

NATIONAL SCIENTIFIC COUNCIL ON THE DEVELOPING CHILD

A World of Differences: The Science of Human Variation Can Drive Early Childhood Policies and Programs to Bigger Impacts

WORKING PAPER 17



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ACKNOWLEDGMENTS

We gratefully acknowledge the significant contributions to this paper made by:

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Russell Booker, Ph.D., C.D.E., Spartanburg Academic Movement

W. Thomas Boyce, M.D., University of California, San Francisco

Alan Cohen, MBA, Child Poverty Action Lab

David Edwards, M.P.P., Office of the Mayor, Atlanta

David Erickson, Ph.D., M.P.P., Federal Reserve Bank of New York

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The National Scientific Council on the Developing Child, housed at the Center on the Developing Child at Harvard University, is a multi-disciplinary collaboration designed to bring the science of early childhood and early brain development, as well as the biology of adversity and adaptation, to bear on public decision-making. Established in 2003, the Council is committed to an evidence-based approach to science synthesis that is informed by the peer-reviewed literature and recognizes the shared opportunities for government, businesses, communities, and families to promote the well-being of all young children. For more information, go to www.developingchild.harvard.edu

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Suggested citation: National Scientific Council on the Developing Child. (2024). *A World of Differences: The Science of Human Variation Can Drive Early Childhood Policies and Programs to Bigger Impacts: Working Paper No. 17*. Retrieved from www.developingchild.harvard.edu

THE ISSUE:

One Size Does Not Fit All

It is now widely accepted that investing in early childhood development helps build the foundations of a healthy, productive, and equitable society. Guided by that knowledge, a range of broad-based programs and targeted services clearly make a significant difference for millions of young children,¹ yet a closer look at program evaluation research shows that some children benefit greatly, some benefit less, and some not at all.² Within this variation lies opportunity. Increasing the effects for all children—especially those who currently benefit the least—may be the key that unlocks greater impacts for society.

To understand why programs and policies designed to benefit all children have such variable effects, we must understand why the same experiences affect children differently. Any family with more than one child knows that siblings do not react to similar conditions in the same way. Providers of services for young children are also fully aware that not everyone benefits equally from the same programs. Extensive evidence from research across multiple disciplines confirms that child development cannot be fully understood by focusing solely on average patterns and timelines. The variability underlying both human development and socioeconomic influences on educational achievement and lifelong health helps explain this concept in two ways.

The first type of variation, between-group differences, categorizes people according to demographic factors (e.g., parent education, family income, race, ethnicity, and community context) and focuses on differences between groups in terms of access to opportunities and outcomes in health, educational achievement, and lifetime earnings. Communities and families with more material assets have the capacity to provide

supportive infrastructure and spaces that benefit well-being (e.g., for sleep and exercise) as well as access to high-quality services that promote healthy development (e.g., medical facilities and childcare). In contrast, communities and families undermined by the effects of structural inequities such as intergenerational poverty and systemic racism face significant challenges in providing the conditions and opportunities that young children need to thrive.³ These disparities among places and population groups have deep historical roots, yet the persistence of inequalities in life outcomes is neither inevitable nor unchangeable. Policy actions (and inactions) created them over time, and new policies can reverse them. One way early childhood policies and programs try to address disparities between groups is by targeting the distinctive needs of those who are challenged by socioeconomic barriers while serving a universal goal like supporting healthy development for all.

A closer look at program evaluation research shows that some children benefit greatly, some benefit less, and some not at all. Within this variation lies opportunity.

Yet within every demographic group, the outcomes for individual children also vary widely. This second type of difference—the concept of within-group variation—is firmly grounded in decades of research on child development and its underlying biology at the molecular, cellular, and physiological levels. Starting prenatally and within the earliest years after birth, a range of experiences and exposures interact with each child's individual genetic makeup in different ways at different stages of development. Through this process, the brain and other

biological systems, such as the immune and metabolic functions, respond to the environment they are encountering.⁴ The cumulative influence of each child's unique set of interactions among genes, experiences, and the timing of when some experiences occur explains variation in outcomes at the individual level, both in the short term and over the life course.⁵ This understanding of development calls for a significant shift in the way we conceive, implement, and evaluate policies and programs—one that recognizes the significance of disparities between groups associated with demographic variables, but also expects and designs for individual variation within each of those groups.

The current mindset in early childhood policies and programs justifiably requires evidence of effectiveness for investment. However, an “evidence-based” program or policy is typically defined as one that shows a statistically significant mean effect, which answers one question: “Does it work on average?” While a good starting point, incentivizing programs to demonstrate impact on average risks overlooking the wide range of children who show effects well below or above the average. An expanded mindset that focuses on differences between population groups, as well as variation within each group, would analyze outcome data on both average effects and differential outcomes by asking: “What works for whom, why, and in what context?”² Although analysis by subgroups is more challenging and not without controversy,⁶ evaluating policies and programs in this way would introduce flexibility in design and implementation in order to get more impact from finite resources.^{7,8}

Investments that address multiple levels of variation take three complementary approaches:

1) broad-based programs and policies to ensure as many children as possible have their basic needs met (e.g., universal access to health care and/or preschool);

2) strategic targeting of resources focused on differences between groups to address distinctive needs and assets identified by different communities (e.g., economically secure, low income, or mixed; rural or urban) and demographic groups (e.g., racial, ethnic, religious, immigrant, and/or parent education level); and

3) flexible implementation of evidence-based programs focused on variation within groups (e.g., early intervention for children with special needs), enabling staff to adjust their approach/delivery of services and make referrals to specialized expertise when needed, thereby offering the promise of larger impacts for more children.

