ITEM # 10

July 28, 2016

SUBJECT **PREVENTING THE ACHIEVEMENT GAP** **Strategic Priority Area 1. Children and Families:** Support children prenatal through age 5 and their families by providing culturally and linguistically effective resources, knowledge, and opportunities for them to develop the skills needed to achieve their optimal potential in school and life. **Goal: Goal 1.1 Child Health:** Children prenatal through age 5 and their families access the full spectrum of health and behavioral health services needed to enhance their well-being. **Goal 1.2. Early Learning:** Children birth through age 5 benefit from high-quality early education, early intervention, family engagement, and support that prepares all children to reach their optimal potential in school and life. **Goal 1.3. Family and Community Support and Partnership:** Families and communities are engaged, supported, and strengthened through culturally effective resources and opportunities that assist them in nurturing, caring, and providing for their children's success and well-being.	☐ Action ☒ Information

SUMMARY OF THE ISSUE

The vision of First 5 California (F5CA) is for the state's children to receive the best possible start in life and thrive, and includes a focus on closing the achievement gap. By the time children enter kindergarten, significant school readiness gaps are already profound for many children of color, children living in poverty, and dual-language learners. In fact, a substantial body of research confirms this early childhood gap presents as early as 18 months of age and widens throughout early childhood with correlation to an opportunity gap. Staff will outline strategies consistent with the F5CA

Strategic Plan and First 5 funding, partnerships, and advocacy for preparing California's most vulnerable children for success in school.[1][2]

RECOMMENDATION

This is an information-only item. F5CA staff is not requesting action at this time; however, it should be noted that the F5CA Dual Language Learner Pilot (Agenda Item # 9) request also relates to preventing the achievement gap.

Staff suggests that the Commission take a deeper look at the F5CA Strategic Plan for effective areas in which targeted advocacy, partnership, and leveraged funding efforts to narrow the opportunity gap and the resulting achievement gap can be continued or strengthened. A January Commission retreat will provide this opportunity for a Strategic Plan update.

BACKGROUND OF KEY ISSUES

Each year, more than half a million babies are born in California. With approximately three million children ages 0 to 5, California has more children in this age span than any other state.[3] California also has the highest number of children in the U.S. living in poverty, contributing to a high number of families with limited access to the resources necessary to help children grow up healthy and ready to succeed. A national ranking on measures of children's economic well-being placed California 49th, exceeding only Mississippi.[4] Gaps in both services and opportunities for low-income children and children of color remain significant in the earliest years, despite investments under Proposition 10. It is critical for California to address existing gaps, starting with educating families and then by providing high-quality services and programs that support the development of all young children in the state.

Despite profound gaps that exist for many of our children, a robust body of research demonstrates high-quality early learning programs and services can improve their health, social-emotional, and cognitive outcomes; enhance school readiness; and help close the wide school readiness gap that exists between children with high needs and their peers at kindergarten entry — thus reducing the achievement gap prior to the start

[1] Shonkoff, J. & Phillips, D. (2000). *Neurons to Neighborhoods. The Science of Early Childhood Development.* Washington, D.C.: National Academy Press.
[2] Early learning encompasses the school readiness definition including family functioning, child health, child development and systems of care.
[3] *State of California, Department of Finance, Report P-3: State and County Population Projections by Race/Ethnicity, Detailed Age, and Gender, 2010-2060.* Sacramento, California, December 2014.
[4] *The 2016 California Children's Report Card: A survey of kids' well-being and a roadmap for the future.* Children Now.

of kindergarten.[5,6,7,8] Children with high needs who participate in high-quality early learning benefit greatly, often exceeding national averages on measures of school readiness.[9] In fact, when controlling for risk factors such as maternal education, race, and parents' ages, these gains persist. These children experience the benefits that result from early and effective instruction, which includes a focus on language and literacy, early math skills, and social-emotional competence. On the other hand, a child who is considered to have high needs and who does not receive quality early learning faces a life filled with disadvantages. Children with high needs are 50 percent more likely to be placed in special education classes, 25 percent more likely to drop out of school, 70 percent more likely to be arrested for a violent crime, and 40 percent more likely to become a teen parent.[10]

Research shows effective early learning programs, when combined with access to health care and preventive services, can prepare children for success in school. In 2000, University of Chicago economist James Heckman, a Nobel Laureate in Economics, analyzed the effects of early learning investments and concluded the younger the child is at the time of the intervention, the greater the payoff to the child's positive development and to the well-being of the larger society (see Heckman Curve below). Heckman found that early nurturing, positive learning experiences, and good physical health from ages 0 to 5 greatly impact future success. The returns to society include long-term outcomes such as higher reading and math achievement, lower rates for special education, 44 percent lower grade retention rates, higher graduation rates by as much as 29 percent, increased four-year college enrollment, higher earnings, and less welfare assistance.[11]

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[5] Camilli, G., Vargas, S., Ryan, S., & Barnett, W. S. (2010). *Meta-analysis of the effects of early education interventions on cognitive and social development*. Teachers College Record, 112(3), 579-620.

[6] Reynolds, A.J., Temple, J.A., Ou, S., Arteaga, I.A., & White, B.A.B. (2011). *School-based early childhood education and age-28 well-being: effects by timing, dosage, and subgroups*. Science, Retrieved from http://www.sciencemag.org/content/early/2011/06/08/science.1203618.abstract doi: 10.1126/science.1203618.

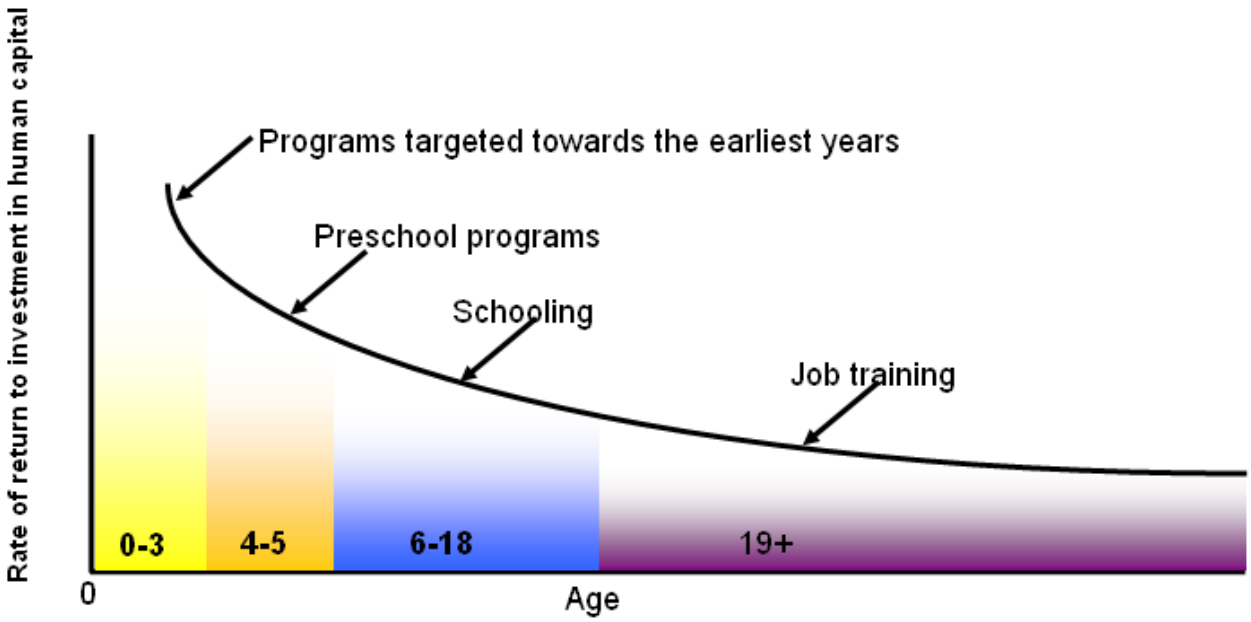
[7] Princiotta, D., Flanagan, K. D., and Germino Hausken, E. (2006). *Fifth Grade: Findings From The Fifth-Grade Follow-up of the Early Childhood Longitudinal Study, Kindergarten Class of 1998–99 (ECLS-K)*. (NCES 2006-038) U.S. Department of Education.

[8] Halle, T., Forry, N., Hair, E., Perper, K., Wandner, L., Wessel, J., & Vick, J.(2009). *Disparities in Early Learning and Development: Lessons from the Early Childhood Longitudinal Study – Birth Cohort (ECLS-B)*. Washington, DC: Child Trends.

[9] Children with High Needs refers to children from birth through kindergarten entry who are from low-Income families or otherwise in need of special assistance and support, including children who have disabilities or developmental delays; are English learners; reside on "Indian lands" as defined by Section 8013(6) of the United States Department of Education, Elementary and Secondary Education Act; are migrant, homeless, or in foster care; infants and toddlers; receive protective services through the local county welfare department; are identified by a legal, medical, social service agency, or emergency shelter as abused, neglected, exploited, or at risk of abuse, neglect, or exploitation.

[10] Ounce of Prevention, http://www.ounceofprevention.org/about/why-early-childhood-investments-work.php.

[11] Heckman, J., Grunewald, R. & Reynolds, A. (2006). The Dollars and Cents of Investing Early: Cost-Benefit Analysis in Early Care and Education. *Zero to Three,* 10-17.



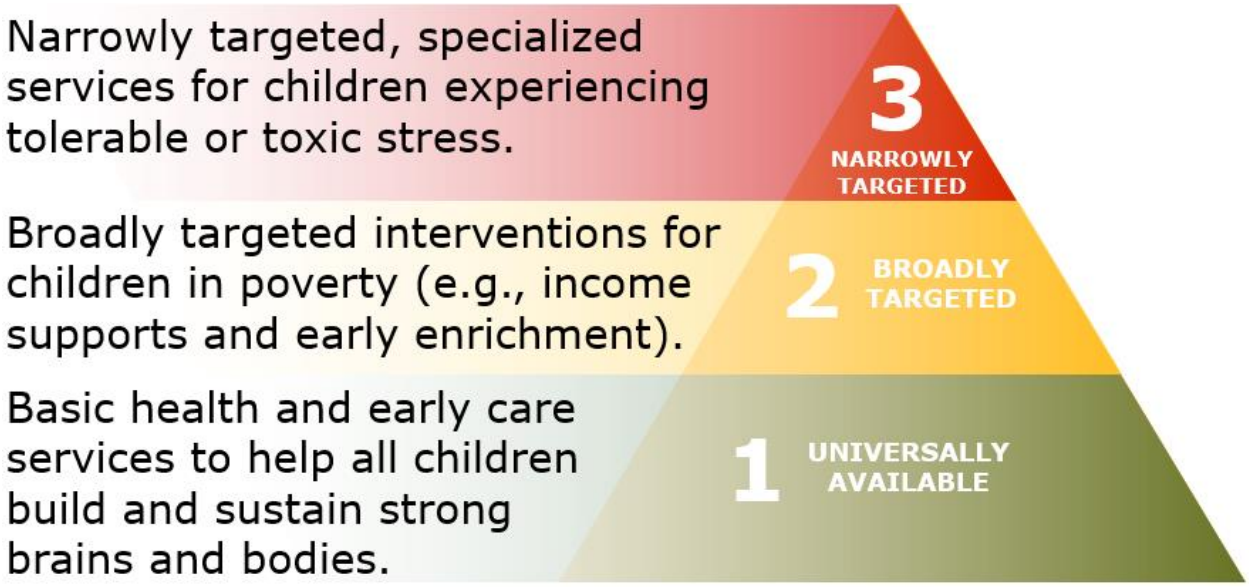
Even though research strongly indicates early learning programs are one of the best investments a society can make, access to effective early childhood programs remains a challenge for most California families. For example, a RAND Institute study conducted before the most recent recession showed only 13 percent of California's low-income children were in high-quality early learning programs.[12] In addition, there aren't nearly enough slots for all of California's eligible low-income children. A mere 9 percent of eligible infants and toddlers have access to a subsidized early learning program, and only 40 percent of all eligible three-year-olds — compared to 70 percent of eligible four-year-olds — are enrolled in a publicly funded preschool program.[13] Through the braiding of various Home Visiting programs funded with federal and local First 5 dollars, only approximately 30,000 families are being served by a home visiting program, and only 28 percent of children ages 0 to 5 are receiving crucial developmental screenings (First 5 Association, 2016).

Powerful Investments for California Kids

We know early intervention is most effective, but we also know every child and family has vastly different needs. Science points to a three-tiered approach to ensure the best outcomes for all children (see pyramid graphic below).

[12]Karoly, L., Ghosh-Dastidar, B., Zellman, G., Perlman, M. & Fernyhough, L. (2008). Prepared to Learn: The Nature and Quality of Early Care and Education for Preschool-Age Children in California, TR-539-PF/WKKF/PEW/NIEER/WCJVSF/LAUP. http://www.rand.org/pubs/technical_reports/TR539/.
[13] *The 2016 California Children's Report Card: A survey of kids' well-being and a roadmap for the future.* Children Now.

Tiers of Services and Supports



At the base, Tier 1, are services and supports universally available to all children and families, such as basic health and early learning services. Within Tier 2 are broadly targeted services and supports to address issues related to poverty, such as subsidized child care, income, and housing assistance. Tier 3 services are narrowly targeted and support children and families with even more intensive needs.

Since the passage of Proposition 10 in 1999, First 5 counties, partners, and the state Commission have adopted numerous strategies and funded many services that research indicates are the most successful approaches to address health disparities and the school readiness gap for all Californian children. All of these strategies lie within one of these three tiers.

Tier 1 strategies aligned the F5CA Strategic Plan include universal access to quality early learning, ensuring the basic health needs of all children are met, parent education through mass media, and increasing parent access to affordable paid family leave. The majority of F5CA investments are at Tiers 1 and 2 for universally available and broadly targeted programs, services, and messaging such as *Talk. Read. Sing.®*, First 5 IMPACT, and our state and federal advocacy efforts. However, in each case, all F5CA Tier 1 efforts take a systemic approach that are intended to serve a primarily low-income population through universal influencers and programs. Below are two examples of F5CA's current and largest Tier 1 investments:

Talk. Read. Sing.® is a F5CA media campaign to build community and public awareness of infant and child brain development through positive verbal engagement with young children from the moment they're born. It encourages parents and caregivers to talk, read, and sing to babies and toddlers in order to build stronger brains and thus better life-long learners. Through a combination of mass media, social media, and partnership efforts, the *Talk. Read. Sing.®* campaign's goal is to reach 90 percent of new parents in California. While universal in approach, *Talk. Read. Sing.®* media plans and

partnerships are also targeted to low-income, minority, and dual language populations. An evaluation of the campaign's first round indicated a 60 percent campaign message recall rate amongst all surveyed new parents, and a 74 percent self-reported behavior change rate for parents whom the campaign reached.

Another F5CA investment, First 5 IMPACT, supports a network of local quality rating and improvement systems (QRIS) statewide to improve the quality of all early learning settings with a first priority for targeting programs serving children with high needs — from alternative settings and family, friend, and neighbor care to family child care homes, centers, and preschools. Despite this $190 million investment from F5CA, local First 5 county investments, and the additional state investments in QRIS, less than 15 percent of early learning settings are currently participating in state-funded quality improvement efforts. Research has shown high-quality programs improve child outcomes and model and support positive parent-child interactions[14]. Those programs include highly skilled teachers, small class sizes, high adult-to-child ratios, age-appropriate curricula and stimulating materials, safe physical settings, language-rich environments, warm and responsive interactions between staff and children, and high and consistent levels of child participation.[15] While First 5 IMPACT is a Tier 1 strategy because it ultimately improves the quality of all early learning settings through a market-based approach, the goal of the First 5 IMPACT investment and program design is to focus resources first on state and federally-subsidized early learning settings which serve our lowest income children.

In addition to F5CA's direct Tier 1 investments, much of the Commission's advocacy efforts also have been universal in approach, while targeted to the needs of low-income populations. For example, F5CA's successful advocacy for an overhaul to the state's Paid Family Leave program will make universal Paid Family Leave more accessible to all families, but specifically eliminated barriers to Paid Family Leave participation for low-income new parents. Likewise, current administrative advocacy efforts to better integrate early learning strategies into California's federal and state education accountability systems would impact all public education students. However, the focus of the state's new accountability system is on increased resources and services to bridge the achievement gap for low-income, minority, and dual language students, thus making our universal advocacy more likely to impact our targeted student population.

For those families who need a little extra help — like those who are struggling with poverty — Tier 2 targeted services, such as subsidized child care and health services, can make a significant difference. To date, most national debate on the achievement gap and the effectiveness of prevention and intervention strategies has focused on these types of services targeted to the achievement gap populations: children of color, low-income children, and dual language learners, as well as special-needs populations.

