



EDUCATION FORUM

Protecting Brains, Not Simply Stimulating Minds

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Curricular enhancements in early childhood education that are guided by the science of Learning must be augmented by protective interventions informed by the biology of adversity. The same neuroplasticity that leaves emotional regulation, behavioral adaptation, and executive functioning skills vulnerable to early disruption by stressful environments also enables their successful development through focused interventions during sensitive periods in their maturation. The early childhood field should therefore combine cognitive-linguistic enrichment with greater attention to preventing, reducing, or mitigating the consequences of significant adversity on the developing brain. Guided by this enhanced theory of change, scientists, practitioners, and policy-makers must work together to design, implement, and evaluate innovative strategies to produce substantially greater impacts than those achieved by existing programs.

Advances in neuroscience, molecular biology, epigenetics, and the behavioral and social sciences indicate that the foundations of educational achievement, lifelong health, economic productivity, and responsible citizenship are formed early in life. Based on this knowledge, early childhood policy and practice are grounded in a growing understanding of the extent to which early experiences are incorporated into the developing brain, for better or for worse (1). An environment of stable, stimulating, and protective relationships builds a strong foundation for a lifetime of effective learning. In contrast, when young children are burdened by significant adversity, stress response systems are overactivated, maturing brain circuits can be impaired, metabolic regulatory systems and developing organs can be disrupted, and the probabilities increase for long-term problems in learning, behavior, and physical and mental health (2).

An Enhanced Theory of Change

Most programs for children in disadvantaged circumstances (typically defined by low family income and limited parent education) combine enriched learning experiences for the children and parenting education for mothers. Over four decades of evaluation research have generated ample evidence of the benefits of such interventions, but the magnitude of impact is typically modest (3). As promising new preschool curricula focus on teaching science (4), numeracy (5), and executive function skills (e.g., focused attention and impulse control) (6), advances in neurobiology suggest that socioeconomic disparities in educational achievement could be reduced more effectively by linking high-quality pedagogy to interventions that prevent, reduce, or mitigate the disruptive effects of toxic stress on the developing brain.

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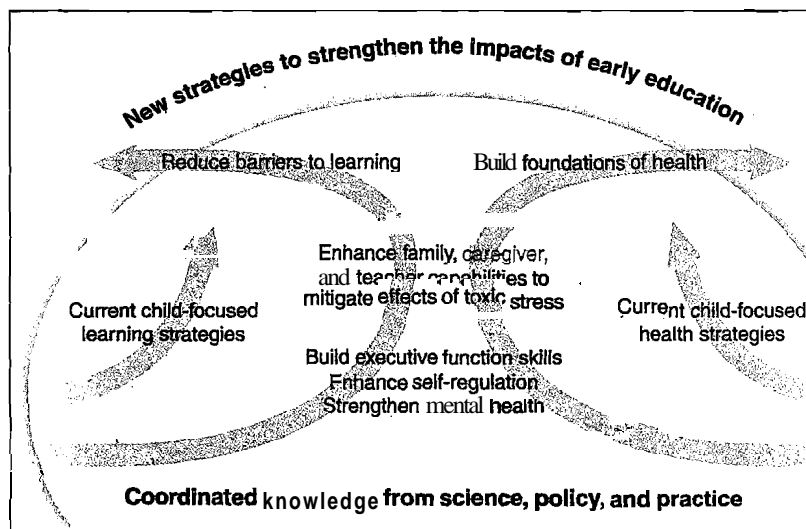
There is extensive evidence that significant adversity can lead to excessive activation of stress response systems (including persistently elevated stress hormones, such as cortisol) that can disrupt the developing brain (7). When children experience recurrent threat, fear conditioning affects developing circuits in the amygdala and hippocampus, which can lead to anxiety that impairs learning (8). This "fear learning" can begin early in infancy, whereas "fear unlearning" requires further development of the prefrontal cortex (PFC) later in childhood (9). In contrast to the relatively early maturation of the amygdala and hippocampus, the range of executive function and self-regulation skills mediated by the PFC develops well into adulthood. As the foundations of these skills emerge in the infant-toddler period, social class differences in the development and function of the PFC begin to appear (10). Because these higher-level neural circuits have extensive interconnections with deeper structures in the amygdala and hippocampus that control sim-

ple memory formation and responses to executive function skills both influence and are affected by a young child's management of emotions. Thus, early and repeated exposure to adversity can lead to emotional problems as well as compromised working memory, cognitive flexibility, and inhibitory control.

Young children who experience the effects of multiple economic and social stressors in preschool with higher rates of emotional problems related to fear and anxiety, disruptive behaviors, impairments in executive function, self-regulation, and a range of difficulties categorized as behavior problems, learning disabilities, attention deficit hyperactivity disorder (or mental health problems) (11). Vulnerable children who do well in school often have developed capacities in executive function, emotional regulation, which help them cope with adversity more effectively and provide a foundation for academic achievement and a sense of competence (12). Evidence that executive function and self-regulation predict literacy and numeracy skills underscores the salience of these capacities for targeted intervention (13). Teachers also contend that competence in these domains is more important at school than knowledge of letters and numbers (14). The neuroplasticity that leaves these capacities vulnerable to early disruption also enables remediation during sensitive developmental periods (15). For example, responsive caregiving has been shown to be a potent buffer for priming "vulnerability genes" that affect stress regulation (16), as well as for human toddlers who are biologically predisposed to be more anxious than typically developing children.

