



Importance of early childhood development

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Invest in the Very Young¹

James J. Heckman, PhD
2000 Nobel Laureate in Economic Sciences

Henry Schultz Distinguished Service Professor of Economics,
University of Chicago, USA

(Published online September 1st, 2004)

Topic

Importance of early childhood development

Learning starts in infancy, long before formal education begins, and continues throughout life. Early learning begets later learning and early success breeds later success, just as early failure breeds later failure. Success or failure at this stage lays the foundation for success or failure in school, which in turn leads to success or failure in post-school learning. Recent studies of early childhood investments have shown remarkable success and indicate that the early years are important for early learning. Moreover, early childhood interventions of high quality have lasting effects on learning and motivation. As a society, we cannot afford to postpone investing in children until they become adults, nor can we wait until they reach school age – a time when it may be too late to intervene.

However, current policies regarding education and job training are based on fundamental misconceptions about the way socially useful skills embodied in persons are produced. By focusing on cognitive skills as measured by achievement of IQ tests, they exclude the critical importance of social skills, self-discipline and a variety of non-cognitive skills that are known to determine success in life. Furthermore, this preoccupation with cognition and academic “smarts” as measured by test scores to the exclusion of social adaptability and motivation causes a serious bias in the evaluation of the human capital interventions.

Another common error in the analysis of human capital policies is the assumption that abilities are fixed at very early ages. This static conception of ability is at odds with a large body of research in the child development literature. More specifically, research has shown that, in the early years of life, basic abilities can be altered. A more corrective view of ability (or rather abilities) is that they are developed in a variety of learning situations and that early ability in turn fosters further learning.

¹ Adapted from the paper “The real question is how to use the available funds wisely. The best evidence supports the policy prescription: Invest in the very young,” published by the Ounce of Prevention Fund and the University of Chicago Harris School of Public Studies. 2000. The present paper has been approved by Dr. Heckman.

Also missing from current policy discussion of education and training policy is any consideration of priorities or recognition of the need to prioritize. Unfortunately, in an era of tight government budgets, it is impractical to consider active investment program for all persons. The real question is how to use the available funds wisely. The best evidence supports the policy prescription: invest in the very young and improve basic learning and socialization skills.

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Human Capital, Early Childhood Development and Economic Growth²

David Dodge, PhD

Ottawa, CANADA

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Topic

Importance of early childhood development

While parents, along with some psychologists, sociologists and public-health experts, have long intuitively understood the importance of early childhood development (ECD), it is really only over the last quarter-century or so that scientists, physicians and social scientists have come to recognize the crucial role played by ECD. And it is only very recently that ECD has taken its place in the economic literature beside schooling, on-the-job training, public health and informal learning.

Successful ECD depends on the interaction of a number of factors. As is the case for the development of human capital in later years, the various factors influencing ECD interact multiplicatively to produce “success,” as measured by readiness to learn when entering primary school. Good health (of both mother and child), good nutrition, good parenting, strong social supports and stimulative interaction with others outside the home all combine to provide the best chance of success. Since neglecting investment in any one of these areas reduces the value of investment in other areas, investments to improve pre- and post-conception health of the future mother are a crucial input to ECD. Thus, support of all types to improve parenting during this period is crucial. This support includes development of parenting skills, social support, employer and government support to increase the amount of time parents can spend with their children and, in some cases, direct income support.

In the final period of ECD – roughly ages three through five – the research demonstrates clearly that some form of ECD outside the home makes a very important contribution to the development of the child. This form of intervention, in combination with effective parenting, would appear to significantly increase the chances of a child being “ready to learn” when he or she enters primary school.

The issue then arises as to the appropriate allocation of public (and private) funding for human capital formation. To generate the maximum total return on investment in human

² Adapted from Dr. Dodge’s Keynote address “Human Capital, Early Childhood Development and Economic Growth: an Economist’s Perspective,” delivered at the Sparrow Lake Alliance’s Annual Meeting, May 2003. Dr. Dodge, who spoke at this event in a personal capacity, has approved this excerpt.

capital, it is important that new investment be allocated efficiently at the margin – just as is the case for physical capital. Thus, it is critical to try to ascertain the return at the margin for different types of investment in human capital – a very difficult exercise. And we should not be surprised that empirical research does not produce definitive numerical results. So while it seems clear that, at the margin, public investment in human capital should be directed towards the very young, how to make those investments most productive is far less clear.