The majority of F5CA's advocacy and partnership work is focused on Tier 2 efforts. Our 2016 Children's Policy Agenda is focused on increasing the access of low-income

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[14] ECE Consensus Letter for Researchers | nieer.org. (n.d.). Retrieved January 5, 2015, from http://nieer.org/publications/ece-consensus-letter-researchers.

[15] *A Science-Based Framework for Early Childhood Policy: Using Evidence to Improve Outcome in Learning, Behavior, and Health for Vulnerable Children*. Center on the Developing Child, Harvard University. National Forum on Early Childhood Program Evaluation; National Scientific Council on the Developing Child.

children and families' to high-quality services, including child care, health services, and family supports through state budget and policy changes. Each of these areas has significant access gaps that will require state and federal policy changes in addition to dramatically increased funding. Advocacy efforts in child care, for example, have yielded $1 billion dollars in increased funding for early learning programs for low-income children ages 0 to 5 over the past three budgets, along with numerous policy reforms. These achievements are dwarfed by the access and quality gaps that remain in the system for low-income children, as cited earlier.

One Tier 2 strategy that F5CA funds directly is the high-quality early learning model Educare, which in California is supported by F5CA, First 5 Santa Clara, and other local partners. Recent research on Educare suggests the more time children spend in high-quality programs, the more they benefit in positive developmental outcomes, particularly for dual language learners. For those children starting in Educare programs as infants, they are also finding a lack of a later achievement gap.[16]

For those children at greater risk for developmental, health, and academic concerns, narrowly targeted and intensive Tier 3 services are needed. Children who are most likely to be in an environment of toxic stress need additional supports, and Tier 3 programs screen for those families and offer them specific kinds of supports geared to their needs, whether mental health services, substance abuse services, or home visiting by trained nurses.

One example of a Tier 3 service supported by First 5 counties is home visiting. Home visiting programs help families connect to necessary services, such as health care or community resources, and monitor child development and progress on developmental milestones. These targeted interventions have proven to be effective strategies for strengthening families and saving money over the long term — up to $5.70 for each dollar invested. Research shows these investments can lead to reduced health care costs, reduced need for remedial education, and increased family self-sufficiency. Home visiting can strengthen family self-sufficiency, and help build the skills needed to parent successfully. Over 60 percent of First 5 county commissions currently offer home visiting programs, implementing evidence-based models such as Healthy Families America and Parents as Teachers, as well as locally developed home visiting models[17]. Even with this funding, only about 11 percent of children have received one or more home visits, while an estimated 65 percent of children could benefit, based on risk factors[12].

Regardless of the Tier in which any service or policy resides, the foundation of Proposition 10's investments to address the opportunity gap has been research-driven strategies. Attached to this item (Attachment A) is a recent publication from the Center on the Developing Child at Harvard University, which highlights the most recent body of research on effective early childhood policy strategies. This continued emphasis on

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[16] Yazejian, N., Bryant, D., Freel, K., Burchinal, M.& the Educare Learning Network (ELN) Investigative Team. (2015). High-quality early education: Age of entry and time in care differences in student outcomes for English-only and dual language learners. *Early Childhood Research Quarterly*, 23–39.
[17] First 5 Association of California, home visiting program information data. (2014).

effective, research-based investments and advocacy will be crucial as declining First 5 funds leverage larger child health, family strengthening, and early learning systems.

Significant Access Gaps Remain to All Strategies

The table below provides a broad overview of the various Tier 1, 2, and 3 investments, partnerships, and advocacy efforts in which F5CA and/or First 5 counties are currently engaged, that are consistent with F5CA's Strategic Plan and that staff believe are consistent with research-backed strategies to prevent the achievement gap for children at risk. This list is not exhaustive of all First 5 engagements, possible early childhood policy strategies to address the achievement gap, or active California policy strategies intended to address the achievement gap. However, this table provides a good starting point for examining the link between F5CA's current Strategic Plan, active or planned programs and partnerships, and the potential for linking current investments and partnerships to the achievement gap. Staff would also note for the Commission no strategy listed is currently funded to meet 100 percent of the targeted need at this time.

Strategic Plan Strategies Aligned to the Achievement Gap

First 5 CA Strategic Plan Goal	Strategy	Achievement Gap Link?	Access	First 5 CA Efforts	Other Funding Sources
Tier 1. Universally Available					
1.1 Child Health	Developmental Screening (e.g., Help Me Grow)	Y	28 percent of CA's youngest children screened (2013)	$ ★ ✋	State, Local First 5
1.2 Early Learning	Quality Improvement/ QRIS (e.g., First 5 IMPACT)	Y	58 counties, 10 percent licensed sites statewide	$ ★ ✋	Federal, State, Local First 5
1.3 Family Community Support and Partnership	*Talk. Read. Sing.*® campaign	Y	60 percent of survey respondents recalled ads; 74 percent of respondents changed behavior	$ ★ ✋	Local First 5
1.3 Family Community Support and Partnership	Family friendly policies (e.g., Paid Family Leave)	N	Up to 6 weeks at 60 percent–70 percent of weekly income	★	State
1.3 Family Community Support and Partnership	Kit for New Parents	N	4.7 million Kits distributed statewide (2001-2015)	$ ✋	Local First 5
Tier 2. Broadly Targeted					
1.1 Child Health	Health care services (e.g., Medi-Cal)	Y	Approx. 50 percent of births in CA; approx. 170,000 undocumented children served (2016)	★ ✋	Federal, State, Local First 5

First 5 CA Strategic Plan Goal	Strategy	Achievement Gap Link?	Access	First 5 CA Efforts	Other Funding Sources
1.1 Child Health	Health care services (e.g., Denti-Cal)	Y	63 percent of Medi-Cal children under 6 had no dental visits in the previous year (2013)	★ ✋	Federal, State, Local First 5
Tier 2. Broadly Targeted					
1.1 Child Health	Special Supplemental Nutrition Program for Women, Infants, and Children (WIC)	Y	60 percent of all births in CA	★ ✋	Federal, Local First 5
1.2 Early Learning	Educare	Y	Approx. 168 low-income children served in Santa Clara; 2nd site opening TBD	$ ✋	Federal, State, Local First 5, Philanthropy
1.2 Early Learning	Infant/Toddler early learning for low income children (e.g., Title 5, Early Head Start, etc.)	Y	9 percent have access	★	State, Federal
1.2 Early Learning	Preschool for low income children (e.g., CSPP, Head Start, etc.)	Y	40 percent of 3-year-olds and 70 percent of 4-year-olds have access	★	Federal, State, Local First 5
1.2 Early Learning	Inclusion of Dual Language Learners in high quality early learning programs (e.g., F5CA DLL Pilot)	Y	180,263 English Language Learner (ELL) kindergarteners in CA (2015-16)	$ ★	Federal, State, Local First 5
Tier 3. Narrowly Targeted					
1.1 Child Health	Early Intervention Services (e.g., Help Me Grow)	Y	28 percent of CA's youngest children screened (2013)	$ ★ ✋	State, Local First 5
1.3 Family Community Support and Partnership	Home Visiting (e.g., Nurse Family Partnership, Healthy Families America, Early Head Start, etc.)	Y	Over 30 counties, approx. 30,000 families served	★ ✋	Federal, Local First 5

Table Key:

$ = F5CA Funding ★ = F5CA Advocacy ✋ = F5CA Partnership

SUMMARY OF PREVIOUS COMMISSION DISCUSSION AND ACTION

The Commission heard an information item on the achievement gap at the April 2016 Commission Meeting presented by California Department of Education's Chief Deputy Superintendent of Public Instruction, Glen Price.

In January 2014, the Commission adopted F5CA's current Strategic Plan.

In 2015 and 2016, the Commission approved the State Children's Policy Agenda for the Commission, aligned the 2014 Strategic Plan, to focus on the policy areas of Children's Early Learning, Health, and Family Strengthening.

Prior to 2015, the Commission heard related presentations when it was considering funding the First 5 School Readiness Initiative and the First 5 Signature Programs, CARES Plus and the Child Signature Program. Each of these prior programs addressed a research-based approach to prevent the achievement gap through a Tier 2 investment.

ATTACHMENTS

A. *A Science-Based Framework for Early Childhood Policy: Using Evidence to Improve Outcomes and Learning Behavior and Health for Vulnerable Children*, Center on the Developing Child, Harvard University, 2016.

From Best Practices to Breakthrough Impacts

A science-based approach to building a more promising future for young children and families

Center on the Developing Child HARVARD UNIVERSITY

MAJOR FUNDING SUPPORT

Buffett Early Childhood Fund

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The Center on the Developing Child gratefully acknowledges the numerous people who helped to shape our learning over the past several years and who provided specific comments on this report, as well as the growing Frontiers of Innovation community that provides continuous inspiration and shows us firsthand how to co-create, learn as we go, and scale our work. We also thank the FrameWorks Institute for their enduring partnership and research on communicating the science of child development.

Illustrations (pages 13, 21, 26, 28, 32, 34) by Ernesto D. Morales

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The Center on the Developing Child's mission is to drive science-based innovation that achieves breakthrough outcomes for children facing adversity. We believe that advances in science provide a powerful source of new ideas focused on the early years of life. Founded in 2006, the Center catalyzes local, national, and international innovation in policy and practice focused on children and families. We design, test, and implement these ideas in collaboration with a broad network of research, practice, policy, community, and philanthropic leaders. Together, we seek transformational impacts on lifelong learning, behavior, and both physical and mental health.

Crafting a Roadmap to Better Outcomes

Early childhood is a time of great promise and rapid change, when the architecture of the developing brain is most open to the influence of relationships and experiences. Yet, at the same time, significant disadvantages in the life circumstances of young children can undermine their development, limit their future economic and social mobility, and thus threaten the vitality, productivity, and sustainability of an entire country. A remarkable expansion of new knowledge about brain development in the early years of life, linked to advances in the behavioral and social sciences, is now giving us deeper insights into *how* early experiences are built into our bodies, with lasting impacts on learning, behavior, and both physical and mental health. These insights can be used to fuel new ideas that capitalize on the promise of the early years and lead to breakthrough solutions to some of the most complex challenges facing parents, communities, and nations.

Half a century of program evaluation research has demonstrated repeatedly that effective early childhood services can improve life outcomes for children facing adversity, produce important benefits for society, and generate positive returns on investments. Policymakers and practitioners often invoke this evidence base to build support for existing programs, but the average magnitude of intervention effects has not increased substantially in 50 years, while the challenges most current programs were originally designed to address have become even more complex. During this same period, scientific understanding of the early origins of lifelong health and development has been advancing rapidly. These discoveries offer a compelling opportunity to generate creative, new approaches to problems that are not being resolved by existing services. The time has now come to raise the bar and leverage the frontiers of 21st-century science to pursue a bolder vision.

Fifty years ago, a high school diploma created a pathway to the middle class in the United States; the same cannot be said today.

The world as it existed in the 1960s, when many current child and family policies and programs were created, has changed dramatically. Arguably the most relevant of these changes for families with young children facing adversity has been the decreasing opportunity for people at the lower end of the socioeconomic spectrum to improve their financial circumstances, within and across generations. Massive global labor market restructuring, for example, makes it increasingly difficult for workers with low levels of skills to support a family and stay employed. Fifty years ago, a high school diploma created a pathway to the middle class in the United States; the same cannot be said today.

Over this same period, racial gaps in educational achievement have decreased, and both test scores and graduation rates for children in low-income families have moved upward, but the largest gains have been documented for children in the most economically advantaged families.[1] Thus, disparities in achievement have grown wider not because early childhood programs have had no impact, but because the size of their effects has failed to keep pace with the benefits of growing up in a high-income family in a rapidly changing world.

Social class differences in population health also begin early and lead to significant costs to society. Adult health impairments in the United States that are disproportionately associated with adverse childhood experiences include many of the most costly, led by $96.5 billion in direct medical care expenses annually for cardiovascular disease and $86 billion for mental health disorders.[2] Globally, although child mortality rates in many low- and middle-income countries have decreased dramatically in recent decades, about

one-third of children under age 5 fail to meet their developmental potential as a result of poverty and inadequate nutrition.[3]

In addition to the effects of global macroeconomic forces, multiple social patterns and life circumstances influence the life prospects of young children in the United States. To name just a few:

- Changes in family structure and stability, such as an increase in single-parent households, affect the ability of many parents to provide consistent social and financial security for young children.[4]
- Delaying the birth of a first child has been shown to contribute to greater economic opportunity, yet women in poverty have less access to effective means of planning pregnancies and disproportionately higher rates of unanticipated pregnancies than women with higher income.[5]
- Mounting evidence indicates that repeated experiences of racial or ethnic discrimination are associated with increased risk of a multitude of stress-related illnesses across the lifespan.[6]

While proposed solutions to these social and economic challenges fuel hotly contested partisan debates, knowledge about the foundations of healthy development is politically neutral and clear—whatever the source of the adversity, experiencing too much of it early in life without adequate support from adult caregivers (both inside and outside the home) is detrimental to child well-being. Although the full consequences of family structure, labor market transformations, K-16 education reform, and the cumulative toll of stress caused by discrimination and other social disadvantages all require serious attention, a deeper analysis of these issues is beyond the scope of this report. Instead, we present a research and development (R&D) approach that transcends partisan disagreement because it is built on a rigorously peer-reviewed, science-based understanding of *how* the foundations of learning, behavior, and health are built or weakened over time.

Advances in neuroscience, molecular biology, and epigenetics offer an unprecedented opportunity to stimulate new responses to these complex social, economic, and political challenges by explaining *why* young children facing adversity are more likely to have disrupted developmental trajectories.[7-9] Neuroscience is also producing extensive evidence suggesting that the later we wait to support families with children who are at greatest risk, the more difficult (and likely more costly) it will be to achieve positive outcomes, particularly for those who experience the biological disruptions of toxic stress during the earliest years.[10,11] More specifically, at a time when the discourse around early childhood investments is dominated by debates over preschool for 4-year-olds, the biological sciences cry out for attending to a missing niche in the field—new strategies in the prenatal-to-three period for families facing adversity.

At a time when the discourse around early childhood investments is dominated by debates over preschool for 4-year-olds, the biological sciences cry out for attending to a missing niche in the field—new strategies in the prenatal-to-three period for families facing adversity.

The call for fresh thinking and new ideas grounded in rigorous science that is presented throughout this document is driven by a thoughtful examination of the current environment in which policy and practice are conducted. On the one hand, many leaders in the field are engaged in critically important efforts to improve the quality of programs, increase the effectiveness and efficiency of service delivery systems, enhance the skills and compensation of a highly diverse early childhood workforce, and encourage innovation. These efforts are happening at multiple levels across a variety of sectors—and they must be sustained. On the other hand, most decision makers urge funding *solely* for

programs with previously demonstrated effectiveness, regardless of the nature or magnitude of their impacts. This widespread preference for "evidence-based" programs, many of which have produced small effects on random categories of outcomes that have not been replicated, seriously limits the likelihood of achieving increasingly larger impacts at scale over time. Indeed, many of the most compelling challenges facing the early childhood field today are linked to the absence of sufficient professional and political incentives for developing and testing new ideas.

The creation of this document has been driven by an intensive review process by the National Scientific Council on the Developing Child and the National Forum on Early Childhood Policy and Programs to assure the credibility of its scientific content. Over the past 12 years, the Council's ongoing work to bring science to bear on public policies for young children has resulted in a series of 13 working papers that continues to grow. Chapter one of this report consolidates key concepts from the entire series into one cohesive story of early childhood and early brain development.

We believe that dramatic improvements in lifelong learning, behavior, and health are not only achievable but also absolutely essential for a thriving and sustainable society.

The Forum has built an extensive database incorporating 47 years of program evaluation data and conducted multiple meta-analyses, along with examining other literature reviews, all aimed at answering important questions about early childhood program impacts and effectiveness factors. Drawing on this massive knowledge base, chapter two of the report distills five core principles that can guide decisions about how to improve the quality of existing programs and increase their return on investment. Although the evidence base reviewed in this chapter focuses primarily on programs that provide direct services for young children and their parents, we acknowledge the comparable need for science-informed innovation at the neighborhood, systems, and policy levels, including investments in housing, income support, and job training, among many other domains of influence on child well-being.

Chapter three builds on the first two and proposes an approach to answering the following question: "How can we do better?" Shaped by the growing Frontiers of Innovation community, it is inspired by the conviction that achieving significantly greater impacts on the lives of young children facing adversity will require a more creative approach to investment that invites new ideas, supports responsible risk-taking, demands more rigorous measurement and evaluation, and learns from failure. Decades of research in developmental psychology, neurobiology, and implementation science provide a rich knowledge base to catalyze such creativity—and the transition into a new (and substantially more effective) era in early childhood policy and practice will be led by those who view current best practices at multiple levels as a vital starting point, but not a final destination.

