

ISSUE BRIEF

Fixing Behavioral Health Care in America

Promoting Brain Health and Brain Fitness: A National Call for Action

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*Note: The Kennedy Forum hosted several focus groups to discuss Brain Fitness opportunities in the behavioral health field. This list is not exhaustive of all focus group participants. In addition, focus group participation does not mean a formal endorsement of The Kennedy Forum recommendations or this issue brief by the attending organizations.

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Executive Summary

The Race to Inner Space

During global Brain Awareness Week in March 2015, The Kennedy Forum convened experts at the historic Kennedy compound in Hyannis Port, MA to consider perspectives and review recent findings on brain research. Representatives from the fields of neuroscience, pediatrics, psychology, mindfulness, neurocognitive behavior, education, healthcare, research, and technology gathered to explore ways to effectively convert brain health and fitness knowledge into high-powered tools for improving the well-being of the U.S. population.

These experts agreed that focusing on early childhood development through neuro-supportive, school-based intervention models would maximize an investment in national brain health and fitness. Evidenced-based, brain-building activities are among the most accessible and direct routes to improving academic achievement and optimal mental health in our nation's youth, especially when reinforced throughout childhood and adolescence. Effective brain health and fitness interventions will play a key role in revitalizing grade school learning and American society.

While this issue brief and its recommendations prioritize brain fitness interventions in children and adolescents, The Kennedy Forum also recognizes the importance of brain fitness through the entire life cycle. Just as physical fitness is needed for all ages, it is necessary for people to practice brain building exercises throughout their lives. The evidence supporting brain fitness exists for all age groups. Many programs and interventions for older adults are ready for wide-scale adoption. The Kennedy Forum will focus on the role that brain health and conditioning plays in keeping all Americans mentally fit.

During the 1960s, President Kennedy initiated the "Race to Outer Space." The Kennedy Forum is proud to now launch the "Race to Inner Space." Recent scientific findings show that implementing interventions that develop children's brains in the areas of cognition, mental and emotional states, and prosocial behavior, increases children's higher-order processing, inner-resilience, and overall well-being. The Kennedy Forum suggests that a concentrated focus on brain health and fitness will improve the lives of Americans, and restore our nation's status as a global frontrunner in education, ensuring prosperity for citizens and country alike.

The Challenge

Our Current Education Model is Failing

America's education system has always strived to respond to the needs of society, changing overtime to accommodate the agrarian, industrial and now information ages. Yet, despite significant investments in updating standards, curriculum, and content delivery, in many sectors of American society today, the current education paradigm is failing to adequately prepare children for some of life's most fundamental challenges, including college readiness and persistence, as well as career success.

Early brain fitness interventions that enhance brain health are a key missing ingredient in these educational reforms. The Kennedy Forum believes that the poor academic performance in the U.S., when compared to other countries, is largely due to a lack of early and optimal childhood interventions, especially in schools with large, low-income populations. A report in 2013 from the Council on Foreign Relations (CFR) concurs. Author Rebecca Strauss, Associate Director for CFR's *Renewing America* publications states, "(t)he real scourge of the U.S. education system, and its greatest competitive weakness, is the deep and growing achievement gap between socioeconomic groups that begins early and lasts through a student's academic career." In fact, the U.S. currently ranks below the global Organisation for Economic Co-operation and Development (OECD) average on reading and science scores, and is close to last in mathematics. Asia and some European countries are far outpacing American academic achievement in a trend that has been developing for decades.

Research in neuroscience proves that even the best teaching and curricula can have surprisingly little effect when a child's cognitive and emotional readiness to learn is not adequately addressed.

Research in neuroscience proves that even the best teaching and curricula can have surprisingly little effect when a child's cognitive and emotional readiness to learn is not adequately addressed. "Traditional education has been about transferring educational content, not optimizing these fundamental underlying information processing systems," states cognitive neuroscientist, Adam Gazzaley, MD, founding director of the Neuroscience Imaging Center at University of California, San Francisco. Research also shows that brain health and fitness interventions significantly boost students' abilities to learn and engage socially by building habits of mind and reinforcing neuroanatomical and neurochemical states that promote learning and self-regulation.

The Roots of Academic Underperformance

Multiple and overlapping causes can be identified that lead to educational weakness in America. On the academic level, many teachers and schools are underfunded, overburdened, and forced to find more efficient ways to move large classes through the required curriculum to pass standardized tests for state and federal funding. Passing grades show achievement, but often at the cost of not effectively educating the whole student and preparing that student for career success. At the socioeconomic and environmental levels, as Strauss states above, our current education system has not adequately addressed America's income-related achievement gap. Currently:

- 44 percent of American children live in low-income families
- 22 percent in poverty
- 69 percent of children living with single parents are low-income.