The need to design, implement, and evaluate policies and programs in ways that anticipate both between-group differences and within-group variation is well-supported by scientific research and the lived experiences of service providers and caregivers raising young children. Many programs already attempt to address between-group differences by targeting specific socio-economic, geographic, and demographic populations—but few account for individual variation within those groups. Many clinicians and program staff already make adjustments for individual children and families—but they often do it independently, and lessons learned are not disseminated widely or built into policies and systems. A mindset shift that intentionally incorporates this flexibility into the core architecture of all early childhood policies and services would offer tremendous promise for increased program effectiveness and larger impacts at scale.

What Science Tells Us: Individual Variation Is the Norm, Not the Exception

The ability of humans to adapt to a broad diversity of opportunities, challenges, and threats is integral to our species' fitness to survive. Individual differences and adaptability are core principles of developmental biology, but incorporating those principles into policies and practices that are expected to address the needs of millions of children is challenging. Understanding how these differences occur can help us find solutions.

Children's development varies based on the interactive influences of genes, experiences, and timing: the unique and complex genetic profiles they inherit (e.g., differences in temperament), the ongoing effects of accumulated experiences and exposures, and whether certain life-shaping influences occur during particularly sensitive periods of development.⁵ Experiences themselves differ according to their intensity, how long they last, when and how often they occur, and whether they are positive or negative, predictable or unexpected.⁹ The interplay among all of these influences contributes to the full spectrum of human variation, including how children learn, behave, and adapt to the world around them. Programs, policies, and systems that are intended to enhance children's well-being provide many experiences that influence their development—interacting with their temperament and the timing of these and other experiences. In order to improve the impacts of services, we first must understand how these complex interactions lead to differences in how children respond.

Early experiences, starting prenatally, interact with genes to shape the development of the brain and other biological systems. All individuals carry their own set of genetic instructions

(what scientists refer to as the genome) that shape how the body develops in response to what we experience. In short, the genome is designed to react to the environment. Its response establishes when, where, and how the expression of individual genes is turned on or off.¹⁰ This dynamic interaction shapes how each child will react to both positive and negative experiences, a characteristic that biologists study at the molecular level and child development researchers often refer to as differences in temperament. These differences are often noticeable in early infancy and affect children's sensitivity to their environment.¹¹ Even when they have the same biological parents and are raised in the same household, siblings often differ in the type and intensity of their responses to similar exposures.

Just as the sound of a violin is determined by its structure, materials, size, and shape, but also by the player's technique, the musical composition, and the acoustics where it is being played, the impact of our genes is incomplete without the experiences and contexts that bring them to life in distinctive ways.

While commercial genetics research tools can identify ancestry through DNA (based on the area of the world where one's forebears came from), the degree to which any individual's genes are activated varies in response to experiences. Research in the rapidly advancing science of epigenetics has revealed that experiences activate molecular markers that attach themselves to individual genes in unique "signatures" that affect whether and how the gene is expressed.¹² Just as the sound of a violin is determined by its structure, materials,

size, and shape, but also by the player’s technique, the musical composition, and the acoustics where it is being played, the impact of our genes is incomplete without the experiences and contexts that bring them to life in distinctive ways. Thus, although the genetic code of each person is fixed, epigenetic changes in response to a wide range of environmental influences account for remarkable variation in learning, behavior, and both physical and mental health.

Experiences and exposures vary widely within families and communities. A child’s social environment during the early years may consist of both positive experiences, such as responsive “serve and return” interactions and predictable daily routines, and negative experiences, such as abuse or neglect, community violence, or the stresses experienced by families facing the burdens of racism and interpersonal discrimination. At the same time, children are exposed to many influences in the physical environment—both positive factors, such as green space and safe, stable housing, and negative ones, such as excessive heat, air pollution, and lead in drinking water. All of these factors differ according to their type, duration, frequency, intensity, and the child’s age when they occur,⁹ as well as whether they are expected or unpredictable.^{13,14} This is why the sum total of a child’s experiences and exposures doesn’t tell the whole story of development.

In contrast to studies that look at the effect of the total number of adverse experiences on lifelong health (see sidebar), a growing body of research is examining how different kinds of adversities can influence brain development in different ways.¹⁵ A review of more than 100 studies using MRI brain scans, for example, found that children exposed to significant threat (e.g., overt physical abuse) on average showed structural effects in different parts of the brain compared with children experiencing deprivation (e.g., prolonged emotional neglect).¹⁶

Studies of other biological variables, such as sex, have documented differences in how men’s and women’s brains respond to stress, which may help explain sex differences in underlying stress-related illness.¹⁷⁻¹⁹ Complex interactions among various experiences and exposures with the brain and other biological systems during sensitive periods of development produce differences in response that ultimately shape how the body will adapt over the life course. Scientists refer to this variation as heterogeneity.

