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**THE PATH TO BETTER CHILDHOODS**

## **Brain science provides a clear road map for policies that give children more learning abilities and brighter futures—yet the U.S. continues to wander off course**

ON VITAL MEASURES THAT PREDICT LATER SUCCESS IN SCHOOL AND life, small children in the U.S. do worse than kids in comparable countries. This distressing information comes from an Organisation for Economic Cooperation and Development (OECD) study of five-year-olds. For years the OECD has been examining the academic achievement of 15-year-old students from around the world, and recently it extended this work to the younger group. On average, American children had lower literacy and numeracy scores, poorer self-regulation skills, and engaged in fewer acts of cooperation, kindness and other prosocial behaviors than did children in England and Estonia, the other countries studied. Just about the only bright spot was that U.S. children were roughly equivalent to their international peers on some—but not all—social-emotional measures.

These findings did not get the attention they deserved, because they were announced in March 2020, a few days after the World Health Organization declared that COVID had become a pandemic. But they did not come as a surprise—other recent research has shown that about half of American children are not "on track" in at least one critical area of school readiness. Because the OECD report looked at kids who were just starting school, it was a powerful reminder that we have lost sight of something basic: Learning begins on the first day of life—and not the first day of class. The earliest years of a child's life are full of opportunity. A child's brain will never be more receptive to experience, more plastic, than it is during this pivotal time. Nearly 85 percent of brain growth occurs between birth and the age of three. During this period one million neural connections per second are formed.

Two decades of child development research tell us that small kids need two things above all else to get off to the best possible start: nurturing interaction with caregivers and protection from toxic stress. Over the past five years a new wave of neuroscientific studies, highlighting the neurobiological effects of early experience, has strongly pointed toward ways of accomplishing these goals. Such research provides an early peek at what is happening in young children's brains. The studies show that environments and relationships we know benefit development are also associated with higher levels of activation and connectivity in parts of the brain that underpin language and cognitive development.

One of us (Suskind) is a pediatric physician and early-learning researcher who has been tracking the way emerging science on brain development can inform not just what we do as parents but as a society. For instance, paid leave gives parents time to develop nurturing relationships. Child allowances and tax credits can alleviate the poverty known to be detrimental to development. When parents work outside the home, as a considerable majority of American mothers and fathers must, access to quality child care provides young children with responsive, engaged caregivers.

Yet there is a disconnect between what science tells us children need and what we as a society do to help them. The U.S. is the only developed country in the world that does not mandate paid leave for a parent after childbirth. In 2020 four in 10 children in the U.S. had families who were struggling to afford basic necessities.

Congress just allowed an expanded child tax credit to lapse—a credit that helped millions of families weather the pandemic and had dramatically cut the number of poor children. Further, approximately half of Americans live in so-called child care deserts, where there aren't nearly enough facilities or caregivers, and fewer than 10 percent of existing child care programs are considered high quality. The pandemic highlighted these gaps. Like

a powerful earthquake with lingering aftershocks, it showed just how shaky our nation's support for parents and their children really is.

The science of brain development is rarely part of any public discussion of ways to fix these gaps. But it should be at the center of that conversation because it lays out a road map to improve national and local policies that can make children's lives much better.

## THE MANY EFFECTS OF LANGUAGE

WEARING his ever present Chicago Bulls cap, Randy settled onto the soft carpet of his living room and pulled his two-year-old son, Julian, into his lap. "Want to play?" he asked.

Julian grinned and began to stack some blocks. Father and son counted together ("one ... two ... three ... four ... five ...") until a tall and precarious tower stood in front of them.

"Drop it, drop it." Randy nudged Julian, encouraging him to tip the tower over. Julian gazed at his dad, his eyes twinkling with delight as Randy added a few more blocks. When the stack—and the counting—reached 16, the tower came crashing down.

"Boom!" Randy shouted.

"Boom!" Julian echoed.

Randy fully embraced his role as a responsive parent—so much so that he signed up for a home-visiting research program in the Chicago area to learn more about child development. (We are using only first names to protect the family's privacy.) He was tuning in to his child, talking to him, and taking turns in their ongoing conversation even though Julian couldn't say much yet. This kind of rich language input is central to the importance of nurturing relationships. For years researchers focused on the quantity of words a child heard—the so-called 30-million-word gap—as the best predictor of language development. The newest research reveals that quality of language exposure matters even more. Overhearing conversation isn't enough. Children must participate, just as Randy encouraged Julian to do.

In a 2018 study, which was the first of its kind, researchers at Harvard University and the Massachusetts Institute of Technology put 36 four- to six-year-old children in a brain scanner and told them stories about playing hide-and-seek and opening birthday presents. While the kids listened, the scientists looked at brain structure and function. Previously the researchers had recorded everything the children heard for two days, to get a sense of their language environment.