Additionally, almost half of America's children are exposed to Adverse Childhood Experiences (ACEs), such as divorce, substance abuse by an adult, violence, economic hardship and ethnic discrimination.

Despite No Child Left Behind and other standards designed to equalize educational opportunity across America, almost half of our children are predisposed by environmental conditions (poverty and ACEs) to not fully benefit from the federal and state educational opportunities in the current public school curricula.

ACEs significantly impact the neurology of children. Research repeatedly shows that ACEs affect a child's ability to learn, integrate into social settings, self-regulate, and respond appropriately within the school environment. Children who are affected by ACEs often lack the neuro-abilities to maintain focused attention, manage interpersonal relationships, and resolve conflict effectively, and engage with authority properly. These children generally have lower intrinsic motivation for learning, and are often missing the basic skills required for academic and social success. Despite No Child Left Behind and other initiatives designed to equalize educational opportunity across America, almost half of our children are predisposed by environmental conditions (poverty and ACEs) to not fully benefit from the federal and state educational opportunities in the current public school curricula.

The Opportunity

Brain Fitness is the Key

Today we know that without interventions that directly address a child's ability to learn and function in society, our current academic paradigm and process will continue to be less than effective. Neuroscience shows that brain fitness interventions can build higher-order processing skills, promote emotional resilience, and mitigate stress. These interventions interrupt and ameliorate many of the underlying neuro-developmental lags in children caused by the environmental stressors that thwart learning. In fact, many of the current adverse and economic conditions that almost half of our children are exposed to are likely due, in part, to the limitations our education system had in preparing their parents to succeed. Brain health and fitness interventions implemented across American education will benefit our nation's children now and into the future, and help close the academic achievement gap.

Research over the past two decades illuminates the powerful opportunities that simple, targeted, effective brain fitness interventions offer. On the neuro-cognitive level, these interventions can shift the intrinsic dispositions, abilities, and capacities of children to help them cultivate the cognitive capacity, attention, and self-regulation needed to succeed both academically and in life.

While scientists continue to unravel the secrets of the brain, brain fitness interventions are increasingly supported by reputable research and success in multiple school-based implementations. Science is proving that brain fitness is one of the most viable solutions towards remediating the developmental issues caused by inequity. When applied across the entire spectrum, these interventions can benefit the entire population. Regardless of economic status, race or background, brain fitness improves a child's academic performance and overall well-being.

The most effective brain fitness interventions fortify learning across all academic subjects and build emotional mastery by developing underlying core cognitive capacities known as executive function (EF). These EF skills make higher-order processing and self-regulation possible. Successful brain fitness protocols also include “social and emotional learning” (SEL) curriculums that are designed to build on EF skills to promote traits scientifically associated with inner resilience, such as optimism, gratitude, social and self-awareness, and goal perseverance. Additionally, brain fitness interventions are targeted at reducing stress and training brain states for optimal learning while simultaneously reinforcing EF and social and emotional skill

building. This integrated approach works synergistically to help all children become more focused and resilient, giving them the mental and emotional grit to overcome adversity and develop mastery in school and beyond.

The Kennedy Forum proposes the following brain building interventions on the basis of sound research and proven efficacy:

- **Executive Function Training** – Increases and improves higher order processing; engages the prefrontal cortex (PFC) in learning and decision-making.
- **Social and Emotional Learning (SEL) Activities** – Increase and improve self-regulation, the ability to understand and manage emotions, set goals, feel compassion and empathy, maintain attention, and create social harmony.
- **Mindfulness Training** – Allows for purposeful brain regulation that increases and improves ability to be present, maintain attention, down-regulate disruptive emotions, and direct learning and social input to higher-order processing.
- **Brain Literacy** – Introduces brain anatomy and physiology, and how the brain works and learns to students and teachers; empowers participants with education and understanding of brain function, as well as the opportunities brain fitness offers.
- **Neurofeedback** – Provides self-reflective feedback loops that allow individuals to witness brain activity and increase and improve EF skills, such as attention, focus, and other cognitive abilities.

Establishing Strategic Goals

Now is the time for America to strategically reinvest in education by introducing comprehensive brain fitness into early education and reinforcing brain health and fitness tools from pre-school through high school. Brain fitness training will complement and enhance existing curricula, and will provide our children with powerful strategies for school and lifelong success.

Wide-scale adoption of a brain fitness movement will have barriers and challenges. In schools today, cash-strapped districts are understandably resistant to anything that sounds like the next best fix. Faculty and administrators are hesitant to adopt programming they perceive as add-ons to an already over-scheduled curriculum. Further, teachers and administrators themselves typically have little or no experience with brain fitness or brain literacy.