The timing of when an experience occurs during development also affects its impact. There are periods in the development of multiple biological systems that are exceptionally susceptible to experiences and exposures in the surrounding environment. During these highly sensitive periods in the brain, specific kinds of experiences are expected—and in some cases required—to sculpt the cell-to-cell connections comprising circuits that perform different types of functions, from basic senses, emotions, and motor skills to language, reasoning, and self-control. Whether a child has (or does not have) experiences that support healthy development during these sensitive periods is an important factor in whether and how that child develops these foundational capabilities and, thus, how the child will respond to future experiences.³¹

The same principles apply to other developing systems, also beginning before birth—those that fight infection, turn food into energy or establish the composition of bacteria and viruses that live in our gut and influence brain, metabolic, and immune functions.⁴ Whether and when these systems have certain experiences or exposures affects how they are set up to perform necessary functions throughout life—in a way that either promotes good health or undermines it.⁵

The underlying biology of development is naturally inclined toward adaptations that help us survive and thrive in a wide range of conditions. An accumulation of certain kinds of experiences over

ACEs and Individual Variation

The practice of identifying the risk of future health problems by tallying how many types of Adverse Childhood Experiences (ACEs) an individual has experienced has gained traction in the early childhood field and in pediatric practice, more specifically, over the past decade. This “ACE Score” approach is based on widely cited studies that found a significant relation between documented health conditions in a large sample of mostly White, middle-class adults and their self-reported recall of adverse childhood experiences.^{20,21} Subsequent studies have replicated a similar pattern in Black, Hispanic,²² and Indigenous populations,²³ albeit with several examples of *between-group differences*. For example, marginalized populations are subjected to more ACEs than were previously estimated based on the majority White population of the original study, and different types of ACEs and health impacts are more common among some groups than others based on the environments in which they live.²⁴

Within-group variation, however, remains largely unaddressed by ACE screening, which raises several concerns about using the original questionnaire alone to predict an individual’s future health outcomes. For example:

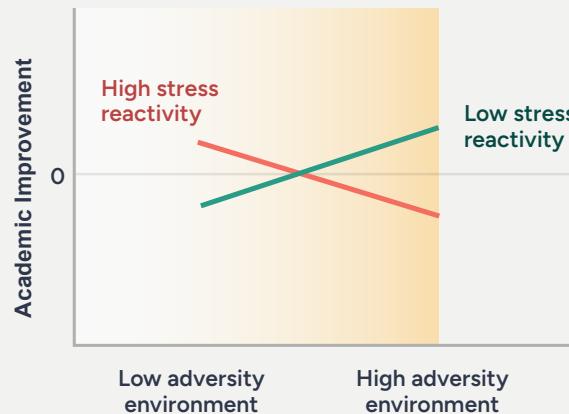
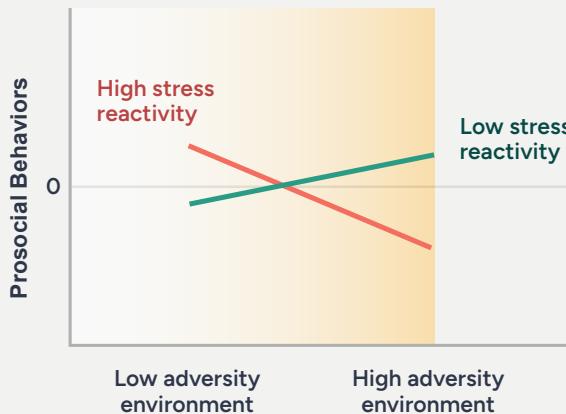
- The original ACE questionnaire does not reflect the full range of adverse conditions experienced by young children beyond the family context, such as the compounding influences of poverty, racism, food insecurity, housing instability, or community violence.²⁵ The questionnaire also does not account for the significance of the age at which the experience occurred or the presence of protective factors that might have mitigated its effects.²⁶
- Identifying a child as “high risk” for a mental or physical health impairment without considering these other influences can lead to inaccurate labeling, negative psychological effects, and prejudicial expectations,²⁵ particularly for marginalized groups that are already subjected to systemic biases and disproportionate exposure to adversity.
- Although many studies have confirmed the validity of ACE scores as predictors of *population-level risk* of later disease, they are no better than the flip of a coin for predicting *specific health risks for individuals*.^{27,28} While high ACE scores are associated, on average, with a higher risk for a number of poor health outcomes, the trajectory of any one individual depends on the interactions among genetic differences and the timing and nature of specific experiences. The number of experiences alone cannot tell the whole story.

Despite these problems with ACE scores, experiencing toxic stress from early life adversity can have lifelong consequences. It is critical for providers of services for young children and their families to be trained to recognize the signs and symptoms of trauma, to respond with interventions that build resilience, and to identify and build on protective factors by leveraging family and community strengths.²⁹ Using expanded ACE screening tools that account for a broader range of experiences and contexts, embedding them in trauma-informed practices that include *individualized clinical assessments*, and providing access to behavioral health specialists can offer the additional context and support that is lacking in the standard ACE questionnaire alone.³⁰ Finally, beyond screening for adverse events, the most effective strategies for preventing stress-related impairments focus on creating environments that prevent exposure to adversity before it occurs.

time can “train” developing biological systems (e.g., brain, immune, metabolic) to expect and respond in certain ways to similar experiences in the future. Although personal circumstances change significantly over the life course, earlier adaptations may remain, whether or not they are appropriate for later contexts and experiences. For example, some biological responses to early trauma that

provide protection in the short term (e.g., persistent activation of the stress system) may exact a high price later in life (in the form of greater risk for stress-related disease), even in the absence of continuing adversity. In short, early experiences do not determine our destiny, but they can have a powerful influence on lifelong physical and mental well-being.⁵