We invite all who share this sense of constructive dissatisfaction with the status quo—whether from the worlds of policy, practice, research, philanthropy, or those who simply want to make their communities a better place for children—to join us on a journey of discovery in an effort to create a new era in early childhood investment. Our goal is nothing less than breakthrough impacts for children facing adversity. We believe that dramatic improvements in lifelong learning, behavior, and health are not only achievable but also absolutely essential for a thriving and sustainable society. Leveraging what we are learning from science to generate and test new ideas is a critical, untapped key to unlocking these dramatic improvements.

The Science of Early Childhood Development

1

The capacities developed during childhood are the building blocks of a well-functioning, prosperous, and sustainable society, from positive school achievement and economic self-sufficiency to responsible adult behavior and lifelong health. When we give children today what they need to learn, develop, and thrive, they give back to society in the future through a lifetime of productive citizenship. Building on a well-established knowledge base more than half a century in the making, recent advances in the science of early childhood development and its underlying biology provide a deeper understanding that can inform and improve existing policy and practice, as well as help generate new ways of thinking about solutions. The following core concepts are grounded in decades of behavioral and social sciences and recent discoveries in neuroscience, molecular biology, and epigenetics. Together they help explain how healthy development happens, what can send it off track, and what we can do to restore it.

Responsive Relationships and Positive Experiences Build Strong Brain Architecture

Brains are built over time, and the foundations of brain architecture are constructed early in life. The neural connections that comprise the structure of the developing brain are formed through an ongoing process that begins before birth, continues into adulthood, and establishes either a sturdy or weak foundation for all the health, learning, and behavior that follow.

During the first few years after birth, 700-1,000 new synapses (connections between neurons) form every second.[12,13] After a period of rapid proliferation, these connections are reduced through a normal process called pruning, which enables remaining brain circuits to become stronger and more efficient. Early experiences affect the nature and quality of the brain's developing architecture by determining which circuits are reinforced and which are pruned through lack of use. Some people refer to this as "use it or lose it."

Just as in the construction of a house, certain parts of the developing brain must be built in a predictable sequence and what is built early must be strong enough to support the long-term structure. And, just as the unavailability of needed materials at key points in the process can force changes to blueprints, the lack of appropriate experiences can lead to alterations in neural architecture. Moreover, although the brain retains the capacity to adapt and change throughout life, this capacity decreases with age. Thus, building more advanced cognitive, social, and emotional skills on a weak foundation is far more difficult and less effective than getting things right from the beginning.[14-17]

The exceptionally strong influence of early experiences on brain architecture makes the early years a period of both great opportunity and great vulnerability for development. A growth-promoting environment that provides adequate nutrients, is free of toxins, and is rich in social interactions with responsive caregivers prepares the developing brain to function well in a range of circumstances. An adverse environment in which young children are not well-nourished, are exposed to toxic substances, and/or are deprived of appropriate sensory, emotional, and social experiences is likely to disrupt the construction of important foundational capacities. Once established, a weak foundation can have detrimental effects on further brain development, even if a healthy environment is restored at a later age.

The interaction of genes and experiences shapes the circuitry of the developing brain. Scientists have discovered that the experiences children have early in life—and the environments in which they have them—not only shape

their developing brain architecture, but also affect how genes are turned on and off and even whether some are expressed at all.

The old ideas that genes are "set in stone" or that they alone determine developmental outcomes have been fully disproven. It is more accurate to think about genes as packages of biological instructions that require an authorizing signature to be carried out. Both positive experiences, such as rich learning opportunities, *and* negative influences, such as exposure to stressful life circumstances or environmental toxins, leave a "chemical signature" on the genes. These signatures can range from temporary to permanent, but all affect how easily the genes are switched on or off.[8,18,19]

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This phenomenon is known as "epigenetic adaptation" and it shapes how our brains and bodies develop. Epigenetic influences are one of the biological mechanisms through which the environment of relationships, the physical, chemical, and built environment, and early nutrition all get "under the skin" and influence lifelong learning, behavior, and health.[20] In work that has important implications for providing appropriate prenatal experiences and adequate nutrition for expectant mothers, research in both animals and humans now shows that some epigenetic changes can occur during pregnancy. In fact, some can actually be passed on to later generations, thereby affecting the health and well-being of children, grandchildren, and even their descendants.[21-23]

Supportive environments and rich learning experiences generate epigenetic signatures that activate *positive* genetic potential.[24] Early stimulation of the brain through active use of learning and memory circuits can thus result in epigenetic changes that establish a foundation for more effective learning capacities in the future.[25,26] On the other hand, highly stressful early experiences can authorize genetic instructions that disrupt the development of systems that manage responses to adversity later in life.[18,19,27]

Children develop within an environment of relationships that begins in the family but also involves other adults who play important roles in their lives. This can include extended family members, providers of early care and education, nurses, social workers, coaches, and neighbors.

These relationships affect virtually all aspects of development—intellectual, social, emotional, physical, and behavioral—and their quality and stability in the early years lay the foundation that supports a wide range of later outcomes.[15,29-33] These outcomes include self-confidence and sound mental health, motivation to learn, achievement in school and later in the workplace, the ability to control aggressive impulses and resolve conflicts in nonviolent ways, behaviors that affect physical health risks, and the capacity to develop and sustain friendships and close relationships and ultimately become a successful parent.[34]

Children's experiences with all of the people who are consistently in their lives have an important influence on their brain structure and function. This developmental process is fueled by reciprocal, "serve and return" interactions between children and the adults who care for them. Young children naturally reach out for interaction through babbling, facial expressions, gestures, and words, and adults who are responsive *return* these *serves* with similar vocalizing, gesturing, and emotional engagement. This serve and return behavior continues like a game of tennis or passing a ball back and forth. If the adult's responses are unreliable, inappropriate, or simply absent, the architecture of the child's developing brain may be disrupted, and later learning, behavior, and health may be impaired. Young children and parents both can initiate and respond in this ongoing process.[14,32,35-40]

These reciprocal and dynamic interactions are essential for healthy development and literally shape the architecture of the developing brain.

They provide what nothing else in the world can offer—experiences that are individualized to the child's unique personality style, that build on his or her own interests, capabilities, and initiative, that shape the child's self-awareness, and that stimulate the child's growth and development.

Skill begets skill as brains are built from the bottom up, with increasingly complex circuits building on simpler circuits, and increasingly complex and adaptive skills emerging over time.[41-43] Times of exceptional sensitivity to the effects of environment and experience for different brain circuits are called *critical* or *sensitive periods.*

Sensitive periods begin and end at different ages for different parts of the brain. For example, the sensitive periods for neural circuits related to vision, hearing, and touch tend to end in the first years of life.[44,45] In contrast, the sensitive periods for circuits that process more complex aspects of the world, such as communication, the interpretation of facial expressions, reasoning, and decision-making, all end later in development.[46-48] Because circuits mature sequentially, different kinds of experiences are critical at different ages.[49] Soon after birth, basic sensory, social, and emotional experiences are essential for optimizing the architecture of low-level circuits, and at later ages, more sophisticated kinds of learning opportunities are critical for shaping higher-level circuits.

It is vitally important that experiences provided in the earliest years are appropriate for the child's stage of development. Encouraging self-directed, creative play is one important strategy for supporting that goal. Indeed, the key dimensions of play are precisely those that fuel the development of increasing capabilities as a child gets older by promoting a state of low anxiety and providing opportunities for novel experiences, active engagement, and learning from peers and adults.

Reading a picture book with a toddler who is learning to speak offers another example of age-appropriate skill-building by providing an important opportunity to point to and talk about the pictures, rather than focusing on the written words. The ability to decode written language comes later, when the appropriate, higher-level brain circuitry is being built. If adults ask young children to master skills for which the necessary brain circuits have not yet been formed—such as programs that attempt to drill toddlers in reading or math facts—they will be wasting time and resources, and might even impair healthy brain development if they induce excessive stress in the child.

Serve and return interactions shape brain architecture. When an infant or young child babbles, gestures, or cries, and an adult responds appropriately with eye contact, words, or a hug, neural connections are built and strengthened in the child's brain that support the development of communication and social skills.

For the developing brain, this means that the abilities to perceive simple aspects of the world and to make simple emotional and social judgments develop long before the ability to carefully weigh multiple factors during reasoning and decision-making tasks.[50,51] The gradual acquisition of higher-level skills, including the ability to focus and sustain attention, set goals, follow rules, solve problems, and control impulses, is driven by the development of the prefrontal cortex (the large part of the brain behind the forehead) from infancy into early adulthood.[52-55] A significant part of the formative development of the prefrontal cortex occurs during early childhood, as critical connections are forged between this region and other parts of the brain that it controls. This circuitry is then refined and made more efficient during adolescence and the early adult years.[56,57]

Known as executive function and self-regulation, these higher-level capacities serve

as the brain's "air traffic control system," which enables planning, monitoring, and managing multiple streams of information at the same time. Children aren't born with these capabilities, but they're born with the potential to acquire them within the context of responsive relationships that model skills and scaffold their development. Acquiring the building blocks of executive function and self-regulation is one of the most important and challenging tasks of early childhood. The opportunity to build further on these foundational capacities is critical to healthy development through middle childhood, adolescence, and into adulthood.[57]

Acquiring the building blocks of executive function and self-regulation is one of the most important and challenging tasks of early childhood.

The brain's many functions operate in a richly coordinated fashion with multiple systems throughout the body. The circuitry that affects learning and behavior—our thinking and reasoning skills, language abilities, emotional resilience, and social competence—is interconnected with physiological systems that affect physical and mental health.

All cognitive, emotional, and social capabilities and physical and mental well-being develop through a lifelong process that is deeply embedded in the function of the brain as well as in the cardiovascular, immune, neuroendocrine, and metabolic regulatory systems. These capacities are highly interrelated through multiple biological systems that are woven together like strands of a rope. Together, these strands comprise the foundations of success in school and later in the workplace and community. When each strand is sturdy and woven together tightly, the "rope" is strong, flexible, and can be used to meet different needs.

Oral language acquisition, for example, depends not only on adequate hearing, the ability to differentiate sounds, and the capacity to link meaning to specific words, but also on the availability of serve and return interactions with adults. If a baby receives no response to babbles and other pre-linguistic attempts to communicate, her or his language development will be undermined. The interconnectedness between health and development can be seen in the way an illness can distract a child's focus away from learning, leading to setbacks in school, and in the correlation between higher educational achievement and health-promoting behaviors in adults that are associated with greater well-being and longevity.[9,58,59]

Beginning in early infancy, children rapidly develop their abilities to experience and express different emotions, as well as their capacity to cope with and manage a variety of feelings.[60-62] The development of these capabilities occurs at the same time as a wide range of highly visible skills in mobility (motor control), thinking (cognition), and communication (language).[51] Recent scientific advances have shown how the interrelated development of emotion and cognition relies on the emergence, maturation, and interconnection of complex neural circuits in multiple areas of the brain, including the prefrontal cortex, limbic cortex, basal forebrain, amygdala, hypothalamus, and brainstem.[63] The circuits that are involved in the regulation of emotion overlap with those that are associated with executive functioning, which are intimately involved in the early development of problem-solving skills during the preschool years.[64] In

Each type of executive function skill draws on elements of the others.

terms of basic brain functioning, emotions support executive functions when they are well-regulated, but interfere with attention and decision-making when they are poorly controlled.[14,65-68]

Despite its foundational importance, emotional development receives relatively less recognition than other domains as a core emerging capacity in the early childhood period. And yet, when feelings are not managed well, thinking can be impaired. Moreover, the foundations of social competence that are developed in the first five years are linked to emotional well-being and affect a child's later ability to adapt to the challenges of school and to form successful relationships throughout life.[31,58,69,70]

Adversity Disrupts the Foundations of Learning, Behavior, and Health

Research on the biology of stress shows how significant hardship or threat (e.g., from extreme poverty or child maltreatment) can lead to physiological disruptions that affect lifelong outcomes in learning, behavior, and physical and mental well-being. This scientific knowledge can be used in designing strategies to prevent these negative effects and in developing effective intervention approaches to reduce the consequences of early adversity. Because nature provides children with a powerful stress-protection shield in the form of supportive caregivers, strengthening stable and responsive relationships in the earliest years of life can literally block excessive activation of stress hormones and protect children from potentially damaging effects. Supportive and nurturing relationships can also help children develop their own capacities to cope with the effects of early life stress, and thus help mitigate its disruptive effects on their well-being.

Toxic stress responses can impair development, with lifelong consequences. When we are threatened, our bodies prepare us to respond by increasing our heart rate, blood pressure, inflammatory reactivity, and blood sugar levels. These changes are brought about by the rapid deployment of stress hormones such as adrenaline and cortisol. This "fight or flight" response is life-saving in the face of an acute threat, but its continuous activation can have a wear and tear effect on a wide range of important biological functions.

Learning how to cope with adversity is an important part of healthy child development. When a young child's stress response systems are activated within an environment of supportive adult relationships, these physiological effects can be either blocked by the adult's presence or restored to baseline quickly. The result is the development of a well-functioning stress response system. However, if the stress response is extreme and long-lasting, and buffering protection from a caring adult is not available, the result can be a system that is set to learn fear rapidly, shift into defensive mode with very little provocation (act now, think later), react strongly even when not needed, or potentially shut down completely as a result of constant wear and tear. This can have negative repercussions across the lifespan, requiring more intensive and costly solutions later.[9,11,71-75]

Because not all stress is bad, it is important to distinguish among three kinds of stress responses—*positive, tolerable,* and *toxic.*

- **Positive stress response** is a normal and essential part of healthy development, characterized by brief increases in heart rate and blood pressure, and mild or brief elevations in stress hormone levels. Some situations that might trigger a positive stress response are a child's first day with a new caregiver or receiving an injection at the doctor's office.

- **Tolerable stress response** activates the body's alert systems to a greater degree as a result of a more severe or longer-lasting threat, such as the loss of a loved one, a natural disaster, or a frightening injury. If the activation is time-limited and buffered by relationships with supportive adults who help the child adapt, the brain

Three Types of Stress Response

and other organs recover from what might otherwise be damaging effects.

- **Toxic stress response** can occur when a child experiences major, frequent, and/or prolonged adversity—such as recurrent physical or emotional abuse, chronic neglect, caregiver substance abuse or mental illness, repeated exposure to violence, and/or the accumulated burdens of family economic hardship—without adequate adult support or, worse, where the adult is the source of both support and fear. Excessive and/or prolonged activation of the stress response systems can disrupt the development of brain architecture and other developing organs. This cumulative toll increases the risk for stress-related disease and cognitive impairment, including heart disease, diabetes, substance abuse, and depression, well into the adult years. Research also indicates that supportive, responsive relationships with caring adults as early in life as possible can prevent or reverse the damaging effects of a toxic stress response.[71]

The interaction between genetic predisposition and exposure to significant adversity makes some children more susceptible to long-term problems in cognitive, social, and emotional development, as well as to impairments in health. Any child who experiences prolonged adversity is at risk for physical and mental health problems, and individuals who are more physically or emotionally vulnerable to stress are more likely to experience long-term impacts.

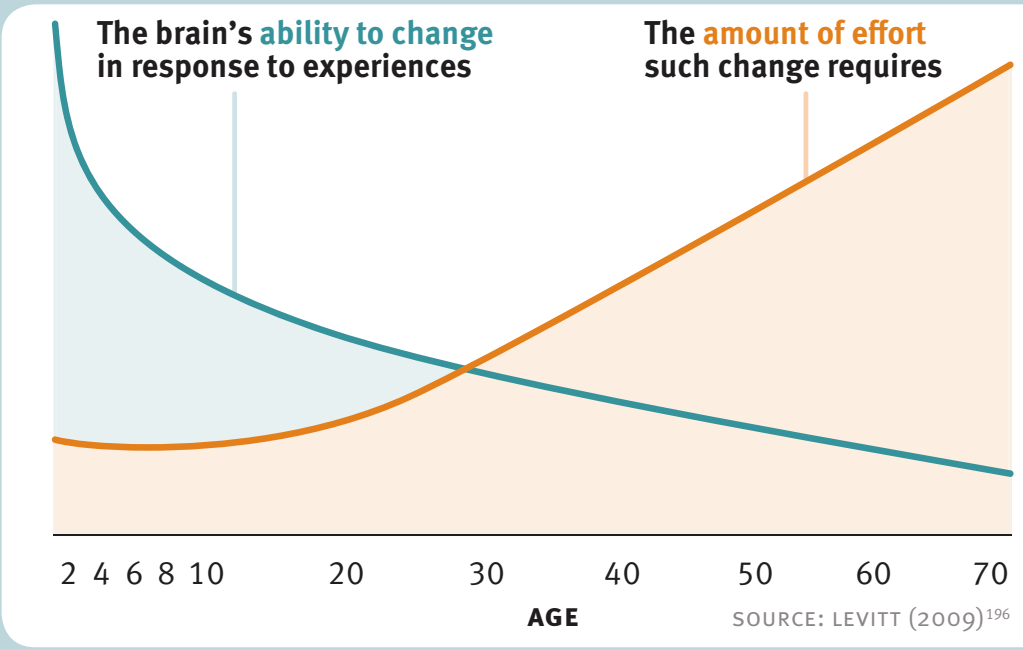
For example, a young child with a fearful temperament is more likely to develop anxiety or depression than a child without that predisposition. This is especially likely in the context of harsh, inconsistent relationships and experiences, such as those associated with deep poverty, poor-quality child care, or a mother with serious depression.[76,77] This interaction between genetic predispositions and sustained, stress-inducing experiences early in life can lay an unstable foundation for development in general, and for physical and mental health specifically, that endures well into adulthood. Researchers have also found that children who are genetically more vulnerable to adverse environments may also be more sensitive to (and therefore better able to profit from) positive experiences.[28] Thus, children who fare the worst after experiencing sustained adversity may in fact fare even better than their peers if supportive intervention is provided.

