by all 50 states, the District of Columbia, and Puerto Rico, between Oct. 1, 2009, and Sept. 30, 2010. "Other" includes abandonment, threats of harm, and drug addiction. Graphic courtesy of the Center on the Developing Child at Harvard University. Data source: U.S. Department of Health and Human Services. <http://developingchild.harvard.edu>

State welfare systems typically define neglect in the categories of:<sup>27</sup>

- 1) physical or supervisory oversight (failure to provide adequate food, shelter, hygiene, and/or appropriate monitoring)
- 2) psychological neglect (failure to attend to a child's emotional and/or social needs)
- 3) medical neglect (failure to secure adequate medical treatment)
- 4) educational neglect (failure to provide for a child's formal learning needs)

***Young children who are neglected may not have suffered physical harm, but may still have disruptions in their brain circuitry.***

These long-standing standards are valid, but they do not help judge the severity of neglect or when to intervene. The federal Child Abuse Prevention and Treatment Act (CAPTA), which was amended by the Keeping Children and Families Safe Act, includes in its definition failure to prevent imminent risk of serious harm. This definition fails to sufficiently acknowledge the less immediately visible but still highly threatening, long-term consequences of excessive deprivation that can have severe lifelong consequences. Indeed, science tells us that young children who meet the criteria for neglect may not have suffered physical harm, but may still have experienced disruptions in their brain circuitry. Here is where science can help by identifying four types of responsive care that provide a useful framework for knowing when and how to protect vulnerable children.<sup>28</sup>

***Occasional inattention.*** Loving and responsive parents who do not always respond in a timely fashion to the needs of young children are not a need for concern. Indeed, sometimes it can be beneficial when parents occasionally do not respond immediately because it helps build a child's independence and capacity for self care and problem solving.

**Chronic under-stimulation.** When caregivers fail to provide attention to children on an ongoing basis, this can be harmful to children. Examples include caregivers who do not engage children in active conversation and who leave children in front of a television for hours at a time. Understanding the reasons for caregiver unresponsiveness (e.g., depression, illness, poverty, discrimination, social or geographic isolation) can help identify what responses are most appropriate. Parent education and high-quality care and education programs can produce strong returns on relatively simple, voluntary interventions.

**Severe neglect in a family context.** When a child’s basic needs for nutrition, medical attention, and education are unmet and when young children are left alone or ignored for hours, a child’s very survival is threatened. This can lead to lifelong problems in learning, behavior, and health. Immediate attention is crucial.

**Severe neglect in an institutional setting.** Institutions that “warehouse” large numbers of infants and young children are examples of extreme deprivation. Even though a child’s basic needs for food, shelter, and medical care are met, there are often no reliable and responsive relationships with adults. Staff typically have little or no training, youngsters are ignored for most of their waking hours, and infants are cared for by many different people, making it difficult to develop meaningful relationships with any single caregiver. Most of the research on neglect in institutional settings comes from locations outside the United States such as Eastern Europe, but there is growing evidence that some residential care facilities in the United States are harmful to infants and toddlers, and are not a good substitute for adoption or high-quality foster care.

Science can help policymakers determine when it is best to intervene. Table 1 describes the features of four types of unresponsive care and indicates which types warrant policymakers’ attention and which do not.

**Table 1.** Science Helps to Differentiate Four Types of Unresponsive Care

	Occasional Inattention	Chronic Under-Stimulation	Severe Neglect in a Family Context	Severe Neglect in an Institutional Setting
Features	Intermittent, diminished attention in an otherwise responsive environment	Ongoing, diminished level of child-focused responsiveness and developmental enrichment	Significant, ongoing absence of serve and return interaction, often associated with failure to provide for basic needs	“Warehouse-like” conditions with many children, few caregivers, and no individualized adult-child relationships that are reliably responsive
Effects	Can be growth-promoting under caring conditions	Often leads to developmental delays and may be caused by a variety of factors	Wide range of adverse impacts, from significant developmental impairments to immediate threat to health or survival	Basic survival needs may be met, but lack of individualized adult responsiveness can lead to severe impairments in cognitive, physical, and psychosocial development
Action	No intervention needed	Interventions that address the needs of caregivers combined with access to high-quality early care and education for children can be effective	Intervention to assure caregiver responsiveness and address the developmental needs of the child required as soon as possible	Intervention and removal to a stable, caring, and socially responsive environment required as soon as possible