To address these barriers, The Kennedy Forum recommends a three-level approach:

- I. National leadership to facilitate mass adoption of evidence-based, brain fitness interventions that address Executive Function training and integrate Social Emotional Learning, and brain literacy through the development and dissemination of easy-to-adopt programs, tools, and resources for schools and communities.
- II. A national brain health and fitness public awareness and advocacy campaign that extends into schools, communities, research, and politics.
- III. State and federal policy initiatives that fund nationally-required brain health and fitness implementation and assessment plans in early education through high school (including teacher trainings), with special funding for high-need districts.

In addition to creating a solid pathway for children and adolescents, the brain fitness and wellness recommendations in this Issue Brief should be applied to all Americans, regardless of age and socioeconomic status.

Level I: Mass Adoption of Brain Health and Fitness Interventions

Now is the time for our nation's educational and health leaders to commit to the implementation of these strategic goals and specific interventions into school and community programming.

While there are schools across the country who have already adopted brain fitness interventions, scaling these practices and fully integrating brain health and fitness into the education curriculum will require national leadership. Federal leaders, including the U.S. Departments of Education and Health and Human Services, working in partnership with the education and educator advocacy community, should develop and disseminate the following national guidance and resources:

- Easy-to-adopt brain health and fitness programs
- Best practices to integrate Executive Function training, Social Emotional Learning and brain literacy into current curricula
- Measurements to assess students' brain fitness strengths and weaknesses annually (similar to the yearly physical)
- Technical assistance and training tools for teachers and school faculty.

Level II: National Public Awareness and Advocacy Campaign

Knowing the problem and understanding the solution is only the first step. A public awareness campaign also is needed to bridge the research gap and communicate the wide scope of brain fitness benefits and the immense risk of inaction. We need to send a clear and urgent message to all influential groups including educators, parents, industry leaders, and politicians. In addition to educating the public and key influencers, leaders across segments of society who understand the pressing need for change in childhood education must be encouraged to step forward and become champions of universal adoption of brain fitness interventions in our public schools.

As a nation, we must act now to interrupt negative educational, socio-economic, and health trends and patterns, including the:

- Downward trend in global education rankings and poverty's role in the U.S. achievement gap
- Resulting economic impact from lower productivity in all areas of business, innovation, and academics
- All-time high national incarceration rates
- Continued increase in mental health issues, such as attention deficit hyperactivity disorder (ADHD), depression and anxiety, and the concurrent increase in prescription medication use, with attendant dependencies and medical costs
- Persistent trends in teacher attrition
- Inadequate testing system that continue to be an ineffective predictor of college readiness and career success
- Impact of ACEs on behavior in youth, including substance abuse and bullying.

All stakeholders—from scientists to school superintendents to parents to friends to future employers—must become aware that brain fitness is the missing link in American education and that they have an important part to play for a national implementation to be successful.

Level III: More Educational Funding Needed to Promote Brain Health

To really make an impact, brain fitness must be part of federal and state education funding and standards, not as an added hoop for districts and states to jump through. We must position brain fitness as a high-priority and well-positioned solution to some of the greatest shortcomings and stressors in the current education system at the state and federal level.

To scale these interventions and reach our most disadvantaged students and schools, we will need additional federal and state funding authorized to support state and local education agencies in the implementation of brain health and fitness interventions and teacher training.

While budgets are tight, advocates and policymakers have many opportunities to pursue this funding through current law and pending reauthorizations of federal education legislation. The Kennedy Forum believes these interventions, supported by state and federal policy and funding, will greatly enhance our nation's ability to thrive – academically, economically, and socially. Further, their implementation will produce overall, long-term savings in state and federal budgets, including spending less on healthcare, remedial education, and the social programs.

Conclusion

This issue brief details important brain health and fitness interventions, public engagement strategies, and policy recommendations. The Kennedy Forum concludes that there is an opportunity to stimulate a shift in the American education paradigm by adding the needed and previously missing pieces of brain health and fitness to existing academic curricula. The Race to Inner Space will bring brain health and fitness into the nation's public policy forefront.

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Issue Brief:

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Introduction

Reclaiming Our Elite Global Standing

The long-term, overarching goal of a brain health and fitness movement is to affect change in American education, and consequently academic outcomes, mental health, life achievement, and the quality of American society. To reach this goal, we must start with the seeds of our future society: our children.