Children who typically experienced not just more language but more conversational turn taking showed more activation in key language areas of the brain as they heard stories in the scanner. These kids also showed stronger connections between language areas that govern speech perception and speech production. "At every socioeconomic level, more conversation was related to more mature brain development," says speech language pathologist and neuroscientist Rachel Romeo, who led the study and is now at the University of Maryland.

Other research indicates that important connections between very young children and caregivers actually occur on a neural level. Their brains sync up. Elise Piazza and her colleagues at the Princeton University

Neuroscience Institute found this out when they used a method called functional near-infrared spectroscopy that can track the activity of neurons. The scientists looked at adults and infants between nine and 15 months old, in a variety of situations. The brain waves of the infants and the adult synchronized when the two were directly playing together or jointly paying attention to the same object. They did not sync when the adult spoke to someone else in the room, affirming that overheard language does not count. This kind of synchrony has been linked to social learning, problem-solving skills and vocabulary development. And when in sync, the adult turned out to be following the baby's lead, anticipating smiles and interest, rather than the other way around.

"We already knew that infant-directed speech is very important for babies' learning and that a variety of communicative cues could be important for them," says Piazza, who is now at the University of Rochester. But "even before they're fully verbal, there are a lot of ways in which [babies'] brains are picking up on these different cues in the environment."

Such research strongly supports the need for parents to have time with their children. It also underlines why parents also need access to high-quality, affordable child care. The problem faced by Randy, and millions like him, was that there was rarely enough time to parent the way he wished. To make ends meet, he was holding down multiple jobs. His wife, Mayra, worked fulltime, too. Most days Randy saw his kids for all of 30 minutes. And the only child care Randy could afford was custodial—at pickup he often found Julian in front of a blaring television. "Here we have this body of research showing over and over that the core adult-child interactions in the early years of life are critical for brain development and social development," Romeo says. "Anything we can do as a society to create an environment where [those] relationships can flourish, that's the best investment we can make in children's futures."

## EARLY HELP FOR PARENTS

LANGUAGE is just one dimension of the powerful nurturing interactions between children and caregivers. For infants, connections begin on the first day of their lives. That is why paid leave at the birth of a child is consistent with policy centered on early brain development. But few Americans have such leave. Randy and Mayra didn't have it. When their two children were born, Mayra was one of the roughly one quarter of mothers who return to work within two weeks, and Randy took only a day or two off each time.

Traditionally research on paid leave has focused on the economic side of the equation—assessing the impact on employers or on household incomes. Yet more recently, studies of the effects of paid leave on the health of mothers and children found it was associated with lower levels of postpartum depression, improved infant attachment, decreases in infant mortality and rehospitalizations, as well as increases in pediatric visits, timely immunizations and the duration of breastfeeding. When fathers took paid leave at the birth of a child, it benefited both parents' mental health, lowering depressive symptoms and stress. Plus, married parents who both take leave are less likely to divorce.

To this already persuasive evidence, the newest studies add positive impacts of paid leave on infants' cognitive development. In 2021 developmental psychologist Natalie Brito of New York University and her colleagues published a study of 328 mothers and babies from across the socioeconomic spectrum, some of whom had paid leave and some of whom had unpaid leave at the birth of their child. When the children were two years old, the researchers asked the mothers to report on their children's language abilities, as well as their emotional responses in social situations. Paid leave was associated with higher language skills for the toddlers at all socioeconomic status (SES) levels and with better emotional skills among children whose mothers had

lower education levels. "It seems as though paid leave was beneficial for every family, but it may have an outsize effect for lower-SES families," Brito says.

Paid leave actually changes patterns of brain activity. In a second study of 80 mothers and babies published this past April in *Child Development*, Brito and her colleagues used electroencephalography (EEG) to eavesdrop on babies' brain waves three months after birth. Interactions between neurons create these waves, or oscillations. Everyone has high- and low-frequency waves, and both types are important. But as children get older, the relative amount of high-frequency activity tends to increase. Previous studies suggested that young children with more high-frequency waves, when tested a little later on in life, tend to have higher scores on skills necessary for learning and thinking.

In the work by Brito and her co-workers, infants whose mothers could take paid leave tended to have more higher-frequency waves, and fewer low-frequency ones, than babies whose mothers had unpaid leave. Although the sample was relatively small and not a truly random selection of babies, the researchers did control for a range of potentially confounding variables, such as gestational age at birth, number of children in the home, maternal relationship status, education and occupational prestige. The association between paid leave and brain-wave patterns persisted, explaining 12 to 30 percent of the variance in infant brain activity.