Note: Graphic courtesy of the Center on the Developing Child at Harvard University. <http://developingchild.harvard.edu>

The clearest findings on the effect of deprivation on the developing brain come from children who experienced severe neglect while being raised in institutions, and also from studies of how their lives have been turned around by foster care placements or permanent adoption. Based on extensive research, severe neglect in institutional settings is associated with physical, social, and behavioral disadvantages. Physically, when children are severely neglected, abnormalities occur in the developing brain. For example, severe neglect is associated with delayed growth in head circumference, which directly reflects brain growth. Children who experience profound deprivation have more infections and are at greater risk of premature death. This may occur because disrupting the stress response long-term causes the immune system to malfunction when challenged, which then increases the risk of stress-related disease throughout life.<sup>29</sup>

Children who experience deprivation and extreme social neglect show diminished electrical activity in the brain, decreased brain metabolism, and poorer connections for integrating complex information. Severely neglected children also struggle when looking at human faces to correctly identify different emotions. Significant neglect also affects the development of a variety of brain regions such as the prefrontal cortex that supports a wide range of executive functions such as planning, controlling impulses, solving problems, and staying focused. Also, serious deprivation is associated with abnormal activity in areas of the brain involved in emotion and stress regulation (i.e., the amygdala and hippocampus) and also attention and self-control (e.g., the anterior cingulate cortex).<sup>30</sup>

**Secure attachment predict qualities societies value in their citizenry—competent problem solving, involvement, leadership, and self-confidence.**

Whether neglect occurs in a family, day care, school, or institutional setting, children experience difficulties in relationships with family members, caregivers, and friends. Children who have experienced neglect have higher rates of insecure attachment with their primary caregivers.<sup>31</sup> Secure attachment, basically the relationships that form when caregivers are reliably available and responsive, predicts a number of qualities that most societies value in their citizenry—competent problem solving, involvement, leadership, and self-confidence. In addition, secure attachment and the quality of care early in life reduce the risk of kids dropping out of school later in life.<sup>32</sup> Compared to their non-neglected peers, preschoolers who experience serious neglect also are more likely to become overly dependent on their teachers for support and nurturance. Furthermore, youngsters who experience serious neglect in their families engage in fewer social interactions with peers during preschool, a pattern that continues into adolescence, which normally is a challenging time for all teens.<sup>33</sup>

Compared to their non-neglected peers, children who have been neglected also have higher rates of emotional and behavioral problems such as more negative emotions, poorer impulse control, less confidence, and reduced assertiveness in problem solving. Compared to other forms of maltreatment, significant neglect is associated with increased risk for personality disorders, anxiety, and depression. Although the majority of adults who were neglected as children do not engage in criminal activity, the odds are greater that they will be arrested for violent crimes or be diagnosed with antisocial personality disorder compared to adults who were not maltreated as children. Severely neglected children are more apt to experience

academic delays and to be rated as inattentive and hyperactive by teachers. They exhibit lower IQ scores, have poorer reading skills, and are less likely to graduate from high school.<sup>34</sup> Their economic and personal achievements typically are lower than their peers.