Protective Factors in the Early Years Strengthen Resilience

Providing the right ingredients for healthy development from the start produces better outcomes than trying to fix problems later. Scientists use the term "plasticity" to refer to the capacity of the brain to learn from experience, which is greatest early in life and decreases with age. The increasing specialization of the brain over time makes it both more efficient and less capable of reorganizing and adapting to new or unexpected challenges.

Although windows of opportunity for specific skill development and behavioral adaptation remain open for many years, trying to change behavior or build new skills on a foundation of brain circuits that were not wired properly from the beginning requires more effort—for both individuals and society. For the brain, this means that more physiological energy is needed to compensate for circuits that do not perform in an adaptive fashion. For society, this means that providing remedial education, clinical treatment, and other interventions later in life is more expensive than providing nurturing, protective relationships and appropriate learning experiences earlier.[78-80]

The developing brain's more flexible circuitry in the earliest years is explained primarily by three factors. First, during its initial stages of development, the brain forms far more extensive connections than it needs in order to function



As shown by this conceptual graph, drawn from multiple studies on humans and animals, the brain's plasticity is strongest in the first few years after birth. Thus, it is easier and less costly to form strong brain circuits during the early years than it is to intervene or "fix" them later.

optimally, and connections that are used less are pruned away over time. Thus, it is easiest to form new connections while they are proliferating most rapidly.[78] Second, adjusting to changing environments also involves *eliminating* connections, and the ability to eliminate connections is greatest before the circuit stabilizes.[42] Third, once a particular circuitry pattern becomes established, it is difficult for the effects of new and different experiences to alter that architecture.[79-81] This means that early experience has a unique advantage in shaping the architecture of developing brain circuits before they are fully mature and stabilized.

Finally, it's important to note that neural circuits that are specialized for learning, emotion, and self-regulation continue to adapt in response to experiences throughout the adult years.[82-84] Moreover, this capacity for plasticity in mature neural circuits can be mobilized in the face of less-than-optimal early development. In order for the brain to take full advantage of this continuing ability to change, however, new experiences must activate specific, relevant neural circuits, and the individual's attention must be highly engaged in the task.

The implications for intervention beyond the early childhood years are clear—change is certainly possible, but it will be harder and more expensive in terms of both societal and individual effort. Moreover, adaptive change later in life will also be potentially less extensive and durable, and the ultimate results are not likely to be as good as they would have been if things had been done well in the beginning.[56]

Positive early experiences, support from adults, and the early development of adaptive skills can counterbalance the lifelong consequences of adversity. The connection between adverse early life experiences and a wide range of costly societal problems, such as lower school achievement, criminal behavior, reduced economic productivity, and poor health, is well documented. However, not all children who are exposed to adversity experience detrimental effects later in their lives; some do well despite the odds.

Understanding why some people develop the adaptive capacities to overcome significant disadvantages while others do not is key to enabling more children to experience positive outcomes and building a more resilient society.

No matter what form of hardship or threats may have been experienced, the single most common research finding is that children who end up doing well have had at least one stable and responsive relationship with a parent, caregiver, or other adult. These relationships provide the support, scaffolding, and protection that both buffer children from developmental disruptions and help build key capabilities—such as the ability to plan, regulate behavior, and adapt to changing circumstances—that enable them to respond to adversity and thrive. In other words, positive experiences, supportive relationships, and adaptive skills build the foundation of what is commonly known as *resilience*.[85]

Desirable life outcomes can be achieved when nurturing, capacity-building experiences counterbalance the effects of adversity. Like weights on either side of a balance or a scale, positive experiences tip a child's life trajectory toward good outcomes, and negative experiences tip it toward bad outcomes. Resilience is demonstrated when a child's health and development are tilted in the positive direction, even when substantial negative forces are stacked on the other side.

Yet there is more to development—and to the concept of a resilience scale—than the sum total of a child's life experiences. Children who do well despite exposure to significant hardship typically exhibit personal characteristics, such as

8 Things to Remember about Child Development

1 **Even infants and young children are affected adversely when significant stresses threaten their family and caregiving environments.** Adverse fetal and early childhood experiences can lead to physical and chemical disruptions in the brain that can last a lifetime. The biological changes associated with these experiences can affect multiple organ systems and increase the risk not only for impairments in future learning capacity and behavior, but also for poor physical and mental health outcomes.[77]

2 **Development is a highly interactive process, and life outcomes are not determined solely by genes.** The environment in which one develops before and soon after birth provides powerful experiences that chemically modify certain genes in ways that then define how much and when they are expressed. Thus, while genetic factors exert potent influences on human development, environmental factors have the ability to alter family inheritance. For example, children are born with the capacity to *learn* to control impulses, focus attention, and retain information in memory, but their experiences as early as the first year of life lay a foundation for how well these and other executive function skills develop.[77]

3 **While attachments to their parents are primary, young children can also benefit significantly from relationships with other responsive caregivers both within and outside the family.** Close relationships with other nurturing and reliably available adults do not interfere with the strength of a young child's primary relationship with his or her parents. In fact, multiple caregivers can promote young children's social and emotional development. That said, frequent disruptions in care and high staff turnover and poor-quality interactions in early childhood program settings can undermine children's ability to establish secure expectations about whether and how their needs will be met.[34,102,103]

4 **A great deal of brain architecture is shaped during the first three years after birth, but the window of opportunity for its development does not close on a child's third birthday.** Far from it! Basic aspects of brain function, such as the ability to see and hear effectively, do depend critically on very early experiences as do some aspects of emotional development. And, while the regions of the brain dedicated to higher-order functions—which involve most social, emotional, and cognitive capacities, including multiple aspects of executive functioning—are also affected powerfully by early influences, they continue to develop well into adolescence and early adulthood.[56] So, although the basic principle that "earlier is better than later" generally applies, the window of opportunity for most domains of development remains open far beyond age 3, and we remain capable of learning ways to "work around" earlier impacts well into the adult years.

humor or intelligence, *and* strong relationships with the important adults in their lives. It is that *interaction* between individual characteristics and supportive relationships in both the family and the community that helps a child build the capacities needed to cope with significant threats to healthy development.[86-92]

Just as every individual begins life with certain predispositions, every scale has a balancing point or fulcrum. Where that fulcrum is located makes the scale easier or harder to tip in one direction or the other, and where it is placed at birth is the result of the interaction of genetic factors and prenatal experiences. That said, cutting-edge science is showing us that the position of the fulcrum is not fixed. Quite the contrary, the *accumulation* of positive and negative experiences shapes brain architecture over time, and the acquisition of adaptive skills enables us to respond more effectively to new situations. The combined influences of these experiences and skills have the power to "slide the fulcrum" over time, which makes it easier or more difficult for individuals to respond to adversity in ways that lead to positive outcomes.[85] In short, resilience can be strengthened and is not a fixed characteristic.

How people respond to stressful experiences varies dramatically, but extreme adversity nearly always reduces the likelihood that individuals

5 **Severe neglect appears to be at least as great a threat to health and development as physical abuse—possibly even greater.** When compared with children who have been victimized by overt physical maltreatment, young children who experienced prolonged periods of neglect exhibit more serious cognitive impairments, attention problems, language deficits, academic difficulties, withdrawn behavior, and problems with peer interaction as they get older.[104,105] This suggests that sustained disruption of serve and return interactions in early relationships may be more damaging to the developing architecture of the brain than physical trauma.[104,106,107]

6 **Young children who have been exposed to adversity or violence do not invariably develop stress-related disorders or grow up to be violent adults.** Although children who have these experiences clearly are at greater risk for adverse impacts on brain development and later problems with aggression, they are not doomed to poor outcomes. Indeed, they can be helped substantially if reliable and nurturing relationships with supportive caregivers are established as soon as possible and appropriate treatments are provided as needed.[58,108]

7 **Simply removing a child from a dangerous environment will not automatically reverse the negative impacts of that experience.** There is no doubt that children in harm's way should be removed from dangerous situations immediately. Similarly, children experiencing severe neglect should be provided with responsive caregiving as soon as possible. That said, children who have been traumatized need to be in environments that restore their sense of safety, control, and predictability, and they typically require therapeutic, supportive care to facilitate their recovery.[109]

8 **Resilience requires relationships, not rugged individualism.** The capacity to adapt and thrive despite adversity develops through the interaction of supportive relationships, biological systems, and gene expression.[90,110,111] Despite the widespread yet erroneous belief that people need only draw upon some heroic strength of character, science now tells us that it is the reliable presence of at least one supportive relationship and multiple opportunities for developing effective coping skills that are the essential building blocks for strengthening the capacity to do well in the face of significant adversity.[85]

will reach their full potential and typically generates problems that require treatment. Children who experience circumstances of massive threat or catastrophe—such as genocide, famine, or environmental devastation—almost always exhibit impairments in their health and development.[93-95] Under such conditions, intensive therapeutic interventions tailored to the specific context are imperative.[96]

Both children and adults need core capabilities to respond to or avoid adversity, and these capacities can be strengthened through coaching and practice. Although the definition and precise nature of these critical capabilities is a subject of considerable debate within the scientific community, many of the most important fall under the umbrellas of "self-regulation" and "executive function."

Chaotic, stressful, and/or threatening situations can derail anyone, yet individuals who experience a pile-up of serious adversity are often even less able to deploy all of the skills they have in order to cope with challenging circumstances.

Self-regulation helps us to draw on the right skills at the right time, respond effectively to the world around us, and resist inappropriate responses. *Executive function* is a cluster of skills that support self-regulation. These include working memory (the capacity to hold and manipulate information in our heads over short periods of time), cognitive flexibility (which allows us to adjust to changing demands, priorities, or perspectives), inhibitory control (the capacity to resist impulsive behavior), and the ability to focus and sustain attention, set goals, follow rules, solve problems, and delay gratification. The orchestration of these capabilities is affected by stress, the availability of social supports, and mental health. This results in a continuum of function that ranges between reactive or impulsive behavior at one end and proactive or goal-directed behavior at the other.[57,97]

Chaotic, stressful, and/or threatening situations can derail anyone, yet individuals who experience a pile-up of serious adversity are often even less able to deploy all of the skills they have in order to cope with challenging circumstances.[98-100] Significant and continuous adversity can overload the ability to use the very capacities that are needed to overcome challenges. In addition, the experience of severe, frequent stress early in life compromises the development of those capacities by redirecting the focus of brain development *toward* rapid response to threat and *away* from planning and impulse control.[71] Understanding how these adaptive capabilities are built in the brain and how they are mobilized in the face of adversity offers a compelling example of how science could help inform the design of more effective strategies to build resilience across the lifespan.

Sound and stable mental health is another essential part of the foundation that supports all other aspects of human development—from the formation of friendships and the ability to cope with adversity to the achievement of success in school, work, and community life. Similar to the way a wobbly table may not function well if the floor is uneven, the legs are not aligned, or the tabletop is not level, the destabilizing consequences of problems in mental health can be caused by many interdependent factors. Just as small "wobbles" in a table can become bigger and more difficult to fix over time, the effective management of mental health concerns in young children requires early identification of the causes and appropriate attention to their source, whether they reside in the environment, the child, or (most frequently) in the interaction between the two. Understanding how emotional well-being can be strengthened or disrupted in early childhood can help policymakers promote the kinds of environments and experiences that

prevent problems (i.e., by "leveling the table" through the remediation of early difficulties) so they do not destabilize the developmental process.[76]

Finally, overcoming the effects of adversity on the development and use of these core capabilities requires attention to *both* reducing community-level sources of significant stress that affect family life *and* strengthening the growing capacity of individuals to cope with hardship or threat. The foundations of executive function, self-regulation, and mental health are built in early childhood, but the full range of capabilities and the neural networks that connect them continue to develop into adolescence and early adulthood. Although adults can master these capacities over time, it's easier and more effective to do this on a strong foundation. Building the capabilities of adults is therefore essential not only to their own success as parents and workers, but also to the development of the same capacities in their children.

Science Provides a Powerful Framework for Assessing Current Knowledge and Catalyzing Fresh Thinking about Policy and Practice

The core principles described in this chapter present a rich story of how human development happens, how it can be derailed, and how to keep it on track. This story draws on pioneering work in multiple fields that continue to break new ground today, and its central concepts have been thoroughly vetted by members of the National Scientific Council on the Developing Child. In sum, the chapter presents a highly credible synthesis and translation of current knowledge about the underlying science of development based on a rigorous peer review process, not the latest study making headlines in the popular media.

This synthesis suggests several "next" questions. Now what should we do? How can we use cutting-edge scientific thinking to better understand what we have learned from decades of investment in young children and families facing adversity? How can we leverage evolving scientific insights to inspire new ideas and launch a 21st-century policy agenda? The frontiers of science are telling us a great deal about what children need to assure that their brains and bodies develop in a way that leads to positive outcomes, and what they need to be protected from to avoid negative consequences. But this scientific story, as compelling as it is, does not tell us what kinds of services and policies are most effective at ensuring (or restoring) healthy developmental trajectories for children growing up in a range of challenging circumstances. The next chapter will focus on the best knowledge available to answer those critical questions.

For more on the science of child development, go to:
http://developingchild.harvard.edu/science/

How can we use cutting-edge scientific thinking to better understand what we have learned from decades of investment in young children and families facing adversity?

R&D: The Science of Early Childhood Development

Mobilizing the Frontiers of Scientific Investigation to Inform New Directions in Policy and Practice

Groundbreaking research offers promising sources of fresh thinking that could fuel a game-changing portfolio of new investments to address the following questions.

How can we best build important skills at different stages of development?

Learning more about the brain's ability to change over time (i.e., plasticity) and why it is especially responsive to environmental influences during certain sensitive periods of development are fertile areas of study for the early childhood field. Recent evidence from animal studies that excessive stress can accelerate the opening and closing of critical periods for some aspects of early brain development raises important questions about the timing of interventions to prevent the long-term consequences of toxic stress experienced prenatally and in the first three years after birth. Equally important, as we focus greater attention on strategies for strengthening the capabilities of parents, other caregivers, and service providers, questions about plasticity in the adolescent and adult years also become opportunities for exploration.

Why do individuals respond differently to adversity and to intervention?

Understanding differences among children in their ability to cope with stress is essential for improving their life prospects in the face of hardship, threat, or deprivation. This variation can be influenced by differences in the child, the caregiver, and/or the caregiving environment. Advances in science could inform how to match specific strategies to differences in how children and families respond to different stressors and services. Drawing on lessons learned from the dramatic gains that have been made in the management of infectious disease, progress in combatting the consequences of adversity could be achieved by using multiple strategies—whether reducing the precipitants of toxic stress, matching different services to specific causes, strengthening the body's overall defenses against adverse conditions, or overcoming resistance to available treatments by developing new interventions.

What are the best ways to measure, prevent, and reduce toxic stress?

The term "toxic stress" was first introduced in a working paper by the National Scientific Council on the Developing Child (2005), and the concept has stimulated a broad and deep conversation about the impacts of early adversity on the foundations of lifelong health and development. Identifying valid and reliable measures of the effects of toxic stress is an essential next step in being able to respond effectively.

Biological information is frequently collected to evaluate our health. We take our temperature to determine whether we have a fever and whether it's going up or down. We measure lead levels in blood to screen for toxic exposures that require prompt treatment and to evaluate the effectiveness of that treatment. The striking contrast of our current inability to accurately measure toxic stress effects in children has limited both our capacity to determine who should be prioritized for preventive or therapeutic intervention and our ability to measure whether specific services are having sufficiently positive impacts.

Valid and reliable measures of toxic stress effects in children will become increasingly available for widespread use in the near future. These measures will provide important information above and beyond the current reliance on global predictors of risk—such as family income, parent education, or adverse childhood experiences (e.g., "ACE scores")[101]—that are helpful for assessing risk across a population, but cannot tell us what specifically to expect or do for an individual child. Ensuring the practical application of these new measures and their acceptability in community-based practice settings (and overcoming the shameful history of biology being misused to stigmatize or exploit disadvantaged groups) will require considerable effort. Trusting collaboration among scientists, clinicians, community leaders, and parents will be needed to protect families and children from inappropriate labeling, unwarranted intrusions, and the medicalization of poverty, violence, racism, and other threats to healthy development.