It is hard to disentangle the reasons for these differences, but stress among the mothers could be one factor. The study measured levels of a stress-related hormone, cortisol, in the mothers' hair; those levels tend to go up as psychological and physical stress accumulates. Mothers who had paid leave had lower cortisol levels than mothers with unpaid leave. They also had higher parent-child interaction scores on tests of maternal sensitivity. Because paid leave provides resources and financial stability, Brito suggests, "it is likely to reduce stress and probably indirectly impacts the way that they parent or that they interact with their kids." These are the first studies of their kind and don't prove cause and effect. But, as Brito says, "some of these dots have started to be connected."

## **SOLUTIONS FOR THE FUTURE**

WE KNOW that very young children do best when they are protected from toxic stress and when their lives are stable and predictable. Brand-new research has turned up higher risks of developmental delays in babies born during the COVID pandemic, which some experts suspect may be related to higher stress levels in their mothers. We have known for decades that children growing up in families with lower incomes are more likely to face these types of unpredictable and distressing situations.

More recently, neuroscientists began exploring what poverty does to children's brains. In a 2015 study of more than 1,000 children between the ages of three and 20, neuroscientist Kimberly G. Noble of Teachers College at Columbia University and her colleagues found a consistent relationship between cortical surface area (which is associated with cognitive ability) and socioeconomic factors. That study and others have found that the largest differences appear in areas of the brain that handle language, executive function and memory.

For instance, in 2019 Noble and her colleagues, also using hair cortisol levels as markers of chronic stress, showed that higher levels were associated with smaller hippocampi, a part of the brain integral for memory. These changes may be an adaptive response: The young brain is waiting for instructions from the environment, and if a child grows up in an environment of toxic stress, that child's brain will organize itself to be highly reactive to stress. But such changes can cost children later in educational and employment settings. Tax

credits for families with young children have the most potential to reduce rates of childhood poverty, according to a 2019 National Academy of Sciences report. The benefits of these credits became clear during the pandemic, when a historic expanded tax credit brought about an immediate reduction in childhood poverty rates. For the first time ever, the credit was independent of earnings—a provision that benefited those who were working and those who wished to stay home with their children. More than 90 percent of American children were eligible.

But at the end of 2021 the closely divided U.S. Senate refused to extend this program. When the credits ran out, between December 2021 and January 2022, the childhood poverty rate spiked from 12 to 17 percent, higher than before the pandemic. That pushed an additional 3.7 million children into poverty. According to the NAS report, the long-term effects of childhood poverty on adult employment, crime rates and population health cost the U.S. between \$800 billion and \$1.1 trillion annually, whereas a set of policies centered on tax credits plus nutritional supplements and a few other programs would cut childhood poverty by 50 percent and ultimately cost the country less.

We also know a lot about what works in child care. The U.S. already supports a high-quality, universal system of centers, run by the Department of Defense for military families. About 30 years ago military child care was as bad as the worst we see today. People in the armed forces, doing demanding jobs, had to worry about who was watching their children, and this could detract from their performance. So the Pentagon completely revised these programs, increasing professional development and pay, enforcing high standards of care, capping the costs to families and improving access. Widespread access to quality care is a hallmark of European countries. For example, England and Estonia, the other countries in the OECD study of five-year-old children, both have generous paid leave and nearuniversal preschool programs.

Instituting something similar in the U.S. won't be cheap. Last year Congress did not pass legislation that would have subsidized child care costs for most working families as well as adequate wages for child care providers. The price tag would have been \$400 billion. That might sound steep, but it is not when compared with the price of inaction. A report by ReadyNation, a not-for-profit group started by business executives to research education, found that child care problems cost the U.S. \$57 billion a year in lost earnings, productivity and revenue. It has also been estimated that if American women stayed in the workforce at a rate similar to that of Norway, which has paid leave and government-subsidized child care, the U.S. could add \$1.6 trillion to the gross domestic product.

With no paid leave, no child care and limited child credits, it is glaringly obvious that a devastating divide exists between what science tells us children need and what U.S. policy actually does for them. It is time to start using our wealth of scientific evidence to guide our policies and practices. Healthy brain maturation represents the foundation of our country because it represents our future. That means there is nothing more important we can do as a society than foster and protect the brain development of our children.

FROM OUR ARCHIVES

Brain Trust. Kimberly G. Noble; March 2017

[scientificamerican.com/magazine/sa](https://www.scientificamerican.com/magazine/sa)

Paid leave after the birth of a child was associated with lower infant mortality and hospitalizations and improved infant attachment.

## Care and Cognition

A recent study compared the effects of paid leave at birth with those of unpaid leave. By age two, children with mothers who had paid leave had better language skills, regardless of socioeconomic status. Those from lower-education households with paid leave had improved emotional responses in social situations.

Each oval represents one study participant

More saturated colors indicate that multiple data points fell around the same value

GRAPH: THE PATH TO BETTER CHILDHOODS

PHOTO (COLOR)

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