### What Policies and Programs Work

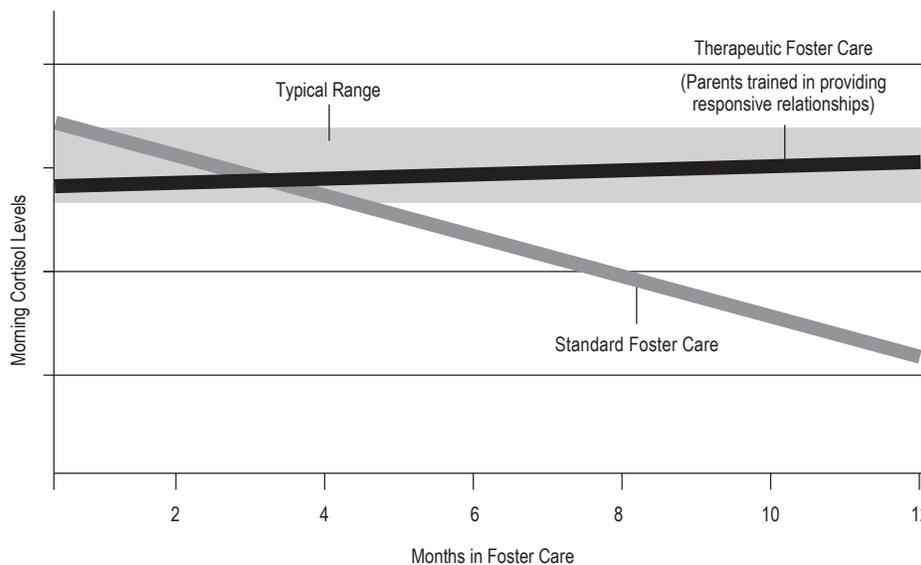
With promising interventions, children who have been neglected and then placed in supportive environments have the capacity to recover. Several promising policies and programs have been able to transform the lives of children placed in foster care and also promote secure attachments in young children who continue to live with their families (see examples in the Magnuson chapter in this report).

Only one program is highlighted here—the Multidimensional Treatment Foster Care for Preschoolers intervention. This program targeted the social-emotional needs of young children living in foster care (most who had been victims of neglect). The intervention includes addressing potential problems that the adults who care for the children may experience. Targeting both children and adults results in more stable and sustainable placements, and even in biological changes that restored preschoolers’ cortisol to normal levels.<sup>35</sup> The dramatic improvements that supportive relationships can provide is illustrated in Figure 3 below.

**Interventions that target both children and adults have been shown to restore preschoolers’ cortisol to normal levels.**

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**Figure 3. Supportive Relationships Restore Disrupted Stress Response**



Note: Children in the child welfare system, many suffering from serious neglect, can see dramatic improvements in stress response with the provision of supportive relationships. Without such relationships, children in this study who received standard foster care showed suppressed levels of the stress hormone cortisol, which worsened the longer they were in foster care. Foster parents trained to provide responsive relationships through the Multidimensional Treatment Foster Care for Preschoolers intervention were able to restore foster children’s stress hormones to typical levels, as measured in a control group of children from the same community who were not in foster care. Graphic courtesy of the Center on the Developing Child at Harvard University. Data source: Fisher, P. A., Stoolmiller, M., Gunnar, M. R., & Burraston, B. O. (2007). <http://developingchild.harvard.edu>

## Implications for Policymakers

Policymakers face two principal questions: (1) What decisions can help ensure that all children receive the caring and responsive relationships they need for healthy brain development that will contribute to a sound economy and a prosperous future? (2) What decisions can help children overcome the impacts of adverse early experiences and exposure to toxic stress?<sup>36</sup> Neuroscience cannot tell policymakers what to do. Yet neuroscience can raise important considerations and provide data from research that will help inform policymakers' decisions about developing more effective strategies to prevent toxic stress and promote healthy brain development.<sup>37</sup>