Lessons Learned from Five Decades of Program Evaluation Research

2

The scientific "story" of development, as described in the previous chapter, did not exist 50 years ago when Head Start and other pioneering programs in the United States were created as part of President Lyndon Johnson's "War on Poverty" and later expanded under Presidents Richard Nixon and Gerald Ford. Today, the early childhood landscape includes a diverse array of policies and services designed to strengthen families' ability to support the healthy development of their children. These include Head Start/Early Head Start, primary health care, state-funded and private preschools, child care, home visiting, and programs for children with special needs.

The body of evidence built around these programs during the past five decades is extensive and is the source of the "best practice" recommendations in this chapter. Yet it should be noted that other policies and programs that affect families facing adversity—including housing vouchers, subsidized employment, and other financial supports, as well as systems and services that address the precipitants and consequences of child maltreatment, including family courts, child welfare, and foster care—are also critically important elements of the landscape, but are not the focus of this document.

As different programs for young children and their families have evolved along parallel pathways, the science of early childhood development and its underlying neurobiology has generated a deeper understanding of the common foundations of learning, behavior, and lifelong health. Drawing on this converging knowledge, entrepreneurial policymakers have invested considerable energy in attempting to reduce the persistent fragmentation that separates services across sectors. Despite these important efforts, however, the full range of supports provided for families with young children continues to struggle with inconsistencies in implementation, inefficiencies in delivery, and occasional conflicts with scientific knowledge. These include the following:

- Preschool programs for 4-year-olds have the largest base of evaluation research from which to draw and currently garner the lion's share of attention and resource allocation, while neuroscience increasingly points to the substantial amount of brain development that occurs *well before* age 4 and the extent to which *preventable* disruptions during that early period can have lifelong consequences.[112]
- The challenges of building, training, and sustaining a skilled workforce that can provide high-quality services, whether they work with adults or children, remain substantial, and the science-informed connections between the skills of caregivers and the development of children remain largely unaddressed in policy planning.[113]
- Extensive research on the effectiveness of a variety of early care and education programs (both center-based and through home visiting) has produced limited data to guide replication and scaling due to significant variation in the type and amount of services that are *actually* received by the intended recipients, the uneven quality of those services, and the extent to which comparison groups access other interventions and supports that confound study findings.[114]

Notwithstanding the lack of conclusive evidence pointing toward a specific set of "best programs," it is possible to identify five key *characteristics* that have been associated consistently with positive outcomes across a range of ages and interventions. A recent report from the Advisory Committee on Head Start Research

and Evaluation provides extensive information that can inform this approach. That report also includes attention to important issues related to culture, language, and mental health that are not addressed in this document.[115]

Although the optimal timing of different investments continues to be debated, evidence of "effectiveness factors" can be summarized within a set of core principles to guide programs and policies across the full early childhood period, whether designed primarily for children or for the adults who care for them. These principles, which could be described as current "best practices" for a range of programs, are described below.

Core Principles to Inform Policymaking and Program Development

#1: Build Caregiver Skills

Adults who care for young children—whether they are parents, relatives, friends, or staff in early childhood programs—need a solid core of capabilities and knowledge to support healthy child development. Most service providers and mothers across the socioeconomic spectrum have sufficient capacities and supports to provide that effective caregiving and to improve their own skills over time. However, parents and other caregivers who struggle with the serious, daily stresses of low-wage jobs (often tied to shift work with unpredictable schedules), community or family violence, and/or chaotic home environments often require additional support and opportunities to strengthen the skills that are essential for providing the stability and responsiveness that young children need. These services are more likely to promote healthy child development, especially in families facing significant adversity, if they actively and intensively help the adults who care for young children to acquire and practice specific capabilities that are linked to explicit child outcomes.[199] With this goal in mind, a variety of program models demonstrate how the skills needed for specific contexts or population groups can be built most effectively.

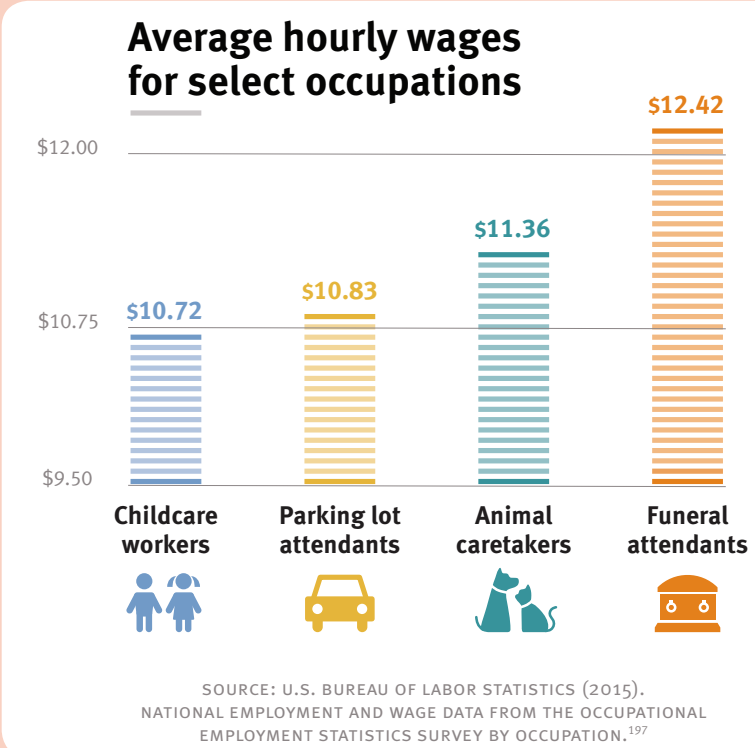
- *Programs that support parents.* In programs that demonstrate the largest benefits, staff members establish a trusting relationship with caregivers and support them in their ability to engage in successful parenting. Other characteristics associated with positive impacts on child learning and socio-emotional development in home visiting programs include:
    - structured, pre-service training for staff;
    - specified visit content or curricula;
    - standards for visit frequency, staff supervision, and implementation; and
    - a system to monitor adherence or fidelity to the program model.[116,117]

  Programs that attempt to address a wide range of client needs without sufficient expertise show small and inconsistent impacts at best. Guided activities and coaching designed to promote responsive, contingent, serve and return interactions have been effective in reducing the adverse effects of maltreatment and family conflict on child development.[118,119]
- *Professional development for teachers and caregivers.* Effective training provides opportunities for individualized observation and feedback *paired with* a curriculum providing a sequence of activities tailored to a specific developmental period and domain of skills.[120-122] Because adult learning occurs best through real-time observation, active modeling, and feedback within a trusting relationship, the ongoing availability of an on-site mentor is likely to both improve skills and reduce some of the isolation and stress that is characteristic of classroom teaching, particularly in preschools serving low-income communities.[123-129]
- *Parent engagement in center-based services.* Preschools that provide more intensive, parent-focused activities (through one or more home visits per month and a structured curriculum) achieve significantly higher impacts on children's cognitive development than those that provide modest levels of participation.

Interventions that facilitate active modeling and practice for parents may lead to even greater child effects. In contrast, there is little evidence that a short course of parenting classes or one or two home visits per year produce measurable gains in child cognitive or pre-academic skills above and beyond the effects of a preschool program alone.[130]

- *Programs for caregivers of children with challenging behavior.* Teaching mothers and fathers of young children how to reward and attend to their child's positive actions, while providing consistent, non-abusive limit-setting to address problematic patterns, has been shown to be highly effective at improving parent-child interaction and reducing children's disruptive behavior.[131-133] Often called "parent management training," effective programs of this type provide opportunities for parents to observe these skills in action as well as to practice and refine them.[134-138] With respect to early childhood educators, a recent meta-analytic study found that programs that implemented curricula focused explicitly on social and emotional development demonstrated positive effects, with increasing levels of specificity and intensity associated with larger impacts on reducing externalizing behavior problems.[139]

Beyond providing effective training for early childhood program staff, the challenge of recruiting and retaining skilled professionals—whether they work with children, parents, or both—is made considerably more difficult by exceptionally low rates of compensation. For example, a recent national study reported that child care providers are among the lowest paid workers in the labor market, and those working with children below age 3 are paid about 70 percent of the wages of those who work with children from ages 3 to 5.[140] In 2012, 46 percent of child care workers and their families (compared with 25 percent of the total U.S. workforce) were



Despite what science tells us about the critical role that caregivers play in a child's early development, the value that society places on childcare workers tells a different story. Not only do childcare workers receive low wages, but they also are paid on average less per hour than people who collect our money at a parking garage, walk our dogs, or greet people attending a funeral.

enrolled in at least one of the four public support programs available for low-income families.[140]

#2: Match Interventions to Sources of Significant Stress

Reducing or eliminating serious adversities in the lives of children and families is the best way to prevent the negative effects of stress on development. The greatest impacts on the largest number of people would thus be achieved by successfully targeted efforts, at a community or societal level, that focus on mitigating the effects of poverty, violence, discrimination, and other threats to well-being. On an individual basis (which is how most early childhood programs are organized), greater impacts are more likely when services build on existing resources and strengths, address identified needs, promote warm and responsive caregiving, and strengthen the ability of parents and other caregivers to scaffold the development of young children's adaptive capabilities. The following examples illustrate the importance of a diversified portfolio of intervention strategies that has the capacity to address the varied challenges facing families with young children.

- *Families dealing with the burdens of poverty.* Decades of research have shown a powerful correlation between family poverty and a range of poor outcomes in life, including reductions in school achievement, high-school graduation, college attendance and graduation, and lifetime income, as well as an increased likelihood of incarceration, lifelong impairments in physical and mental health, and premature death.[141] More recently, research has shown that it is not simply the presence of financial hardship that affects children's outcomes, but that it may possibly be more a matter of the *timing* in the life of the child. For some long-term outcomes, particularly those related to cognitive development and achievement skills, poverty in the early years may be especially harmful.[142] Thus, policies and programs that help alleviate poverty (e.g., Earned Income Tax Credit, parent job training, debt reduction, and financial literacy) while children are youngest may have the greatest impact on their development.
- *Children with special needs.* Intensive early intervention services for infants and toddlers with developmental delays or disabilities can improve psychomotor, cognitive, and social skills, produce higher school achievement, facilitate greater independence, and promote positive family adaptation and well-being.[14] Best practices in this arena enhance child skill development, support parent-child relationships, and strengthen family adaptation as the core elements of effective intervention.[143] Beyond the current landscape of developmental services for children and supports for their families, intensive research being conducted on the underlying biology of neurodevelopmental impairments such as autism, Down syndrome, and multiple metabolic disorders underscores the possibility that dramatic breakthroughs in medical treatments for some children with developmental disabilities may lie just over the horizon.
- *Parents and other caregivers with mental health problems.* Intensive clinical interventions and support programs offer promising opportunities to mitigate the impacts of adult mental illness on child well-being. Children of mothers with chronic depression, for example, are most likely to benefit from services that focus on both treating the mother's primary illness and strengthening her responsiveness to her child. Extensive evidence also indicates that many adults who experience depression often face other significant adversities. This is particularly true for mothers who are young, socially isolated, economically or educationally disadvantaged, and burdened by

family conflict, intimate partner violence, and/or poor health. When co-existing difficulties are detected, treatment strategies must address those concerns as well as the underlying mental health problem. It's also important to note that, despite growing recognition of compromised fathering as a public health issue, very few programs in the early childhood arena have sufficient expertise to address mental health problems or substance abuse in fathers—and new intervention strategies are clearly needed.

- *Child maltreatment.* Interventions that promote responsive, serve and return interactions by parents and foster parents have been effective in reducing the adverse effects of abuse and neglect, as well as family conflict, on the development of vulnerable, young children. Individualized coaching is especially effective if it increases parents' awareness of specific child behaviors and encourages the use of praise and nonviolent disciplinary strategies. For young children in foster care, interventions that focus on promoting warm and responsive caregiving, predictable parenting, and positive reinforcement of good behavior lead to more secure attachment, reduced rates of behavior problems, lower numbers of movement from one home to another, and greater likelihood of permanent placements.[144-146]
- *Parental substance abuse.* Among its many adverse consequences, the excessive use of alcohol or mood-altering drugs is associated with an exceedingly high risk for poor parenting practices.[147] Inconsistent responsiveness from their primary caregiver, particularly during the infant-toddler period, increases the risk for exposed children to exhibit impaired attachment, reduced responsiveness to others, and diminished adaptability. Parenting therapy combined with outpatient substance-abuse treatment has been shown to increase mothers' understanding of how their emotions can influence their behavior, which can then affect their interaction with their child and his or her development.[148]
- *Intimate partner violence in the home.* Despite its prevalence and potential harm, violence in the family has received relatively little attention in early childhood policies and programs. Recent estimates indicate that more than 17 percent of children have been exposed to family violence in the first five years after birth.[149] Science clearly indicates the disruptive effects that recurrent exposure to violence can have on early childhood development and lifelong health. The limited availability of evidence-based programs to address this serious, time-sensitive problem should be a clarion call to develop more effective approaches.

Interventions that promote responsive, serve and return interactions by parents and foster parents have been effective in reducing the adverse effects of abuse and neglect, as well as family conflict.

#3: Support the Health and Nutrition of Children and Mothers Before, During, and After Pregnancy

The foundations of lifelong health begin with the well-being of the future mother before she becomes pregnant. Preventive health care for pregnant women and their young children is essential for supporting physical, emotional, and cognitive development in the early childhood years. The architecture of the developing brain *in utero* can be affected by health problems in the mother, poor maternal nutrition, exposure to a variety of toxic substances (including alcohol, cocaine, and environmental neurotoxins such as organophosphate pesticides, mercury, and lead), and the adverse physiological effects of persistently

excessive levels of maternal stress. High-quality prenatal care can identify many of these threats to later health and development, and preventive services can be provided as needed. After birth, the continuing association between a mother's health and the well-being of her children calls for more effective mechanisms for coordinating medical services for all family members. Automatic insurance coverage for parent-child intervention linked to reimbursement for the treatment of maternal depression is one of many examples.

Appropriately targeted assistance can also assure that the nutritional needs of young children are met, thereby promoting healthy brain development as well as overall physical and mental well-being. The U.S. Supplemental Nutrition Program for Women, Infants, and Children (WIC) is a well-established service that targets pregnant and lactating women and children up to age 5 by providing vouchers for food purchases and strengthening knowledge and skills through health education and nutrition counseling, including the promotion of breastfeeding. Multiple studies indicate that participation in WIC can reduce the chances of low birth weight[150-147] and improve children's intake of iron, folate, and vitamin B-6,[153] with additional evidence that it prevents iron deficiency anemia among infants in low-income households.[154,155]

Even more important is the need for more effective, preventive interventions at the community level to reduce stress-inducing burdens on families that are beyond the capacity of the medical care system alone to address.

Although recent expansions in health insurance coverage in the United States have improved access to needed medical services, persistent racial, ethnic, and socioeconomic disparities in low birth weight, infant mortality rates, and many chronic diseases remain a serious challenge.[156] The fact that social class gradients in physical and mental health are also found in countries that provide universal access to medical care underscores the need for more effective strategies beyond the health care system. In 2012, the American Academy of Pediatrics (AAP) acknowledged the limits of clinical practice alone in a technical report[9] on toxic stress and a policy statement on the role of the pediatrician, which included the following call to action: "Because the early roots or distal precipitants of problems in both learning and health typically lie beyond the walls of the medical office or hospital setting, the boundaries of pediatric concern must move beyond the acute medical care of children and expand into the larger ecology of the community, state, and society.… there is a compelling need for bold, new thinking to translate advances in developmental science into more effective interventions."[157]

Many thought leaders in the early childhood arena point to primary health care as the most appropriate point of entry for a universally available, prevention-oriented system for promoting the development of young children and providing trusted information and support for their parents. That said, even the core objective of achieving full compliance on the basic AAP schedule for immunizations and well-child visits continues to be an elusive goal for many children. With appropriate training and incentives, however, a skilled and motivated team based in a "medical home" could play a more effective, coordinating role in dealing with the more complex challenges of developmental surveillance, early detection of concerns, and prompt referral to community-based services—a role that is not currently fulfilled successfully by most primary care settings.[158,159]

The range of current performance in these domains is broad. At one end of the spectrum, fewer than half of the pediatric practices in the United States include regular, standardized, developmental screening as a consistent part of routine primary care in the first 36 months after birth.[160] At the other end, a growing number are

incorporating a variety of developmentally oriented services that: (1) promote early reading and distribute books during office visits (e.g., Reach Out and Read);[161] (2) facilitate early detection and connections to community-based services for developmental concerns (e.g., Help Me Grow);[162] (3) use videotape coaching to promote positive parent-child interactions (e.g., Video Interaction Project);[163] (4) provide guidance on managing behavior problems in young children (e.g., Triple P Positive Parenting Program);[128] and (5) offer a range of integrated behavioral health services within the primary care setting (e.g., Healthy Steps).[164] The reported benefits of these programs include high levels of parent satisfaction, increased participation in well-child visits, modest changes in parenting behaviors, and variable effects on child outcomes. The inconsistent nature and magnitude of the child impacts, however, underscore the need for new strategies in the health care setting to fully address the diversity of challenges facing families with young children. Even more important is the need for more effective, preventive interventions at the community level to reduce stress-inducing burdens on families (i.e., the social determinants of health) that are beyond the capacity of the medical care system alone to address.