Some Children Are More Sensitive to their Environment—For Better or Worse



This study of five-to-six-year-old children, conducted in the fall and spring of their kindergarten year, compared children’s exposure to adversity, individual levels of stress response, and school performance. Children whose bodies reacted to challenges with higher levels of stress hormones (“high stress reactivity”) AND were exposed to higher levels of adversity showed worse prosocial behavior when starting kindergarten (left) and declines in academic performance when finishing kindergarten (right) compared to their less-reactive peers. However, these high-reactive children demonstrated better prosocial behaviors in the fall and greater academic improvement across the year when living in environments with low levels of adversity. In other words, children with low stress reactivity may appear to be more resilient even when facing high adversity, while children with high stress reactivity will thrive in a low adversity environment but fare worse when dealing with adversity.

Source: Obradović J, Bush NR, Stamperdahl J, Adler NE, Boyce WT. Biological sensitivity to context: the interactive effects of stress reactivity and family adversity on socioemotional behavior and school readiness. *Child Dev.* 2010 Jan-Feb;81(1):270-89. doi: 10.1111/j.1467-8624.2009.01394.x. PMID: 20331667; PMCID: PMC2846098.

Both positive and negative experiences affect development, and some children are more sensitive to one or both.

Although experiencing significant adversity as a young child increases the risk for later problems, this can be particularly disruptive for children whose stress response system is triggered more easily and more powerfully.^{32,33} The stress response is automatic, universal, and necessary for survival. It activates multiple interactive components in the brain, immune, metabolic, and cardiovascular systems, each with different, complementary functions that help the body respond to different kinds of threats. The complexity of these components and how they interact leads to wide variations in any individual's threshold for triggering the response, as well as its intensity, how long it lasts, and what the long-term effects of chronic activation might be.³⁴⁻³⁶ This helps explain why people often respond so differently to the same stressor—something that feels intensely threatening to one person may be experienced as less significant by another. Neither response is “normal” or “abnormal.” Both reflect individual differences in temperament or sensitivity that are shaped by the cumulative impacts of past experiences on

gene expression and the developmental period in which those experiences occur—beginning prenatally.³⁷⁻⁴⁰

Children whose stress response ramps up quickly and powerfully are more likely to experience negative effects from adversity, but may also benefit more from supportive or enriched circumstances than children who are less reactive.⁴¹⁻⁴⁴ In other words, some children are simply more sensitive to their environments than others—in stressful situations, they may fare worse, but in supportive contexts, their health and development may even surpass those of their less sensitive peers. Other children seem to be more resilient and manage to thrive in a wide range of conditions.⁴⁵ Another subset of children have stress response systems that are set very low, sometimes as a result of becoming blunted following chronic, intense adversity, which makes them less responsive to both threats and interventions in the future. These differences in sensitivity to experiences and exposures, both good and bad, help explain why the same children who seem exceptionally vulnerable in some contexts may benefit more than others from positive caregiving⁴⁶ and well-matched programs.⁴⁷

Influences on Variation in Health Outcomes: The Example of Childhood Asthma

Asthma is the most common chronic childhood disease in the United States and globally,⁴⁸ yet there are wide variations in who experiences symptoms, the severity of the symptoms, and how well each child responds to treatment. As with many illnesses, whether a child develops asthma—and whether it becomes chronic— involves multiple interactions among environmental exposures, sensitive periods of development, and differences in genetic susceptibility.⁴⁹

Environment—The wide range of influences that contribute to variation in the development of asthma include sources of both protection and risk.

- *Protective exposures* begin with the early development of the immune system and the gut microbiome (which is populated by bacteria, viruses, and fungi that develop in the digestive tract and play an important role in health and illness). The composition of the gut microbiome is first influenced by maternal and environmental exposures around birth and continues during the early childhood years. There are a number of ways in which early exposure to “good bacteria” and a greater variety of microbes contribute to a lower risk of developing asthma. As one of many examples, children who have dogs in their home in the first two years after birth have a lower risk of developing asthma during their school-age years compared with children who grow up without frequent exposure to dogs.^{50,51} The reason has been traced to differences in the bacterial composition of dust within homes containing dogs. In rural areas, living in close proximity to farm animals also results in exposure to high levels of both good and more varied bacteria species—and lower rates of asthma.^{52,53} Green spaces outside the home can also affect the development and severity of asthma, but the effects may vary. For example, living in a humid climate or near a forest, with its greater biodiversity, may be protective against developing asthma, but living in a dry climate or near an urban park, where pesticides are used, and a smaller variety of trees release particular pollens, may contribute to a higher risk of asthma attacks.⁵⁴ A recent study that found a positive relation between proximity to neighborhood green space and greater microbial diversity of indoor dust raises additional questions about how children’s risk for asthma may be affected by where they live.⁵⁵
- *Harmful exposures*—Exposure to air pollution is one of the most powerful precipitants of asthma symptoms⁵⁶ and is also a common cause of more severe cases and higher emergency department utilization.⁵⁷ The intersection of air pollution, asthma, and structural racism is also well-documented. One prominent example is “redlining,” a federally backed program that denied financial services in areas that were marked as “hazardous” based on residents’ race or ethnicity.⁵⁸ While substantial policy changes have been achieved to overturn the systemic inequities of redlining, such as the Fair Housing Act and the Community Reinvestment Act,⁵⁹ persistent economic and social marginalization still leads to Black children remaining far more likely than White children to live in neighborhoods that are closer to major sources of air pollution, such as highways, transportation hubs, power plants, and industrial sites. Children in these locations are more likely to develop asthma, and Black and Latine children are also more likely than White children to have asthma attacks that are severe and need ongoing attention in hospitals.⁶⁰