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Investment in Early Childhood Development Lays the Foundation for a Prosperous and Sustainable Society

JACK P. SHONKOFF, MD

*Julius B. Richmond FAMRI Professor of Child Health and Development,
Harvard School of Public Health and Harvard Graduate School of
Education, Harvard Medical School and Children's Hospital Boston, Center
on the Developing Child at Harvard University, USA*

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Topic

Importance of early childhood development

The first years of life are important, because what happens in early childhood can matter for a lifetime. Science shows us what children must have, and what they need to be protected from, in order to promote their healthy development. Stable, responsive, nurturing relationships and rich learning experiences in the earliest years provide lifelong benefits for learning, behavior and both physical and mental health.¹ In contrast, research on the biology of stress in early childhood shows how chronic stress caused by major adversity, such as extreme poverty, abuse or neglect, can weaken developing brain architecture and permanently set the body's stress response system on high alert, thereby increasing the risk for a range of chronic diseases.²

The following basic concepts, established over decades of neuroscience and behavioral research, help illustrate why healthy child development from birth to five years provides a foundation for a prosperous and sustainable society.^{3,4}

Brains are built over time, from the bottom up. The basic architecture of the brain is constructed through an ongoing process that begins before birth and continues into adulthood. Early experiences affect the quality of that architecture by establishing either a sturdy or a fragile foundation for the learning, health and behavior that follow.³ In the first few years of life, 700 new neural connections (called synapses) are formed every second.^{5,6} After this period of rapid proliferation, these connections are reduced through a process called pruning, so that brain circuits become more efficient.⁷ Sensory pathways, like those for basic vision and hearing, are the first to develop, followed by early language skills and later by higher cognitive functions. Connections proliferate and prune in a prescribed order, with later, more complex brain circuits built upon earlier, simpler circuits.^{8,9,10,11}

The interactive influences of genes and experience shape the developing brain. Scientists now know a major ingredient in this developmental process is what has been called a

“serve and return” relationship between children and their parents and other caregivers in the family or community. Young children naturally reach out for interaction through babbling, facial expressions and gestures, and adults respond with similar kinds of vocalizing and gesturing back at them.³ In the absence of such responses – or if the responses are unreliable or inappropriate – the brain’s architecture does not form as expected, which can lead to disparities in learning and behavior.¹²

The brain’s capacity for change decreases with age. It is most flexible, or “plastic,” early in life to accommodate a wide range of environments and interactions, but as the maturing brain becomes more specialized to assume more complex functions, it is less capable of reorganizing and adapting to new or unexpected challenges. For example, by the end of the first year, the parts of the brain that differentiate sounds are becoming specialized according to the language the baby has heard. At the same time, the brain is already starting to lose the ability to recognize different sounds found in other languages. Although the “windows” for complex language learning and other skills remain open, these brain circuits become increasingly difficult to alter over time. Early plasticity means it’s easier and more effective to influence a baby’s developing brain architecture than to rewire parts of its circuitry during adolescence and the adult years.⁷

Cognitive, emotional, and social capacities are inextricably intertwined throughout the life course. The brain is a highly integrated organ, and its multiple functions operate in a richly coordinated fashion. Emotional well-being and social competence provide a strong foundation for emerging cognitive abilities, and together they are the bricks and mortar that make up the foundation of human development. The emotional and physical health, social skills and cognitive-linguistic capacities that emerge in the early years are all important prerequisites for success in school and, later, in the workplace and community.^{11, 13, 14}

Although learning how to cope with adversity is an important part of healthy child development, excessive or prolonged stress can be toxic to the developing brain. When we are threatened, our bodies activate a variety of physiological responses, including increases in heart rate, blood pressure, and stress hormones, such as *cortisol*. When a young child is protected by supportive relationships with adults, he learns how to adapt to everyday challenges and his stress response system returns to baseline. Scientists call this positive stress. Tolerable stress occurs when more serious difficulties, such as the loss of a loved one, a natural disaster, or a frightening injury, are buffered by caring adults who help the child adapt, thereby mitigating the potentially damaging effects of abnormal levels of stress hormones. When strong, frequent or prolonged adverse experiences, such as extreme poverty or repeated abuse, are experienced without adult support, stress becomes toxic and disrupts developing brain circuits. Toxic stress experienced early in life can also have a cumulative toll on learning capacity as well as physical and mental health. The more adverse experiences in childhood, the greater the likelihood of developmental difficulties and other problems. Adults with more adverse experiences in early childhood are also more likely to have chronic health problems, including alcoholism, depression, heart disease and diabetes.¹⁵