- 1) Severe neglect is as great a threat to children's health and development as physical abuse, perhaps even greater. Surprisingly, there is still no broad-based agreement on clear and objective criteria regarding how neglect should be defined and when state intervention should be authorized. Despite recent scientific advances, there has been relatively little change in the ways in which services are provided for this highly vulnerable population in the child welfare system. Appropriate and timely referrals are critical.
- 2) Most child welfare agencies have relatively limited capacity to address neglect in young children. Neuroscience has underscored the greater returns for prevention compared to rehabilitation. This suggests a greater need for more effective outreach to families facing the circumstances and conditions that put their children at risk of significant neglect. Beyond socioeconomic hardship, new program strategies can also identify other circumstances that can overwhelm parents such as addictions to alcohol and other drugs, chronic medical conditions, and mental health disorders such as depression. The federal Title IV-E waiver guidelines issued in 2012 offer a promising opportunity to identify families at risk of neglect. Coordination will be needed across service sectors to identify vulnerable children and families as early as possible.
- 3) The timing for interventions is critically important. A consistent and rigorous body of evidence indicates that the sooner neglected children receive appropriate interventions, the less likely they are to demonstrate long-term, adverse effects. In various studies, the benchmark ages for removing children from extreme deprivation has been identified as 6, 12, or 24 months of age. For example, young children in Romania who were removed from institutions and placed in high-quality foster care homes prior to 24 months of age showed remarkable gains in thinking and memory. In general, the more profound and pervasive the deprivation, the earlier the child needs to be removed to foster the greatest recovery.
- 4) Science has well documented that children who are supported in their families or removed from neglectful conditions and placed in supportive foster care have the capacity to recover. However, simply removing a young child from conditions of severe neglect does not guarantee positive outcomes. To heal, severely neglected children need therapy

***Simply removing a young child from conditions of severe neglect does not guarantee positive outcomes.***

and supportive care, often for 6 to 9 months or longer. When such support occurs, even institutionalized children have shown demonstrated improvements in brain activity as measured by EEG. Without supportive services, neglected children remain at high risk for a host of problems that persist into adolescence and adulthood.

- 5) Child neglect does not occur in isolation from other family problems. Evidence-based interventions that address parental depression, addiction to substances, economic hardship, social isolation, and medical challenges can have a very positive impact on child outcomes, even though they do not specifically address children.
- 6) To provide access to non-stigmatizing, community-based services, cooperation will be needed among policymakers, family court judges, and practitioners.

## Conclusion

Growing research in the fields of neuroscience, molecular biology, genomics, and epigenetics tells us that when children experience stress in the absence of supportive relationships from their parents and caregivers, this can activate young children's stress response systems. In turn, this can lead to toxic stress that is built into the architecture of the brain in ways that can have consequences for a lifetime. The importance of caring and responsive relationships is not new, but what is new are the ways in which children's stress responses can be brought back to normal by relationships with caring, responsive parents and high-quality providers of care and education.<sup>38</sup>

Policymakers can use this cutting-edge research on early brain development to formulate and implement innovative policies designed to (a) improve all children's learning and behavior, and (b) overcome the impacts of adverse early experiences and exposure to toxic stress. Failing to do so misses out on a key window of opportunity for building a healthy brain architecture.<sup>39</sup> Influencing a baby's brain early in life is easier than reviving it later, and far less expensive than the subsequent costs of remedial education, clinical treatment, public assistance, incarceration, and so forth.<sup>40</sup> Building a strong foundation for children's early development is a formula for human capital development and community success that provides a solid foundation for economic productivity, responsible citizenship, and a prosperous society.

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briefings, the Congressional Summit for America's Children, and meetings of the National Conference of State Legislatures, the National Governors Association, and the North Atlantic Treaty Organization. His superior research competence and productivity earned him MERIT awards from the National Institutes of Health and the National Institute of Mental Health. Dr. Levitt was elected as a member into the prestigious Institute of Medicine (IOM) and he serves as a member of the National Advisory Mental Health Council for the National Institute of Mental Health. He is an elected Fellow of the American Association for the Advancement of Science (AAAS), Chair-elect of the Neuroscience Division of the AAAS, and an elected member of the Dana Alliance for Brain Initiatives. He is a member of a number of scientific advisory boards for foundations and universities, and is a member of the editorial board of several prestigious journals. He also serves as the Scientific Director of the National Scientific Council on the Developing Child that is committed to bringing the science and underlying neurobiology of early childhood and early brain development to policymakers and business leaders.

This chapter was adapted from the following publications:

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## Endnotes

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