Timing—Pregnancy and early childhood are times when the body’s immature systems are especially sensitive to environmental influences.⁶¹ Emerging evidence suggests that exposure during the first years after birth to a bacterial product found in airborne dust, called endotoxin, can protect children against developing asthma, but only if they have a particular gene variant.⁶² On the other hand, exposure to endotoxin in older children and adults can *increase the risk* of wheezing and asthma,⁶³ unless earlier exposures have counteracted that effect. The fact that exposures occurring during early sensitive periods of development can influence subsequent asthma risk demonstrates the critical importance of the prenatal and early childhood periods. The fact that different impacts on health can result from similar exposures at different times demonstrates the importance of taking developmental timing into account.

Genes—Exposure to air pollution is more likely to increase the risk of developing asthma in children who carry particular genetic profiles.⁶⁴ It is these profiles, *in combination with* the types and timing of experiences and exposures, that explain in part who does and does not develop the disease. In addition, exposure to pollution during the prenatal period and early childhood may trigger changes in the epigenome—which determines whether and how selected genes are expressed—that can be passed on to the next generation.⁶⁵ Ongoing research is developing more precise ways of identifying genetic and epigenetic markers of asthma risk in order to improve our ability to predict and intervene early for those most likely to develop the disease.

Given this growing knowledge base, asthma interventions that only address one variable are far less likely to be successful than those that incorporate an understanding of how multiple variables interact. For example, addressing harmful exposures alone will likely reduce asthma rates across a community, but effective prevention for all children also requires consideration of differences in individual histories of protective exposures, the timing of the exposures, and genetic profiles.⁶⁶ In the final analysis, approaches are most likely to be successful if variation is expected and interventions combine strategies that are *broad* (e.g., screening for all children), *localized* (e.g., addressing local environmental conditions), and *flexible* (e.g., assessing individual histories and genetic profiles to determine optimal treatment).

What Science Tells Us: Between-Group Differences Are Rooted in Social and Economic Inequities

Systemic racism, intergenerational poverty, and other structural inequities lead to higher levels of adversity for some neighborhoods, families, and individuals compared to others. Race is a social invention, not a biological classification. There are no genetic or biological boundaries where racial or ethnic categories begin and end,⁶⁷ but these categories have been and are used to extend opportunities to some and deny them to others.⁶⁸ Public health research has long used these socially constructed demographic identifiers (such as Black, American Indian/Alaska Native, Hispanic, Asian, Native Hawaiian/Pacific Islander, non-native English speakers, and low or high socioeconomic status) to study health disparities between groups. Decades of this

research document persistent differences in stress-related diseases and preventable early deaths,⁶⁹ with people who are identified by categories that historically have been assigned lower social status consistently showing worse outcomes.⁷⁰ In addition to sources of stress experienced by all caregivers, many families in these categories experience hardships from the physical and psychological disruptions of racism; unequal access and treatment in health care, education, child welfare, and criminal legal systems; and barriers to economic advancement.⁷⁰ These hardships challenge well-being and increase the risk for negative life outcomes compared to populations that do not experience comparable stressors and barriers. In short, racism, not race, looms large

as a potent driver of inequality.^{4,71}

There are multiple pathways through which the stresses of racism can get “under the skin” and affect child health and development—whether through the cumulative burden of stress caused by repeated experiences of interpersonal discrimination or through policies that result in unequal exposure to excessive heat, noise, polluted air, contaminated water, and lack of green space, as well as limited access to affordable, healthy foods.³ There is an extensive and ever-growing body of evidence that systemic, cultural, and/or interpersonal racism and other structural inequities impose unique and substantial stressors on the daily lives of families raising young children of color.^{72,73} In addition, growing epigenetic evidence shows the cross-generational effects of traumatic experiences, such as attempts at cultural eradication targeting Indigenous children through forced boarding school attendance.⁷⁴ Racism is thus an important factor to consider in explaining how and why some early childhood programs vary in their impacts on different populations, as well as how to tailor more effective strategies to address the distinctive ways it affects child well-being.⁷⁰

Communities vary in the availability of protective factors that can prevent or reduce early life adversity or mitigate its effects. All young children share certain universal needs, but those needs are not universally met. The common foundations of healthy development include responsive and stable relationships with caregivers, nutritious food, clean air and water, safe and secure places to live and play, high-quality learning experiences, and accessible health care.⁷⁵ More specific needs for optimal development include a language-rich environment, opportunities to build a range of adaptive skills, and secure attachment to at least one supportive caregiver.² Predictability in caregiver relationships both inside and outside the home—including in child care, preschool, K-12 education, after-school care, social services, foster care,

and community programs—is particularly important so young children can count on them and turn to them for guidance and buffering support when needed.^{75,76}