Early intervention can prevent the consequences of early adversity. Research shows that later interventions are likely to be less successful – and in some cases are ineffective. For example, when children who experienced extreme neglect were placed in responsive foster care families before age two, their IQs increased more substantially and their brain activity and attachment relationships were more likely to become normal than if they were placed after the age of two.¹⁶ While there is no “magic age” for intervention, it is clear that, in most cases, intervening as early as possible is significantly more effective than waiting.⁷

Stable, caring relationships are essential for healthy development. Children develop in an environment of relationships that begin in the home and include extended family members, early care and education providers, and other members of the community.¹ Studies show that toddlers who have secure, trusting relationships with their parents or non-parent caregivers experience minimal stress hormone activation when frightened by a strange event, and those who have insecure relationships experience a significant activation of the stress response system.² Numerous scientific studies support the conclusion that providing supportive, responsive relationships as early in life as possible can prevent or reverse the damaging effects of toxic stress.²

Conclusion

The basic principles of neuroscience indicate that providing supportive conditions for early childhood development is more effective and less costly than attempting to address the consequences of early adversity later.⁴ To this end, a balanced approach to emotional, social, cognitive and language development will best prepare all children for success in school and later in the workplace and community. For children experiencing toxic stress, specialized interventions – as early as possible – are needed to target the cause of the stress and protect the child from its consequences.¹⁵

From pregnancy through early childhood, all of the environments in which children live and learn, and the quality of their relationships with adults and caregivers, have a significant impact on their cognitive, emotional and social development. A wide range of policies, including those directed toward early care and education, primary health care, child protective services, adult mental health, and family economic supports, among many others, can promote the safe, supportive environments and stable, caring relationships that children need.

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CENTRES D'EXCELLENCE POUR LE BIEN-ÊTRE DES ENFANTS

Le développement des jeunes enfants

STRATEGIC KNOWLEDGE
CLUSTER ON EARLY

child development



Early Brain Development and Human Development

J. FRASER MUSTARD, PhD

*The Founders' Network, Founding Chairman
Council for Early Child Development, Toronto, Canada*

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Topic

Importance of early childhood development

The early years of human development establish the basic architecture and function of the brain.¹ This early period of development, (conception to ages 6-8), affects the next stage of human development, as well as the later stages. We now better understand, through developmental neurobiology, how experience in early life affects these different stages of development.¹ Poor early development affects health (physical and mental), behaviour and learning in later life.

The architecture and function of the brain is sculpted by a lifetime of experiences which affect the architecture and function of neurobiological pathways.^{1,2} Stimuli transmitted to the brain through sensing pathways pre- and post-natally, as well as in later stages of life, differentiate the function of neurons and neural pathways.

The billions of neurons in an individual's brain have the same gene coding (DNA). The neurons differentiate for their diverse functions (e.g. vision, hearing, touch, behaviour, etc) through epigenetics.^{1,3,4,2} Epigenetics is the molecular and cellular process that governs the function of genes. These processes include [*DNA methylation*](#), changes in [*chromatin structure*](#), non-coding [*RNAs*](#) and [*RNA editing*](#).^{3,4,5} Those working in epigenetics have concluded that understanding the mechanisms that regulate gene differentiation and function will be a critical component of neurobiological research in the 21st century.^{3,4,2} The epigenetic changes in neuron function affect neurobiological pathways that influence health (physical and mental), behaviour and learning.^{2,6,4} The effects of epigenetics on gene function begins at conception and continues during in utero development, and development following birth.

Experiences that affect brain development through the sensing pathways include sound, touch, vision, smell, food, thoughts, drugs, injury, disease and other factors.^{2,4}

Identical twins have the same DNA in their neurons ([*genotype*](#)) but will not have the same experience, leading to differences through epigenetics in gene expression ([*phenotype*](#)). Identical twins can have a 20 to 30% difference in behaviour as adults (phenotype).⁷ This difference is probably related to epigenetic affects on neuron function in early development. As a result of these studies, there is increasing interest in how

epigenetics could be a factor in schizophrenia, bi-polar disorders and conditions such as Attention Deficit Hyperactivity Disorder (ADHD) as well as physical health in adult life.^{2,8,6,9} Studies have shown that there is [hypermethylation](#) of the [DNA promoter region](#) in the [hippocampus](#) of suicide victims with a history of abuse and neglect in early life¹⁰ but not in suicide victims with no early abuse or neglect.