A New Intervention Agenda

If early childhood policy and practice pay more explicit attention on buffering vulnerable children from the neurodevelopmental con-



of toxic stress, then scientists, **practitioners**, and policy-makers could work together to design and **test** creative new interventions that **combine** both cognitive-linguistic stimulation with protective interactions that mitigate the harmful effects of **significant adversity**, beginning as early as possible and continuing throughout preschool. For this two-pronged approach to succeed, new strategies will be needed to strengthen the capacities of parents and **providers** of early care and education (beyond the provision of additional information and **supports**) to help young children cope with stress. To that end, three challenges are worthy of **thoughtful** exploration.

First, although pre-K programs for 4 year **children** represent an important **step** forward in expanding learning opportunities before **kindergarten**, age 4 **cannot** be **characterized** as "early" with respect to brain development. For **children** in adverse **environments**, four years of **inaction** in the face of repeated threats to developing brain **architecture** are difficult to justify.

Second, although the influence of the home environment on school readiness and later **academic achievement** is **well-documented** (11), **conventional** parenting education and **family support** programs that simply provide information and advice have limited **impact** on the development of young children experiencing **considerable** stress (18). Alternatively, advances in neuroscience suggest that **interventions** that **services** that enhance the mental health, executive function **skills**, and self-regulation capacities of vulnerable **mothers**, **beginning as early as pregnancy**, suggest promising strategies to protect the developing brains of their children. Such services are likely to be particularly important for **parents** with **histories** of early adversity, later school difficulties, and **minimal** workforce experience, who have not had ample opportunities to develop the **organizational skills** needed to create a well-regulated **caregiving environment** that helps young children develop their own adaptive **capacities**. To this end, although interventions have been **shown** to improve executive function skills in **college** students with ADHD (19), efforts to build similar capabilities to enhance the parenting skills and stress-buffering capacities of mothers with **limited** education **constitute** unexplored, yet promising, **territory**.

Third, although the call for more effective **strategies** to build parenting **capacities** is broadly accepted, the unmet, skill-building needs of service **providers** in these domains are acknowledged less **frequently**. Although many **preschools** are staffed by highly **trained professionals**, a large

proportion of staff in **early** care and education **programs** have limited education, constrained work experience, and high rates of **depression** (20). Thus, large numbers of **vulnerable** children and highly stressed staff are engaged in dysregulated **interactions** on a daily basis that compromise early learning and undermine the ability to manage routine challenges and **normative** life stresses (12). **Other indicators** of **unmet staff training** needs include **complaints** about high rates of problematic child **behaviors** (14), **increasing** antipsychotic drug **prescriptions** for children as young as age 3 (21), and large numbers of children **being** expelled from **preschool** programs (22). These signs of impending staff burnout **underscore** the need for expanded professional **development** activities to **strengthen** emotional health and **executive function skills** and self-regulation capacities of early **childhood** service providers.

The call for interventions that **build** adult capacities to prevent or **reduce** disruptions in developing brain **circuitry** in young children, above and beyond providing rich learning experiences, raises multiple questions for early childhood **education**. How **does** this new **paradigm** influence thinking about the developmental **requirements** for **successful** learning and our understanding of how to get a derailed process back on track? Which remote risk factors (e.g., toxic stress in **infancy**) and more proximal **impediments** (e.g., **chaotic** home or child care **settings**) are amenable to practical intervention? How much **can** we improve **learning** outcomes in young children by strengthening the mental health and executive **function** and **self-regulatory skills** of parents and program staff? How **can** **responsibility** for building a strong foundation for school success be better shared among education, health, and human services systems?

The call for greater attention to building the stress-buffering capacities of parents and **providers** of early care and education as a promising **strategy** to promote effective early **learning** is relatively new. The challenge of promoting collaboration across disciplines and service sectors is not **Neuroscientists** who study the **impact** of adversity on the PFC have limited interaction with psychologists who **study** executive function in children or adults who live in disorganized **environments**. Neither **group** engages regularly with educators who work with children who exhibit problems in emotional stability or **self-regulation** nor with policy-makers who make **decisions** about allocating resources to education, health care, and **human services** that **interact** separately with the same children and **families**. A shared under-

standing of the common scientific foundations of learning, behavior, and both physical and mental health offers a compelling **strategy** for breaking down enduring barriers (2).

Persistent **socioeconomic gaps** in school readiness and academic achievement as well as the variable effectiveness of existing interventions, demand **fresh** thinking. The formulation of creative strategies to strengthen the **organizational**, self-regulatory, and mental health **capacities** of the adult caregivers and teachers who constitute the environment of **relationships** in which young brains develop **could** offer new pathways toward potentially greater impacts on **early** learning. The extent to which **scientific** advances offer new insights to guide **innovative** policies and **practices** has never been **greater** (23). The need for a more balanced and **integrated** approach to both enrichment and **protection** for the developing brain **has** never been more **compelling**.

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10.1126/science.1206014