Community conditions and social structures affect all of these common foundations. They can either be sources of hardship or sources of protection that buffer children from the impacts of excessive stress activation on health and development.⁷⁷⁻⁷⁹ Yet even different neighborhoods within the same metropolitan area or individual communities within large rural areas are able to provide vastly different access to assets and opportunities.^{80,81} This doesn’t have to remain the case. Substantial financial resources already exist—in the U.S., community development organizations invest over \$300 billion annually in low-income neighborhoods—yet such investments could be targeted more effectively toward the well-being of children and families.⁵⁹ Increasing the availability of quality child care, safe playgrounds, healthy food, affordable housing, good jobs, and opportunities for intergenerational mobility strengthens the capacity of caregivers to provide a more predictable and supportive environment for their children.^{3,82} Communities with supportive services also serve as a source of comfort and resilience for those experiencing other adversities.⁸³ Policies and programs are changeable, and those intended to mitigate the consequences of adversity are likely to have a greater impact if preventive investments are made in the kinds of infrastructure that protect the well-being of children from the beginning and carry on throughout the school years.

The environments in which children are raised offer widely varying opportunities to develop a “toolkit” of adaptive skills that affect responses to new situations. Extensive research has focused on the central role of executive function skills as important building blocks of resilience in the face of adversity as well as for success in school and work. These skills are typically defined to include

the ability to hold information in working memory, to think about multiple courses of action that one could take in a challenging situation, to engage in goal-directed behavior, delay gratification, and have the impulse control to not choose the first line of action that emerges in conscious thought.⁸⁴ These skills are built over time through modeling, coaching, and practice and through helping children develop capacities for adapting to challenges.⁸⁵ Caregivers who have had opportunities to develop their own coping skills play a particularly important role in scaffolding these building blocks of resilience in the next generation.⁸⁵ Because such a wide range of social influences affect the development of these complex sets of skills over such a long period of time—across childhood into early adulthood⁸⁴—there is substantial individual variation in when and how well children develop these skills.⁸⁶

In addition, there are important between-group differences in how these and other life skills develop. Child-rearing practices that reflect distinctive cultural values can lead to variations in child behavior that are adaptive within that culture yet might be viewed differently in others. For example, caregiving approaches that place greater emphasis on cooperation for the benefit of the group help children develop executive function skills in the service of shared goals.⁸⁷ Children raised in a culture that stresses competition and independence are more likely to build executive function skills to advance their own individual achievements.⁸⁸ Neither pattern of development is intrinsically “better” than the other, and the differences between them illustrate the powerful influence of cultural context.

The remarkable range of adaptive strategies exhibited by families facing significant challenges related to poverty, racial or ethnic discrimination, and/or community violence are examples of ingenuity in the face of adversity and the power of caregivers’ investment in their child’s well-being.

Finally, executive function skills are not the only capabilities that help children and their caregivers adapt to a variety of environments. People who deal with the challenges and unpredictability of life with greater threats and fewer resources may develop stronger skills for detecting imminent danger or opportunity, shifting more rapidly among different tasks, or persisting to procure a near-term reward.⁸⁹ The remarkable range of adaptive strategies exhibited by families facing significant challenges, such as those related to poverty or discrimination, are examples of ingenuity in the face of adversity and the power of caregivers’ investment in their child’s well-being. The critical importance of assessing adaptive responses in different contexts cannot be overstated, particularly when a response may be positive in some circumstances but seen as problematic in others. For example, young children who experience physical abuse often develop a heightened ability to detect anger quickly, which triggers behaviors to avoid provocation. Although this response pattern can be protective in a dangerous context, a lower threshold for reading or misinterpreting anger at a later age can trigger an overly aggressive (or avoidant) response, even in a less-threatening situation.⁹⁰

Implications for a Mindset Shift in Policy and Practice

The scientific principles underlying human variation present a powerful yet relatively untapped framework for strengthening the foundations of healthy development in all children. When combined with knowledge derived from the lived experiences of families and service providers, these principles could inform the design of policies and programs that are more likely to achieve better outcomes and larger returns on investment than current best practices. Knowing that individual variation occurs as a result of the interaction between each child's unique genetic makeup and a wide variety of environmental influences at different times during development can help us understand why different children respond differently to the same intervention. This science also points to the critical importance of addressing influences that can be controlled, beginning with the nature and timing of health-promoting experiences and exposures.

Programs that expect variation in effectiveness and plan for flexible implementation are better positioned to achieve larger effects for all children.

Understanding that all children have universal needs, but variation occurs naturally among individuals as well as between groups, highlights the urgency of supporting the healthy development of young children in a way that addresses—and evaluates—both kinds of variation. For more than half a century, early childhood policies and programs have delivered services for children and families identified by low socioeconomic status, with limited attention to the compounding hardships of racism.⁹¹ Recent research focused on young children has documented evidence

of increased stress and inflammation in infants linked to more experiences of racism by their caregivers.^{92,93} Systematic evaluations of how interventions might best address within-group variation related to experiencing racism remain to be done.

As important as it is to document differences between demographically defined groups, they do not account for the substantial variation that exists within groups. Stated simply, “increased risk” does not mean that all children who experience poverty or racism (directly or indirectly) are affected the same way. Evaluations of policies and programs that conduct subgroup analyses based exclusively on race/ethnicity, income, or parent education fail to address the inevitable diversity of intervention effects within these same groups and thus reinforce false stereotypes of homogeneity in marginalized populations. Programs that expect variation in effectiveness and plan for flexible implementation are better positioned to achieve larger effects for all children. Policies and funders that incentivize and support flexibility in both implementing and evaluating services are more likely to get better returns on their investments because improved outcomes for more children will boost overall impacts.