#4: Improve the Quality of the Broader Caregiving Environment

Whether it is home-based or center-based, the structural and interpersonal features of the regular, non-parental care received by young children can help assure their healthy development. Extensive research shows that family and community influences can produce a wide range of positive life outcomes if they provide safety, stability, and frequent, responsive interactions with caregivers in a language-rich context. High-quality caregiving in the early childhood period that is stable and responsive has a greater impact on child outcomes than where that care is provided. That said, the quality of out-of-home child care in the United States is highly variable, with lower quality most frequently experienced by children in families living on lower incomes.

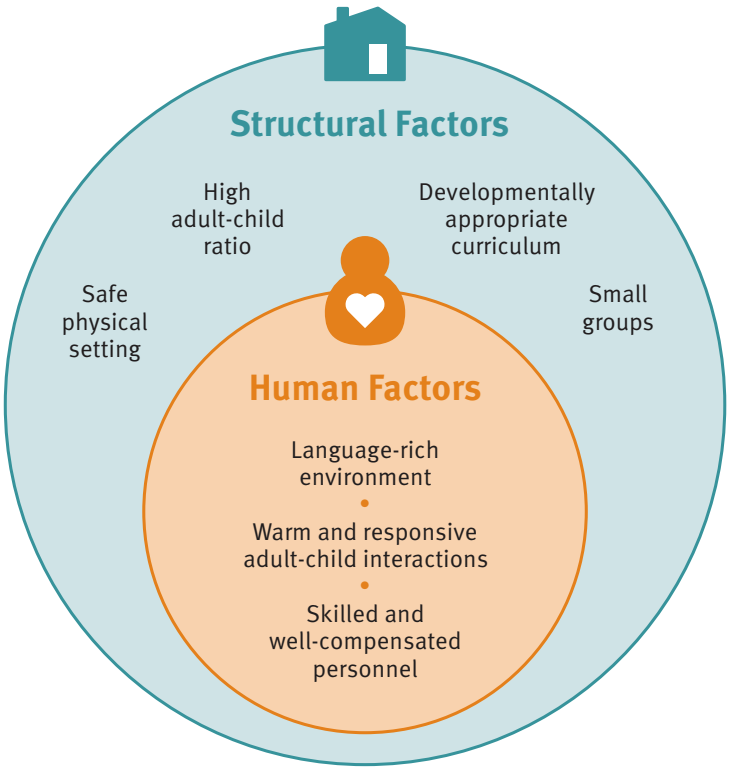
Science and program evaluation research both point to key effectiveness factors for high-quality child care. These include the following:

- a language-rich environment, with warm and responsive serve and return interactions, which builds both receptive and expressive language and interpersonal skills; and
- structural factors, such as a safe physical setting, small group sizes, and high ratios of adults to children, which support more responsive interactions and more effective instruction.

High-quality caregiving in the early childhood period that is stable and responsive has a greater impact on child outcomes than where that care is provided.

Given that the majority of 3- and 4-year-old children in the United States (and increasing numbers of 2-year-olds and younger) participate in early care and education programs,[165] ensuring that all settings adhere to these effectiveness factors is critical for all policies and practices that affect the well-being of the next generation. That said, arrangements for non-parental care of children vary greatly, particularly in the first three years of life. These include variations in setting (centers vs. family, friends, and neighbors vs. non-family, home-based care), type of funding (public vs. private; for-profit vs. not-for-profit), and quality (measured by both structural factors and caregiver attributes/skills). For children facing significant adversity, the negative impacts of low-quality care and the positive impacts of high-quality care can be magnified. In view of extensive evidence indicating the potential therapeutic importance of high-quality child care for children experiencing excessive levels of stress, the persistence of poor-quality options for many families with limited

Effectiveness Factors for Early Care and Education Programs



SOURCE: CENTER ON THE DEVELOPING CHILD (2007). A SCIENCE-BASED FRAMEWORK FOR EARLY CHILDHOOD POLICY.[75] WWW.DEVELOPINGCHILD.HARVARD.EDU

resources is sobering and has long led to calls for improvement.[14]

The fact that all young children in the U.S. military's child care system benefit from high-quality learning experiences provided by well-compensated staff demonstrates what can be accomplished if quality standards are established, enforced, and financed.[166] In 2015, 96 percent of the military's child development centers met professional standards of quality equivalent to those of the National Association for the Education of Young Children (NAEYC).[167] Across the 50 states, the rate of NAEYC-accredited centers is 6.3 percent.[168]

Despite the increasing efforts of state systems and federal requirements to raise minimum standards and provide technical assistance for quality improvement, many challenges remain. A state-by-state patchwork of inconsistent regulations setting minimum standards for child care in the United States leaves many family-based care providers without enforceable guidelines for quality and safety. Quality Rating Improvement Systems (QRIS) are another approach now in use (or being planned) by nearly every state. These systems assign providers a rating along a quality continuum, make the ratings available to parents, and often provide a range of technical assistance, resources, and incentives intended to help programs improve. Despite their promise for enhancing the availability and accessibility of high-quality child care, there is still no consistent

evidence that higher QRIS ratings for preschool programs are associated with better child outcomes.[169] In response to this situation, the federal Race to the Top Early Learning Challenge grants specified that research be undertaken to study the validity of the tools used for rating quality.[170]

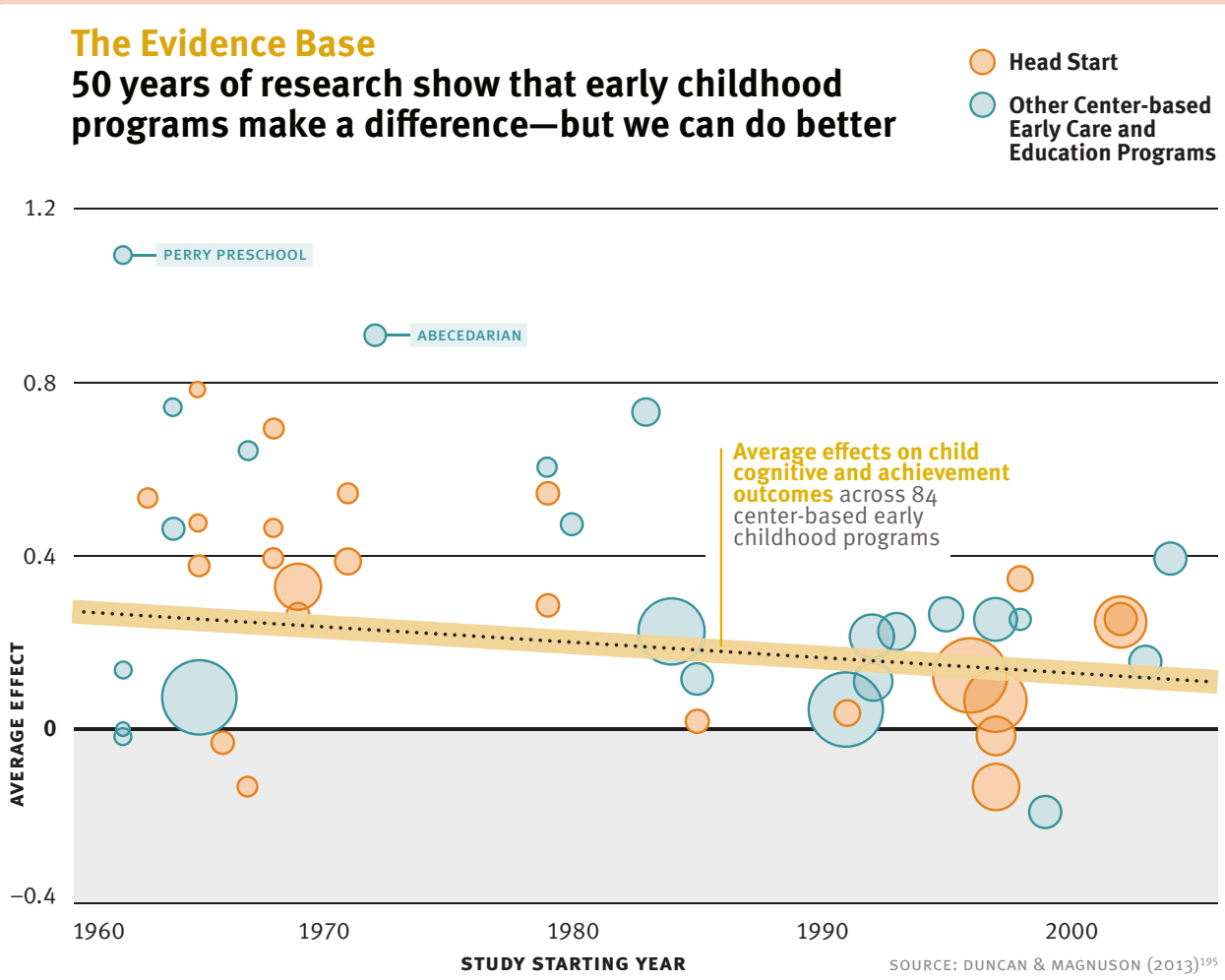
Science and common sense both point to the clear need for a baseline level of quality child care, yet efforts to improve quality also typically increase costs. Moreover, research has shown that the higher costs associated with higher-quality, regulated care can push disadvantaged families into opting for lower-quality, unregulated care, particularly in the absence of financial support that makes such care affordable for those whose low wages constrain their eligibility for subsidies.[171] Because children from economically insecure families experience far greater variations in the quality of the child care they receive compared to children from families with more financial assets, increasing the former group's access to high-quality care is clearly needed.[172,173] At the same time, programs already operating at high levels of quality must be encouraged to generate and test new approaches for children who are not benefiting from existing services.

#5: Establish Clear Goals and Appropriately Targeted Curricula

Programs for young children, parents, or other caregivers are all most effective when they specify clearly defined goals and implement a curriculum or intervention plan that is designed to achieve those goals. The most successful are guided by curricula that provide age-appropriate, engaging activities focused explicitly on identified outcomes. Curricula that do not target specific outcomes are less likely to have significant impact on anything than those that are designed and implemented with clearly articulated goals in mind. Different capabilities (e.g., cognitive and social skills) and areas of achievement (e.g., reading and math) require different kinds of scaffolding at different ages, so effective learning activities are cumulative and sequenced to align with children's developmental stages. For example, letter recognition might begin with children recognizing the letter that starts their own names, followed by actually naming other letters and identifying them in simple words.[174]

Because children from economically insecure families experience far greater variations in the quality of the child care they receive compared to children from families with more financial assets, increasing the former group's access to high-quality care is clearly needed.

Beyond the selection of a specific curriculum, articulating a theory of change—identifying intended outcomes and the underlying capacities or mechanisms on which those outcomes rest—presents a promising yet underutilized approach. When an explicit theory of change leads to carefully targeted impacts, the effects are more likely to be consistent, replicable, and scalable. One prominent example is the model introduced by the Nurse Family Partnership (NFP), which provides home visits by trained nurses starting in the second trimester of pregnancy and continuing to the child's second birthday.[175] NFP has demonstrated significant impacts on many of its targeted outcomes—for example, health care utilization by infants and life course improvements for mothers such as reduced use of government assistance and increased employment.[176-183] However, longer-term follow-up studies have shown a mixed pattern of effects on outcomes that are linked more indirectly to NFP's theory of change, such as child behavior, cognitive development, and later school achievement.[182,184] Given the findings of 50 years of program evaluation data across the full early childhood landscape, it would be unrealistic to expect robust impacts on the school achievement of children facing adversity from an intervention that stops at age 2 and does not specifically target foundational preschool skills.



This meta-analysis of 84 well-designed studies (with bubble size reflecting relative sample size) shows that children who received center-based early childhood services did better than control groups at the time of program completion by an average of about two months of additional learning across cognitive, reading, and math skills. The slight downward trend over time may very well reflect an increase in services received by the control groups rather than a decrease in program effectiveness, but the wide disparity in results for different interventions also indicates the need to better understand why and who benefitted the most (and the least).

NFP's meticulous attention to the details of program implementation and the measurement of explicit outcomes has enabled it to successfully scale program elements that have been effective and seek new approaches for targets that were not reached. Pregnant women and first-time mothers who are struggling with depression or intimate partner violence are two examples of the kinds of challenges that NFP is now targeting for enhanced strategies as it is being scaled for larger and more diverse populations.[185]

Best Practice as a Starting Point, Not the Destination

The five core principles described in this chapter can guide improvements in the quality of a wide array of early childhood policies and programs that have evolved in the United States over the past half-century. These programs typically fall within the following four tiers of investment:

- Universal services for all children and their families (e.g., prenatal care for pregnant women, primary health care for children and parents, and full access to preschool education in some states);
- Broad-based programs serving families across the socioeconomic spectrum (e.g., child care, services for children with special needs, and preschool programs with variable degrees of access);
- Targeted supports for families with low levels of education and income (e.g., parenting education and coaching, programs for infants and toddlers, financial supports, services to promote economic self-sufficiency, and nutritional assistance); and
- Intensive interventions for young children and families at high risk for experiencing toxic stress (e.g., specialized services to reduce, prevent, or mitigate the adverse effects of child maltreatment, mental health problems in parents and caregivers, parental substance abuse, and/or exposure to intimate partner violence in the home).

The rationale for these four levels of investment is strong, but the evidence base for their effectiveness reveals relatively large, long-term benefits in some domains and much smaller or mixed effects in others. The well-documented impacts of model programs include multiple long-term outcomes with high policy salience, such as higher educational attainment, fewer unplanned pregnancies, increased economic productivity, and reduced criminal behavior.[14,189,190] However, the quality of implementation when programs are replicated has been highly variable, and the magnitude of significant impacts in scaled-up programs (when they have been documented) has remained small to moderate over the past several decades.

Determining the appropriate mix of strategies to capitalize on existing strengths and address specific needs is one of the most compelling challenges facing the early childhood field.

Science tells us, and the future of our nation demands, that we can and must do better. This is particularly true for children in the first three years after birth and for families whose needs are not being met by existing policies and services. Effective interventions require resources and expertise that match the challenges they are asked to address. Different precipitants of toxic stress require different responses from a variety of systems. Some challenges can be addressed effectively through direct services for children and families. Many others require more robust, community-level and/or broad-based societal approaches. Some answers lie in the private and voluntary sectors. Others require government intervention. Determining the appropriate mix of strategies to capitalize on existing strengths and address specific needs is one of the most compelling challenges facing the early childhood field.

R&D: Program Evaluation

New Directions in Understanding Program Effectiveness

Studies of early childhood programs in the United States over the last half-century have typically shown a wide variety of impacts that have confounded attempts to draw clear conclusions about their overall effectiveness. Solving the puzzle of variable impacts begins with an understanding of the significant diversity among children and families, and the varied challenges that they face. For example:

- Some toddlers have difficulties in attention and self-regulation that would be challenging for all parents and the most skilled professionals to manage.
- Some parents have more difficulties than others with the serve and return interactions that are essential for promoting early learning and protecting young children from adversity.
- Some families cope remarkably well with the stresses of economic instability. Others (at all income levels) are faced with overwhelming burdens from intimate partner conflict or violence, substance abuse, or mental health problems, each of which requires specialized intervention.[186]

Above and beyond the marked diversity of resources, goals, and needs among all families with young children, individual differences in program participants are frequently acknowledged but rarely studied in terms of how children (and adults) with different strengths and vulnerabilities respond to different aspects of specific interventions. The general question of whether a program "works" on average has guided policy decisions for decades, but achieving greater impact requires that we focus more explicitly on two critical questions that have not been asked with sufficient rigor—who benefitted most from a specific intervention and who benefitted least or not at all? This charge is not new, but a coherent or consistent pattern of findings has yet to emerge, and the absence of a unifying conceptual explanation leaves most policies and programs without a clear theory of change for improving their outcomes.