Animal studies have demonstrated epigenetic effects on gene function. The normal mouse [agouti gene](#) leads to brown pigmented fur and normal body size. The variant agouti gene is dominant over the normal agouti gene and results in obese mice with yellow fur.¹¹ It was found that when pregnant mothers with the variant agouti [allele](#) were fed methyl-donor dietary supplements to methylate in utero, the variant agouti gene regulator, the offspring showed extensive methylation of the gene and were of normal colour and not obese. The coat colour and size of these newborn mice correlated with the amount of methylation of the variant agouti gene.

In rats, behaviour responses to stressful situations are correlated with the number of [glucocorticoid](#) receptors in the brain's hippocampus.⁴ The more glucocorticoid receptors in the hippocampus, the better the adult rat is able to regulate the glucocorticoid hormones and stress. The rats exposed to strong licking and grooming by their mothers after birth, lose the methylation of the glucocorticoid receptor gene, leading to good receptor formation in the hippocampus. The animals with good receptor formation show a better regulated stress pathway and are easy to handle, while the animals with decreased glucocorticoid receptor capacity are easily stressed. In these studies, the researchers found that the administration of a compound ([trichostatin A](#)) removed the epigenetic effect and normalized the stress behaviour of the rats.⁴

Retrospective studies in humans have shown that development in the utero period and infancy influences risks for adult diseases ([type II diabetes](#), hypertension, heart attacks, obesity, cancer and aging).^{2,6,12} The Kaiser Permanente studies in California¹³ found that adults with mental health problems, addiction, obesity, type II diabetes, coronary artery disease, and other conditions in adult life had poor early child development.

If these and other problems related to development are contributed to by epigenetic effects in early life, can early intervention prevent or easily reverse the processes?

The work of Grantham-McGregor and colleagues has demonstrated that stunted children at birth, if given nutrition and stimulation after birth, can approach the performance of control children after 24 months.¹⁴ These studies are compatible with the hypothesis that epigenetic effects initiated during early development can be prevented or reversed by good nutrition and stimulation. The orphanage studies in Romania show that children placed in middle class homes in Great Britain, Canada and the US who were in the orphanages for eight months or longer had, at 11 years of age, in contrast to the children adopted within four months after birth, abnormal brain development (small brain), abnormal electroencephalograms (EEGs) and low metabolic activity.¹⁵ The children adopted late showed abnormal behaviour (ADHD, aggression, and quasi autism) and poor cognitive development (low IQ) at age 11. Some children in the orphanages were

randomized to foster parenting in Romania and compared to children left in the orphanages.¹⁶ When this study was done, the majority of the children had spent at least two years in the orphanages. The mean IQ of the orphanage children was 71; the IQ of children placed in foster care was 81; and for children brought up by their biological parents, the IQ was 110.¹⁶ Children placed in foster care early were approaching normal human development but this was not occurring for children placed in foster care after the age of two.

In the Abecedarian study in North Carolina, African American children at four months of age were randomized into two groups: an intensive yearly preschool program or no specific program.¹⁷ When the children entered the school system, the children in each group were randomized to either a special three-year education program or the standard school program. The special three-year program produced some improvement in the reading and numeracy function of the children not in the preschool program but the effect was small and gradually lost. The children given the preschool program and the standard school program showed much better school performance but there was some loss of performance by age 21. The children given the preschool program plus the three-year education program showed the biggest gains and this was sustained.

We now know that the quality of child development at the time of school entry predicts performance in school programs.^{18,19}

Results from developmental neurobiology studies and animal and human studies provide strong evidence that early neurobiological development affects health (physical and mental), behaviour and learning in the later stages of life. Countries that provide quality universal early development programs for families with young children tend to out-perform countries in which the early development programs are chaotic.¹

Cuba established in the mid-1970s a poly-clinic structure for prenatal and post-natal care (nutrition, healthy development and stimulation). The outstanding improvement in the health status of Cubans in contrast to other Caribbean and Latin American countries may well be related to the quality of the poly-clinic program on early development (according to a conversation with A. Tinajero in 2009). It is possible that this program, which began with pregnancy, is also an important reason why the Cubans substantially out-perform the other Latin American countries in the UNESCO studies of language and literacy and numeracy in grades 3 and 6.

We now know that nurture in early life as well as nature is important in early human development and that nurture in the early years has major effects on learning in school and physical and mental health throughout the life cycle.

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CENTRES OF EXCELLENCE FOR CHILDREN'S WELL-BEING

Early Childhood Development

STRATEGIC KNOWLEDGE
CLUSTER ON EARLY

child development