This approach requires program models to have strategies to capitalize on assets and mitigate challenges identified by communities, families, and other caregivers. Many practitioners already do this, but often in isolation and without explicit recognition or support. In many state and county child welfare programs, “differential response” approaches systematize the ability of caseworkers to customize their engagement with each family and focus more time on those with relatively greater needs. Based on an initial safety and risk assessment,

staff work with families who are likely to benefit from a tailored service plan. Follow-up studies have documented significant reductions in reports of neglect and foster care placement in states that employ these practices.⁹⁴

In a comparable fashion, skilled teachers at all levels of public education—particularly elementary school—have engaged for decades in “differentiated learning” by proactively modifying curricula, teaching methods, resources, and activities to address the diverse needs of students as individual learners or in small groups.^{95,96} That said, a lack of adequate support for differentiation (e.g., incentives for staff development opportunities, extra planning time, flexible curricula) has led to uneven application across classrooms.⁹⁷

At the preschool level, teachers have long applied similar concepts when given the flexibility, training, and support needed to modify their approach for different children. Discussing their role in the Perry Preschool Program beginning in the 1960s—one of the most well-studied, frequently cited, and highly effective early childhood education programs in history—two former teachers recalled, “We were free to generate learning experiences by purposefully taking into account the children’s individual developmental trajectories and the context of their lives, within the mission of the program. We were able to invent new activities while incorporating ideas from existing curricula.”⁹⁸ Today, Early Head Start guidelines recognize the importance of individualizing care for program planning and teacher training, including the use of Individual Support Plans for children with behavioral challenges and recommendations for children who are dual language learners.⁹⁹ Successful implementation of these guidelines, however, is often compromised by insufficient funding and limited resources to support state-of-the-art practice. These persistent tensions between intention and execution offer

important possibilities for progress.

Across the early childhood ecosystem, there is a compelling need for consensus among policymakers, funders, and program evaluators that addressing individual variation is critical to achieving better outcomes. This approach already exists in other fields that have demonstrated its power. As one example, in 1965, fewer than 5% of children with acute lymphoblastic leukemia, the most common form of childhood cancer, were alive five years after the time of diagnosis. Ten years later, the five-year survival rate increased to 60%, and now, the five-year survival rate is over 90%.¹⁰⁰ This extraordinary progress—from an almost universally fatal disease to a fully treatable one—was not achieved by the development of a new “miracle cure” but rather by adopting a mindset that expected, studied, and adjusted for variation in the effectiveness of the best treatments available at any point in time. As oncologists continue to provide state-of-the-art care for all children with leukemia, they also collect and analyze relevant data to best match existing treatments to different responses. Importantly, this strategy has not created an endless roster of unique treatments; it has identified evidence-based protocols—premised on the critical importance of flexibility—that have been shown to be effective for different subtypes of the disease and modified over time as indicated.²

Without minimizing the differences between treating cancer in a medical center and supporting child development across a variety of community-based programs, three compelling lessons stand out for change agents who are working to create early childhood policies and programs that can achieve greater impacts for more children.

1) Address universal needs but plan for and support flexibility to address variation. Broad-based programs—whether they provide direct services for children and families (e.g., childcare) or infrastructure investment

in low-income communities (e.g., affordable housing linked to a network of enriched services)—are still essential to ensure that all children’s basic needs are met. Many of these programs already target between-group differences by reducing barriers to opportunity faced by marginalized populations defined by socioeconomic status or geographic location, but relatively few address the barriers and challenges specific to racism. And even fewer have the capacity to address variation within demographic groups. As a result, evaluations of these programs mask a range of much larger and much smaller effects. A policy or program strategy that addresses variation explicitly can increase returns on investments in the following ways:

- Requiring and generating evaluation research that measures average outcomes and analyzes individual variation in effectiveness in order to develop new approaches that address what is not working, for whom, and in what context. (See *Moving Beyond “What Works?”* for more detail.)
- Strengthening the capacity of the early childhood workforce to anticipate and respond effectively to variation through training focused on the science of child development, provision of high-quality learning resources (e.g., flexible curricula, appropriate materials, access to specialists when needed), and boosting recruitment and reducing turnover of knowledgeable staff through appropriate compensation and continuing professional development.
- Paying greater attention to developmental timing—particularly during the prenatal period and first two to three years after birth—by focusing on the early foundations of healthy development when they are especially sensitive to environmental influences such as adequate nutrition and prevention of excessive stress activation.

2) Develop service models that can be tailored to fit a manageable range of alternative profiles. The answer to addressing variation more effectively does not lie in an extensive, unwieldy menu of highly individualized policies and programs. Rather, authentic collaboration among researchers, service providers, and families could help identify commonalities among children who are not benefiting from evidence-based programs, design and implement modified approaches, and evaluate their impacts. Early childhood programs can then employ a set of “typical variation” profiles that best match the children they serve. Initial screenings for population- and community-level risk and protective factors can provide a preliminary sense of the utility of these profiles. Subsequent analysis of children’s strengths and challenges, combined with family consultation, can provide additional detail to better align specific services to individual needs.¹⁰¹ When more effective interventions are demonstrated, successful adaptations for different profiles can be shared widely through a broadly accessible platform.