Early Head Start (EHS) is an excellent case in point. As the largest existing system of services for disadvantaged infants and toddlers in the United States, EHS provides an immensely valuable infrastructure for designing, testing, and scaling a variety of new approaches for a highly diverse population. Yet research on EHS to date has yielded little clarity on its essential features or replicable impacts, and few lessons have been articulated for improving its effectiveness. Moreover, an extensive body of data from its seminal impact study is of limited value because relatively few EHS participants actually received all of the services intended. For example, the majority of families started the program at a variety of ages after the birth of their child rather than prenatally as originally intended. The search for impacts on subgroups of EHS participants has focused on broad-based family groupings (race/ethnicity and demographic risk) and generic program categories (home-based, center-based, and mixed approaches), but not on baseline child capacities (e.g., attention or self-regulation) or parent characteristics (e.g., interactional skills with their young child) that are much more likely to affect their response to intervention. The net result of these numerous shortcomings is a growing literature on EHS that includes reports on a wide variety of small effects on multiple child and family variables over time, but no clear or consistent patterns or theories to explain the observed variation.[187,188]

This problem is not at all unique to Early Head Start and has, in fact, been found across almost all evaluations of early intervention programs for disadvantaged infants and toddlers for more than 50 years. The practice of focusing solely on the identification of positive outcomes averaged across all program participants has resulted in three missed opportunities. First, conferring "evidence-based" status on programs that found statistically significant mean effects between treatment and control groups undervalues the critical importance of identifying particularly large (or no) impacts on selected subpopulations. Second, the failure to thoroughly analyze null findings undermines an essential element of building a rich knowledge base and limits an important source of new ideas. Third, designing program evaluation studies without specifying a precise theory of change makes it exceedingly difficult to figure out why a program works better for some than for others, which is essential to effective scaling across a variety of contexts and service-delivery systems.

The quest for significantly larger impacts could be strengthened by leveraging advances in scientific knowledge to guide the design, testing, and scaling of a diversified portfolio of well-defined services that are matched to available resources, identified needs, and specific outcomes for different groups of children and families in this age period. Rather than complicate the decision-making process, a greater focus on subgroup differences could generate promising hypotheses and innovative approaches to unaddressed or under-addressed threats to healthy development.

Creating an R&D Engine to Produce Breakthrough Impacts at Scale

3

The rapidly moving frontiers of discovery in neuroscience, molecular biology, and epigenetics offer a remarkable opportunity to catalyze enhanced theories of change and innovative strategies to reduce the consequences of adversity early in life. As this knowledge continues to grow, the development, implementation, and scaling of policies and programs that produce much larger effects on key outcomes of interest must expand accordingly.

This goal of game-changing impacts has striking precedent. In the 1920s, AT&T created a visionary R&D division to drive a nascent telecommunications industry. That department, Bell Laboratories, created an atmosphere of innovation that produced some of the most influential new technologies of the 20th century, including the transistor, solar panel, laser, and multiple programming languages. Bell Labs inspired and influenced multiple generations of leaders in the field, seeding new ideas and developing products and systems that galvanized the modern computer era. The time has come to build a comparable R&D platform to catalyze a new era in early childhood policy and practice—driven by a new way of thinking fueled by advances in science and a new way of working that embraces the culture of innovation.

This chapter provides an action plan for how an R&D mindset could be harnessed to develop and test new ideas, share learning, and build on both successes and failures—all in the service of achieving breakthrough outcomes at scale for children facing adversity. We do not presume this to be the only way to innovate, nor is it a highly prescriptive model that has stood the test of time. It does, however, provide an initial framework for mobilizing the power of scientific precision in theory, practice, and measurement.

There are few examples in the early childhood field that bring together the best approaches from the world of for-profit innovation with expertise in developmental science, effective engagement with community partners, and pragmatic understanding of program implementation and management of complex systems. Shared learning about what did *not* work and iterating programs in response to rapid-cycle evaluation are new concepts for the early childhood arena. Using a common science base to drive cross-sector collaboration and the co-creation of new strategies is exceedingly rare, at best.

History teaches us that the greatest innovations often come not from brainstorms in isolation, but from connecting existing ideas in new ways.[191] This chapter offers a preliminary road map for a relatively uncharted journey whose detailed pathways will be marked out and refined over time. This is an invitation to an audience of highly motivated change agents across a diversity of disciplines, sectors, and communities to find a place on the map and join us in filling a niche that is missing in the early childhood field—a science-based R&D platform.

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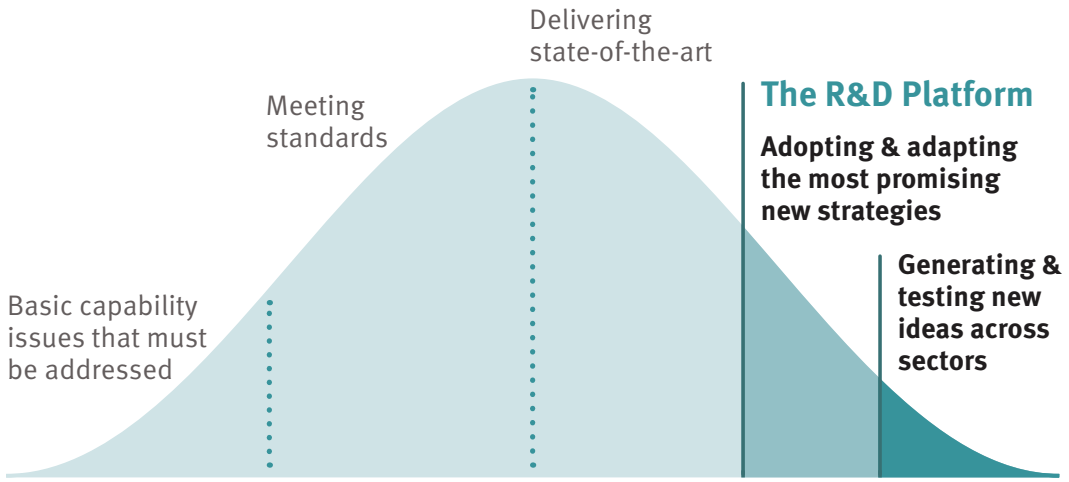
Complementing other important work that is currently being done in the domains of quality improvement, staff development, and system building, this joint effort is intended to change the early childhood landscape by stimulating new ways of thinking and working. This document outlines some core ideas to help spur and guide such an effort. Our aim is to leverage science to inform a more diversified portfolio of investments in young children and families that produces substantially larger impacts at scale than previously achieved to date.

Filling the Missing Niche



SOURCE: CENTER ON THE DEVELOPING CHILD (2016), ADAPTED FROM EVERETT ROGERS, DIFFUSION OF INNOVATIONS (2003).[198]

Science as a New Way of Thinking

In a field guided largely by research on child development and program evaluation, a deeper understanding of the impacts of early experiences on the developing brain and multiple biological and bio-behavioral functions offers a tremendous opportunity to formulate and test new ideas. Science tells us that stable and supportive relationships, language-rich environments, and mutually responsive, serve and return interactions with adults promote healthy brain architecture. Science also tells us that excessive or prolonged activation of the body's stress response can weaken brain circuits and disrupt developing cardiovascular, immunological, and metabolic regulatory systems. Consequently, under conditions of significant adversity, parents and other caregivers play a critical, protective role by providing positive learning experiences, buffering young children from the stresses of hardship or threat, and scaffolding the early development of adaptive skills that are the building blocks of resilience.

These well-established concepts (as described in chapter one) suggest three fundamental shifts in the thinking that informs most current policies and programs focused on young children:

Early experiences affect lifelong physical and mental health, not just learning. In a policy environment where school readiness and educational outcomes are the primary focus of most early childhood programs, science clearly calls for additional attention to early influences on the foundations of health and the origins of stress-related disease across the lifespan. Conventional measures of immunization status, vision and hearing screenings, utilization of dental care, and identification of a "medical home" are appropriate metrics for monitoring access to health services, but they are insufficient indicators of whether children are developing strong foundations for lifelong physical and mental health.

Healthy brain development requires protection from excessive stress, not just enrichment in a stimulating environment. In an early care and education context that focuses on stimulating language development, promoting age-appropriate learning opportunities, and

providing parenting education, science points to the critical need to also prevent or mitigate the disruptive effects of toxic stress on brain circuits that affect emerging capacities in cognitive, emotional, and social development. Children whose brain development is compromised by the consequences of excessive stress-system activation are less able to benefit from enriched learning experiences.

Achieving breakthrough outcomes for children experiencing significant adversity requires that we support the adults who care for them to transform their own lives. In a field that continues to search for effective strategies to promote meaningful parent engagement in child-focused programs, approaches that strengthen adult capacities through mentoring and coaching (not simply providing information and support) offer a promising strategy for working with parents whose skills and behaviors are constrained by the consequences of their own adverse life experiences. Many professional caregivers and teachers would also benefit from active training that helps them improve these essential capacities. Science points to the particular importance of self-regulation and executive function skills as core adult capabilities that are foundational for employability and responsible citizenship, as well as for the ability to provide a stable, well organized, and responsive environment in which children can thrive.[97] Strengthening community resources that reduce precipitants of toxic stress and building the essential supports and social capital needed by all families and professional caregivers are also vital catalysts for transformational change in the face of poverty, violence, racism, and other forms of social disadvantage.

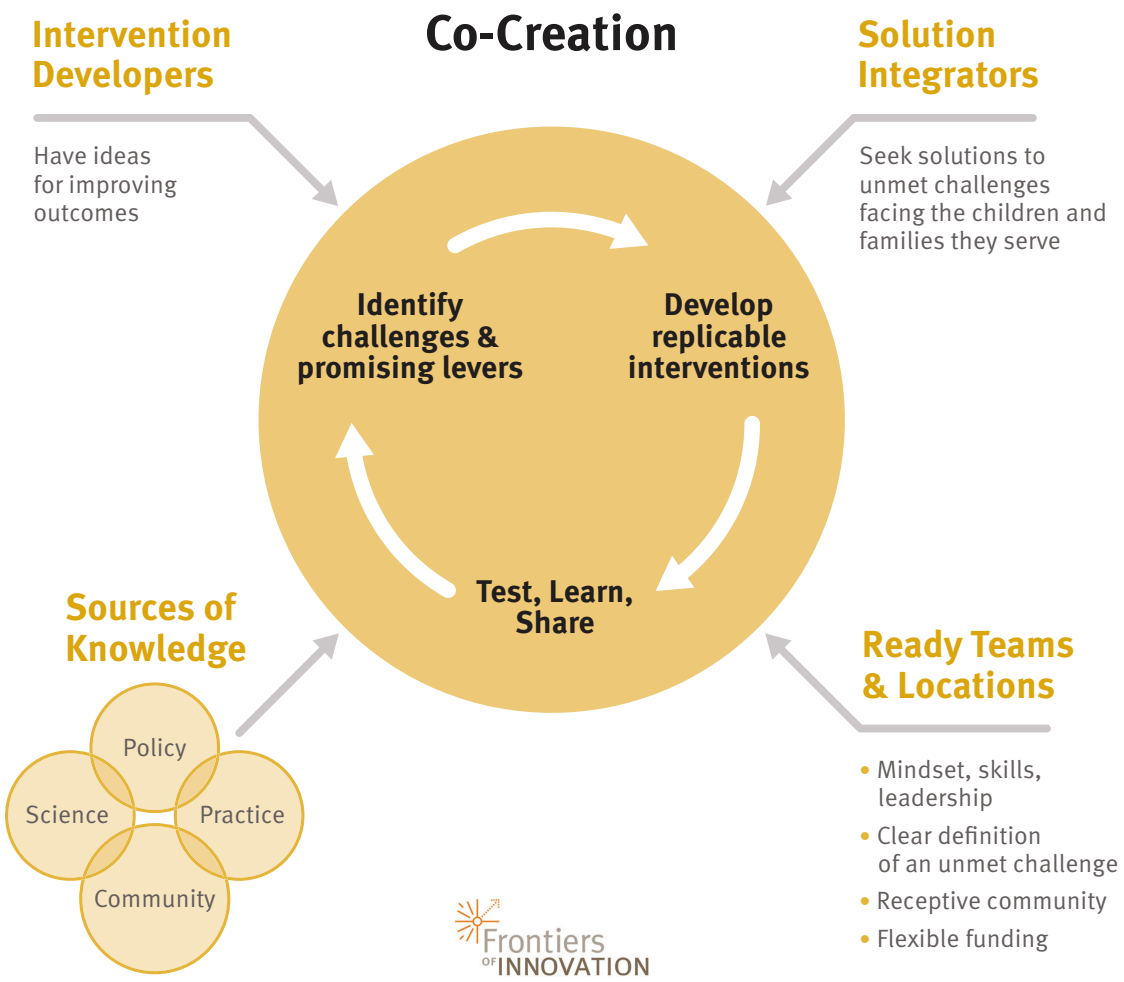
These paradigm shifts point toward novel strategies to be tested and a potential framework for a new era in early childhood policy and practice. Looking ahead, several areas of active scientific investigation—such as research on plasticity and critical periods, vulnerability and resilience, and the measurement of toxic stress effects—are generating a wealth of new knowledge that could be used to inform testable hypotheses about the optimal timing of interventions, the appropriate matching of services to individual needs, and the investigation of why specific approaches have large impacts on some children and little or no effects on others (see sidebar on page 18). Simply having new knowledge, however, does not ensure improved outcomes at a population level. Substantially greater impacts will require changes in the way we design, test, evaluate, and scale promising, new strategies.[192]

Innovation as a New Way of Working

Quality improvement in service delivery and system-building investments alone, while clearly essential, are unlikely to produce breakthrough outcomes for young children who face the cumulative burdens of low family income, limited parent education, recurrent exposure to violence, and/or social exclusion related to racial and ethnic discrimination. While most practitioners and policymakers in the field today are focusing on strengthening existing programs and serving more children, a new cohort of change agents is needed to design and test new ideas. Successful leaders in other fields (e.g., technology, medicine, business, and the military) all maintain a comparative advantage by investing in R&D at the leading edge of innovation in the world in which they work. That same mindset must be incorporated into the policies and interventions that address the needs of young children and their families—from early learning and primary health care to the domains of public health, child welfare, poverty reduction, mental health, community development, and criminal justice.

A Co-Creation Model for Designing and Testing New Program Strategies

Generating, implementing, and evaluating new ideas in the early childhood arena is most effective when it results from an active co-creation process that combines multiple domains of knowledge, expertise, and experience. These domains include:



SOURCE: CENTER ON THE DEVELOPING CHILD (2016). WWW.DEVELOPINGCHILD.HARVARD.EDU

- *Science* that offers relevant contributions from a range of fields, including developmental and social psychology, neurobiology, behavioral and labor economics, and implementation science, among many others.
- *Practice* that is grounded in a pragmatic understanding of what it takes to design and implement specific strategies with identified program participants in particular contexts.
- *Community* that brings the expertise, wisdom, goals, and values of local leaders and parents who understand best what kind of resources and supports are needed.
- *Policy* that assures a focus on scalability, sustainability, the balance between costs and benefits, and how to generate system-level support for promising innovations.

A productive innovation process brings together people who generate strategies to achieve specified outcomes ("intervention developers") with partners who identify specific goals, gaps, and promising levers and seek new ideas to address them ("solution integrators"). When these roles converge in teams and settings that have the mindset, skills, leadership, and sufficiently flexible funding to design and test new strategies, the conditions are in place for breakthrough impact.

The creative process described in the following sections builds on rigorous methods that have been utilized by intervention and prevention researchers for decades. The essence of this approach is embodied in a continuous cycle

linking theory, practice, and research. The process may begin in any one of these three areas and then extend to the others. For example, a community agency and the parents it serves may set a goal of improving the self-regulation of young children in child care settings. Through partnering with a research team, they may choose to focus on specific aspects of the child-rearing environment (such as unpredictability or disorganization) that may be contributing to their concern. This could then lead to the joint formulation of a theory about the development of self-regulation skills and the design of a strategy focused on increasing the predictability of daily routines in the home and/or center-based program setting. The effectiveness of the proposed strategy could then be explored through a carefully designed and implemented pilot test.

As the co-creation team modifies the intervention through a succession of feasibility and efficacy trials, emerging evidence of its effectiveness for specific subgroups of children and families can inform a cost-effective scaling strategy through programs that serve children with similar characteristics. The key to progress is not whether the starting point is located in the domain of research, theory, or practice (at the community or policy level), but whether all three activities are highly interactive and focused together on defining objectives, measuring outcomes, and understanding why specific approaches do or do not work.

Precision in Intervention Definition and Measurement

The ultimate success of a child-centered or adult-focused program in achieving population-level impact depends upon the ability to learn what works (and doesn't) for whom, when, in what context(s)—and why. This degree of specificity requires a precise theory of change, well-defined intervention materials that are tied explicitly to the targets defined there, and an evaluation plan that maps directly onto the theory of change. Within this model, a precisely defined theory of change has the following attributes:

- It can generate testable hypotheses about how changes in target domains (e.g., self-regulation or attention) that result from a specific intervention will lead to explicit, pre-defined outcomes. *This allows project teams to clearly determine* ***what works****—and which specific components of a program are its active ingredients.*
- It specifies salient characteristics of the individuals involved in the intervention (e.g., parents, service providers, and children) beyond the usual reliance on standard variables such as race, family income, parent's education level, or whether a program is home-based or located in a center. These more meaningful characteristics that might be associated with variations in a program's effectiveness could include a child's attention skills, a parent's mental health status, or a teacher's knowledge of child development. *This allows project teams to clearly identify* ***for whom*** *an intervention works—and for whom it does not work.*

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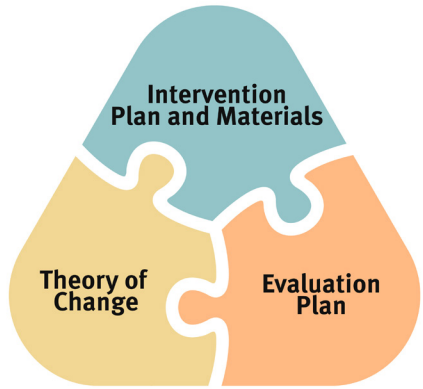
- It identifies measurable capacities needed by the recipients of the program or service to achieve the intended outcomes. For example, a co-created intervention designed to increase a parent's responsiveness to a child may be based on a theory that improving adult executive function and self-regulation skills will facilitate greater responsiveness, which will then promote the child's socio-emotional development. *This allows project teams to clearly identify* ***how*** *an intervention works—which is essential for making continuous improvements and adjustments.*

The precision of a testable theory of change is also reflected in the following two additional elements that are key components of a replicable intervention strategy:

- An implementation plan and accompanying intervention materials (manuals, participant handouts, web-based instructional media, etc.) that are tied to explicitly defined target domains.
- An evaluation plan for the rigorous measurement of intervention target domains, outcomes, and the underlying core capacities that are expected to change.



The ultimate value of this approach to intervention planning and evaluation will be determined by *how much is learned* about the actual impacts of the intervention and not whether evidence is produced to *prove that it was effective on average.* This learning can then be applied to refining the theory of change, identifying the active ingredients of the intervention, and modifying selected aspects as new insights are achieved.

A Rapid-Cycle, Iterative Process for Evaluating and Improving Programs

The conventional approach to assessing a program's effectiveness typically requires a large, randomized control trial (RCT) that takes several years to complete and even longer for the results to be published. This process is extremely costly and does not allow mid-course adjustments based on real-time learning. This is not to say that RCTs should be abandoned, as they continue to be the gold standard for proving that a program has the impact it is designed to achieve. But it does underscore the need for a more nimble, iterative process of learning from small-scale feasibility studies and pilot testing of promising intervention strategies with small numbers of children and families *before* they are ready for a full-scale experimental evaluation.

One example of this approach is the strategic use of micro-trials. These are small-scale and short-duration field tests that are designed to catalyze rapid, shared learning across multiple projects in the field simultaneously. Gathering data on recruitment and early attrition in a standardized way across sites so project teams can spot emerging trends is one example of the potential benefits of this model. Because of their size and flexibility, micro-trials also provide valuable opportunities to explore causal pathways and test program effects across varied contexts, target groups, dosages, and modifications in service components. These small-scale studies offer a lower-stakes environment that requires less upfront funding and a shorter timeframe to generate meaningful findings. While their results are not as conclusive as those generated by large RCTs, their iterative nature provides a potential pathway for targeted replication on a faster track than typically achieved through conventional approaches.

A Strategy for Identifying Who Benefits Most (and Least)

Understanding who benefits most from an intervention (which should trigger targeted scaling) and who benefits least or not at all (which should galvanize the search for new or complementary approaches)—and why we got these different results requires an approach to measurement, evaluation, and replication that can identify meaningful subgroups and actionable differences connected to a precise theory of change In some sectors of work this is called *segmentation.* With this objective in mind, program developers and evaluators should specify testable hypotheses and define subgroups *before* initiating a study. Searching for differences on a variety of unrelated outcomes and subgroups after calculating the average effects across all participants may produce statistically

significant findings, but not an explanation for what caused them or how to replicate them.

When the intervention process begins with a well-defined theory of change, program developers and system leaders can begin to match services to relevant client characteristics. For example, adjusting services for children based on initial differences in their attentional skills or self-regulation, or for mothers based on the presence or absence of depression or an anxiety disorder, is likely to be more productive than current practices that analyze differences in the effects of a program based on the child's race or the mother's income. This initial matching process can then proceed to adapt specific service components to serve specific populations that are most likely to benefit from them, as well as drive the development of new approaches for those who do not benefit. Another promising advantage of this strategy will be the ability to discover where existing programs may already be achieving breakthrough outcomes for some children and families that are not being detected because they are combined with poor outcomes achieved by other program participants in order to report average effects only.

An "Active Ingredients" Approach to Cost-Effective Scaling

Clear theories of change and a better understanding of why different intervention strategies are effective for different populations can help identify active ingredients of both long-standing and new programs that can be incorporated, in suitable mixes, into broader service systems. This type of modular approach offers a practical and cost-effective pathway to targeted scaling and contrasts with the conventional approach, which involves implementing the full package of a comprehensive program, including multiple components whose differential impacts are not known. When program evaluators ask "does it work?" rather than "which features work for whom and why?" the only pathway to scaling is to replicate every aspect of the program. A modular approach, in contrast, enables a more efficient and cost-effective strategy for selectively scaling the active ingredients of an effective intervention within an existing program or service delivery infrastructure.

When the intervention process begins with a well-defined theory of change, program developers and system leaders can begin to match services to relevant client characteristics.

To cite an example, an Early Head Start (EHS) home visiting program might identify providing assistance for mothers in setting their own life goals as a service priority. The project team could begin by drawing on evidence from a program that produced positive impacts using a coaching model to promote economic self-sufficiency in a client population with similar characteristics. The parent-service provider team might then proceed to adapt and test the goal-setting component of the coaching model (in contrast to the whole package) within the broader EHS service strategy. This systematic approach to modular adaptation, implementation, and testing can lead to greater understanding of how differences in the context in which a program is delivered can affect the benefits of an added component. These differences can then be related to the capacity, commitment, and/or circumstances of the organizations, systems, or communities in which they are implemented. Knowing how a program component is affected by all of these different elements of program delivery can help guide further adaptations and scaling efforts.

For examples of applying the model discussed here, go to: http://developingchild.harvard.edu/innovation-application

Innovation that Extends Beyond Programs and into Systems

Above and beyond the challenges of developing novel intervention strategies within new or existing programs, science-based R&D can also be driven by decision-makers in the worlds of policy and public, private, and not-for-profit systems. Although all types of systems can and will reap benefits from program-based innovation, the systems themselves are more than simply an amalgamation of services. They are complex entities that set priorities, establish incentives and barriers to innovation, and facilitate the implementation of a variety of practices that are essential to achieving specified outcomes for children and families at a population level.

Generally speaking, policy and practice systems tend to be highly compartmentalized and composed of multiple layers of program delivery models. As such, they often function as systems within systems, parallel to but separate from other systems. Within this context, credible, translated science offers an integrated knowledge base that could drive multiple systems in a coordinated direction as well as provide a coherent framework for rethinking how different services could be aligned around shared goals. Connections among education, physical and mental health services, early childhood programs, family economic supports, and adult skill-building efforts are striking examples of policies and/or systems that are ripe for such fresh thinking through the lens of a common science base.

Although a science-informed innovation strategy targeting systems might look different from one focused on programs, the same core principles apply in both contexts—a co-creation process that draws on multiple types of expertise and experience, demands precision in identifying and measuring outcomes and target domains, and focuses on what works (and what doesn't) for whom and why. Using this approach, decision makers could create new opportunities for changing the way their work is done both within and across sectors. In the child welfare system, for example, the recruitment of foster parents could direct attention to their capacity for promoting responsive, serve and return interactions with children who are likely to be difficult to engage. As an example of working across systems, policymakers and administrators with responsibility for implementing Temporary Assistance to Needy Families and Early Care and Education could connect job training requirements to parenting skill-building efforts based on a joint focus on strengthening executive functioning and self-regulation in adults *and* children.

Significant progress in these areas will depend on continuing efforts to make scientific knowledge more accessible and contextualized for policymakers, system directors, and community leaders who are motivated to drive innovative action agendas within existing structures and practices. External organizations can play an especially powerful role in policy and systems change by convening potential collaborators across sectors and building a common knowledge base. Large-scale systems change, however, requires sustained engagement by internal system managers, so external organizations must serve as trusted, long-term partners who are not pressing a particular policy agenda. Armed with a common understanding of the science of development and a means of collaborating, creative leaders at the national, state, city, and neighborhood levels can all play important roles in developing and sustaining an R&D function in the early childhood field by:

- integrating and scaling effective, modular components within existing programs;
- joining in the co-creation and testing of programs that would, if successful, meet important system needs; and
- creating a culture that catalyzes innovation by providing flexible funding and regulatory support for developing new ideas, rapid-cycle testing, and focusing on what is working for whom and why.

One prominent, public health success story—the reduction in tobacco use—offers a wealth of valuable lessons learned about the kind of multi-

level systems approaches that will be necessary to achieve major impact in the early childhood field. After years of marginally successful investments focused largely on public education and programs designed to modify individual behavior, significant change in tobacco use at a population level was finally achieved through a mix of synergistic activities involving the health care system, broad-based messaging (including the dissemination of credible evidence of the dangers of second-hand smoke), legislation at multiple levels (including increased taxes on cigarettes and restrictions on smoking in public spaces), and private sector actions (through both incentives, such as reduced health care premiums for non-smokers, and barriers, such as restrictions on smoking in commercial spaces). This multidimensional process tested different strategies in various combinations through a state-by-state effort, ultimately demonstrating that different approaches are variably effective for different population groups, and a multi-sector approach is far more effective than any single intervention.

Reducing Barriers to Developing and Testing New Ideas

Obstacles that impede the design, implementation, and ongoing refinement of promising new ideas—compounded by powerful disincentives to capitalizing on the learning value of disappointing results—are stifling the ability to achieve significant progress in the early childhood field. The following are some of the many challenges.

- In service delivery, regulations typically constrain departure from conventional practice, and the pressure to sustain funding encourages the selective reporting of positive impacts. Connecting practitioners, parents, scientists, and program developers in an environment that embraces creative thinking and tries new approaches requires trusting relationships between service providers and recipients, strong program leadership, and stable funding support.
- In policy, resource allocation that relies *solely* on previously documented effectiveness as determined by RCTs (i.e., "evidence-based" services) reduces the opportunity to test new strategies. Policies that incentivize small-scale pilots, rapid-cycle evaluation, and a mindset that values *both* discovery *and* verification would accelerate innovation.
- In research, requirements for predetermined study designs and fixed protocols for data collection make it difficult to change course based on early findings. Moreover, the bias of the peer-review process against publishing studies that show no significant effects undermines the critical role of learning from failure that drives breakthroughs in other fields. Increased incentives for breaking new ground and sharing preliminary findings in a more timely fashion would reduce these barriers.
- In philanthropy, preferential funding for "best practices" and short-term deliverables misses the opportunity for the kind of grant-making that drives transformational progress through sustained investment in the entrepreneurial design, testing, and eventual scaling of new ideas.

Overcoming these barriers will require new mindsets and new approaches in each of these interconnected domains.

R&D: Producing Breakthrough Impacts

When R&D Works for Children Facing Adversity: Lessons from Precision Medicine

The difference between focusing exclusively on best practices and average effects in contrast to driving a dynamic, science-based R&D agenda is exemplified by comparing the parallel histories of early childhood intervention for children living in poverty and the treatment of acute lymphoblastic leukemia (ALL).[192] When the first Head Start center was opened in 1965, the five-year survival rate for ALL was less than five percent. Ten years later that number had increased to 60 percent, and 40 years afterward the five-year survival rate exceeded 90 percent. Today the treatment of ALL begins with an initial compilation of baseline data that determines the selection of the most effective treatment plan among alternative options, based on the *a priori* identification of disease subgroups. Concurrently, both basic and clinical researchers are continuing to push survival rates even higher and trying to reduce the adverse side effects of existing therapies.[193] A recent report of socioeconomic status differences in relapse and survival rates for children with ALL is stimulating a new frontier in cancer research by addressing the influence of environmental stress on different responses to treatment of the disease.[194]

Over this same 50-year period, the effect sizes of center-based, early childhood education programs on children's cognitive and academic achievement scores at the time of program completion has averaged a modest .21, roughly two months ahead of their peers.[195] This contrast is not presented to equate the adverse impacts of poverty on child development with a diagnosis of leukemia. It is simply designed to underscore important lessons that early childhood policymakers and practitioners could learn from the battle to cure the most common form of cancer in children.

The first lesson is the essential need for simultaneous investment in both state-of-the-art, "evidence-based" care for children with an identified condition or risk profile *and* a robust R&D effort focused on the continuing development of more effective interventions. The second is the critical role of basic science in elucidating causal mechanisms, generating testable hypotheses, and informing the design and evaluation of novel treatments. The third lesson for the early childhood field is the fundamental importance of continuous experimentation (with adequate protections and informed consent) and learning from failure, the need for constructive dissatisfaction with small incremental gains, and the critical value of an unwavering demand for increasingly greater impacts until the problem is fully addressed.

Drawing on lessons learned from decades of biomedical research that have led to increasing precision in targeting the successful treatment of a wide range of diseases across the lifespan, it is clear that multiple intervention strategies are needed to address the diverse needs of different groups of children and families facing adversity. A search for the one most effective intervention for children living in poverty is tantamount to looking for the single best treatment for "cancer," despite the myriad types and causes of this complex, multi-dimensional disease. In contrast, a well-specified intervention that is matched to a rigorously defined condition or risk profile and achieves positive impacts for a particular group can be scaled in a targeted fashion. Other groups that show minimal or no impacts from that intervention can then be the focus of further study to determine why they did not benefit and to try alternative approaches based on science-informed insights. New and more effective approaches to supporting child health and development will thus require a diversified portfolio of interventions that match specific strategies to identified conditions, risk factors, and needs.

A Call to Action

The Center on the Developing Child and our growing number of partners in the Frontiers of Innovation (FOI) learning community are in the early stages of employing a model much like the one described in this chapter. Members of this community are actively co-creating new ideas, testing new strategies, iterating in a rapid-cycle way, and employing a new approach to measurement and evaluation to determine what works for whom and why.

We are not the only ones engaged in creative thinking, nor are our approaches the only ways to achieve breakthrough impacts. We are always looking for new partners who share our enthusiasm for filling a currently underdeveloped and insufficiently resourced niche in the early childhood landscape. An R&D platform is not a replacement for the important work of improving program quality, strengthening the early childhood workforce, building more efficient systems for delivering and evaluating services, and increasing access to today's best practices. We see the presence of an R&D dimension as an essential part of any healthy, sustainable enterprise. Its absence threatens the future of all communities in which the needs of children and families are not being fully met by existing policies and programs.

Building a vibrant and productive R&D platform will not be easy. It will require a more open and dynamic mindset that rejects uncritical loyalty to existing programs and demands fresh thinking across sectors. It will require an active and diverse community of change agents with a shared commitment to try new strategies informed by scientific thinking, practical experience, and collective learning. It will require novel forums to discuss, translate, and apply evolving knowledge and lessons learned from both successes and failures. It will require new sources of long-term investment in exploratory R&D and fast-cycle sharing of promising findings. And, it will require the pursuit of multiple pathways matched to the resources, strengths, goals, and needs of a diversity of children, families, and communities.

This call to action is directed to those who share our constructive dissatisfaction with the best of what we are doing right now. Wherever you are placed and however you are contributing to current communities, programs, policies, and/or systems that affect the well-being of young children and families, we invite you to consider how advances in science might point to new ways of confronting your greatest challenges. Together we can and must demand more innovation, collaboration, and precision. Together we can create incentives to encourage fresh thinking and focus relentlessly on understanding *why* a strategy works (or doesn't), for whom, and in what contexts. Together we can draw on multiple areas of expertise and experience, and we can share what we learn to accelerate the pace of population-level change. The challenges facing cancer researchers and space explorers are no greater than ours—and those challenges have not deterred the progress that has been made by mobilizing scientific knowledge, "real-world" wisdom, "can-do" problem-solving, and a dogged refusal to accept failure as an option.

The possibility for substantial progress in our ability to dramatically improve the life prospects of all young children is real. The time to aim higher is now.

The central question before us is not *whether* strategic risk-taking and fresh thinking are important prerequisites to breakthrough impacts for children and families facing adversity. The more compelling questions are: *How* can we make that happen? *What* will it take to reduce the barriers? *How* can we increase the incentives? *How* can we come together across multiple sectors and work collaboratively with families and communities to learn from both failure and success? The possibility for substantial progress in our ability to dramatically improve the life prospects of all young children is real. The time to aim higher is now.

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