3) Support programs that engage in continuous quality improvement, focusing on both increasing average effects and addressing variation in effectiveness. When evaluators find out who is not responding as well as who is—and why—program implementors can use that information to modify their practices and assess the effects accordingly. The process begins with soliciting input from program participants, practitioners, supervisors, and administrators in order to understand the challenges they are facing and drive potential solutions. The Nurse-Family Partnership (NFP), a globally scaled, evidence-based home visiting program for first-time pregnancies, provides a case in point. NFP’s ongoing research identified two groups that were less likely to benefit from the program—those experiencing intimate partner violence and those

with symptoms of depression and/or anxiety. In collaboration with nurses and informed by interviews with program participants, NFP leadership developed new tools, resources, and supports, which were tested for feasibility and impact. Researchers and practitioners continue to work together to identify (1) the kinds of community-based resources that must be in place, (2) the household and community factors that influence implementation and impact, and (3) the training and support necessary for nurses to be able to deal successfully with challenging situations.¹⁰²

In summary, ensuring that all young children thrive depends on expanding beyond services that work on average by building in the flexibility to modify programs for those who are less or more likely to benefit. This means that those who benefit from lower-cost, broad-based

programs should continue to receive them and that programs and staff should have the capacity to make adjustments for those who are not benefiting. Some adjustments may require referrals to more intensive or individualized approaches provided by specialists. Others may require access to different curriculum materials that are more culturally relevant and/or a shared knowledge of evidence-based ideas that address individual differences both within and across all population groups. Whatever the local needs and opportunities might be, policies and systems are likely to achieve larger impacts—and ultimately greater benefits to society as a whole—by authorizing funding and accountability mechanisms that enable program leaders and practitioners to be flexible and provide opportunities to co-create best practices with families and communities.

Moving Beyond “What Works?”

How we evaluate programs matters. What is measured reflects what is valued, supported, and funded. Going forward, both researchers and policymakers must ask and answer, “What outcomes are we seeking, what works best (and least) for different children and families, in what context, and at what stage of development?” In order to answer these more challenging questions, all policies and programs would benefit from a clear *theory of change* that articulates what they intend to achieve, how their design and implementation are related to their stated objectives, and how the outcome measures being used are linked explicitly to assessing what works, for whom, at what age, and in what context.¹⁰³

Strategies

Strategies are the actions the program will take to achieve desired changes.

Targets

Program targets are the skills, behaviors, beliefs, attitudes, and knowledge that the program strategies aim to change in caregivers, children, and dyads.

Outcomes

Outcomes are the changes you hope the program will ultimately impact in caregivers, children, and the dyads.

Moderators

Moderators are person- or context-based factors hypothesized to affect which participants benefit more from a program and which participants benefit less or not at all.

Evaluations of programs that produce modest effects on average could contribute game-changing data by identifying groups of children and/or families who are *not* benefiting sufficiently from existing services. Focusing more attention on those who are not responding as well as others—and addressing the longstanding problem of program attrition—would provide enhanced opportunities to learn from creative, on-the-ground adaptations that could generate a wealth of new knowledge about what works and what does not. Conversely, the identification of who is most likely to benefit could lead to targeted replication for similar children and families in comparable contexts.²

For more on developing and evaluating a clear and precise theory of change, go to ideas.developingchild.harvard.edu

Supporting a wide range of needs across variations in settings, experiences, environments, contexts, and individual differences is not easy. Promoting optimal well-being at scale is a challenge that requires researchers, service providers, policymakers, and families to work together.

- Early childhood researchers and practitioners could enhance the effectiveness of existing services by collaborating on the development of alternative strategies for children and/or families whose needs and assets are not being addressed adequately by current best practices.
- Researchers and primary care pediatricians are already working together to develop and test non-invasive biomarkers of stress activation and resilience that can be used to identify children who are more sensitive to adversity and measure the differential effectiveness of specific interventions to reduce the risk of toxic stress.¹⁰⁴
- Policymakers, service providers, and researchers are more likely to achieve larger impacts when they are able to understand and address

a wide diversity of local needs, challenges, and opportunities. The success of community-engaged research methods in improving health outcomes in marginalized populations illustrates the power of including families and other caregivers in the research and evaluation process.¹⁰⁵

While there are technical challenges involved in adopting more individualized approaches and in analyzing variation in the effectiveness of policies and programs—as well as considerable inertia invested in the longstanding emphasis on average effects—change is possible. The status quo is the result of choices we have made in policy, practice, and research, and we can choose to do things differently. That change can begin by strengthening the capacity across sectors to tailor the implementation of policies and programs to address inevitable variations in their effectiveness.

The time has come to raise the bar and aim for greater reductions in preventable disparities in health and development, as well as larger benefits for more children across racial, ethnic, and income groups, whether they live in urban, small-town, or rural areas. The first step should always be

to eliminate disparities at their source by reducing poverty, increasing opportunity, and protecting children and caregivers from hardships and threats related to racism and other sources of significant adversity. But even then, there will be differences in how children respond to programs and services. The price of continuing business as usual and ignoring either the science of human variation or the diversity of lived experiences in the early years of life is far too high. The prospect of aligning the power of both to inform a more effective and equitable early childhood ecosystem is within our reach.

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For more specific policy implications, ideas, and examples, visit developingchild.harvard.edu in 2024 and beyond.

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