Evidence-based, brain-centric interventions are the on-the-ground tools of change that teach children brain fitness from a whole-child perspective. Brain-based applications are already showing excellent results across a range of industries. Those committed to top performance, in all sectors, know that brain fitness is essential for success. Elite athlete training programs, high-powered multinational corporations, as well as the U.S. military are all adopting brain-boosting interventions. While brain fitness intervention in early childhood will have the biggest impact, The Kennedy Forum recognizes that brain fitness can improve brain health at any age, as many corporations and athletes have discovered.

Providers, insurers and others also are taking notice of brain training's impact on improved patient well-being and the accompanying cost savings. As such, brain health and fitness protocols are increasingly being integrated into treatment plans. Similarly, well-informed consumers are purchasing cutting-edge, wearable technologies that track brainwaves and help the user build optimal states of mind for performance and/or relaxation. Schools also are investing in brain fitness and are seeing significant improvements in academic and prosocial outcomes. (See Appendix for examples.)

The Kennedy Forum supports and is informed by these trends, and believes it is time for the U.S. to now move from segmented utilization of brain fitness interventions, to national, mass implementation. As a country we must prioritize the adoption of brain health and fitness practices by our nation's schools. Children raised with an emphasis on mind mastery will build a strong foundation for a lifelong practice that improves educational, personal, and professional outcomes. In the short term, these practices will increase performance for all children while interrupting the negative brain impacts caused by poverty and Adverse Childhood Experiences (ACEs). Over the long-term, our children are more likely to avoid the social consequences and societal costs associated with low socio-economic and ACE factors, such as dropping out of high school, lower wages, poorer health, and higher risk of incarceration. As today's children become tomorrow's adults, they will bring these brain fitness tools with them into the workplace and into the home, helping to build a tipping point toward societal transformation. Eventually, brain-based

advantages will be seen as a right for all children who come of age in our nation's school systems. A public awareness and advocacy campaign will inform society of the benefits of brain health and fitness in the same way that the benefits of exercise and nutrition were taught: through the advice of medical doctors, psychologists, parents, peers, published findings, and the media. Simultaneously, policy initiatives will bring awareness to lawmakers and help to integrate brain fitness funding and standards into key educational guidelines and education law.

To reclaim our elite global ranking, we must first have a solid understanding of the fundamental flaws in our present education paradigm, and the knowledge of how a national brain health and fitness effort will strengthen our public school outcomes.

The Challenge

Our Current Education Model is Failing

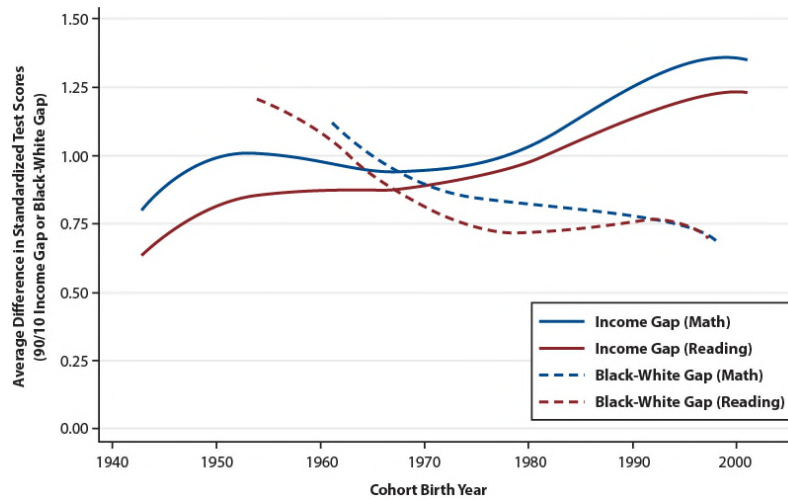
Not 100 years ago, education was vastly different than it is today. The small-town schoolhouse taught children basic academic skills, while family and religion informed the deeper personal developmental processes. As the education paradigm shifted over the decades, public schools prioritized universal access to public education, continuing to emphasize academics, while beginning to give limited attention to social and emotional development.

Society became more secular as religion, gender, and ethnic diversity increased, and this changing national demographic was reflected in the classroom. Schools eventually began to assume responsibility for not only academics, but for greater character development as well. This trend was increasingly supported by new research, which invariably informed and helped create an evolving base of educational best practices.

In the 1960s, President John F. Kennedy promoted physical fitness as an important element of child development and it was soon incorporated into the education model. In more recent years, the role and impact of nutrition have become important aspects of the education equation. The implementations of standardized testing, No Child Left Behind, and the Common Core are among the most recent attempts to optimize academic performance for American school children.

However, even with the significant changes over the last century, including a decline in the racial-related academic achievement gap, American education as a whole has not fully succeeded. In recent decades our global academic standing has been dropping steadily while our country's income-related achievement gap has been on a dangerous ascent.

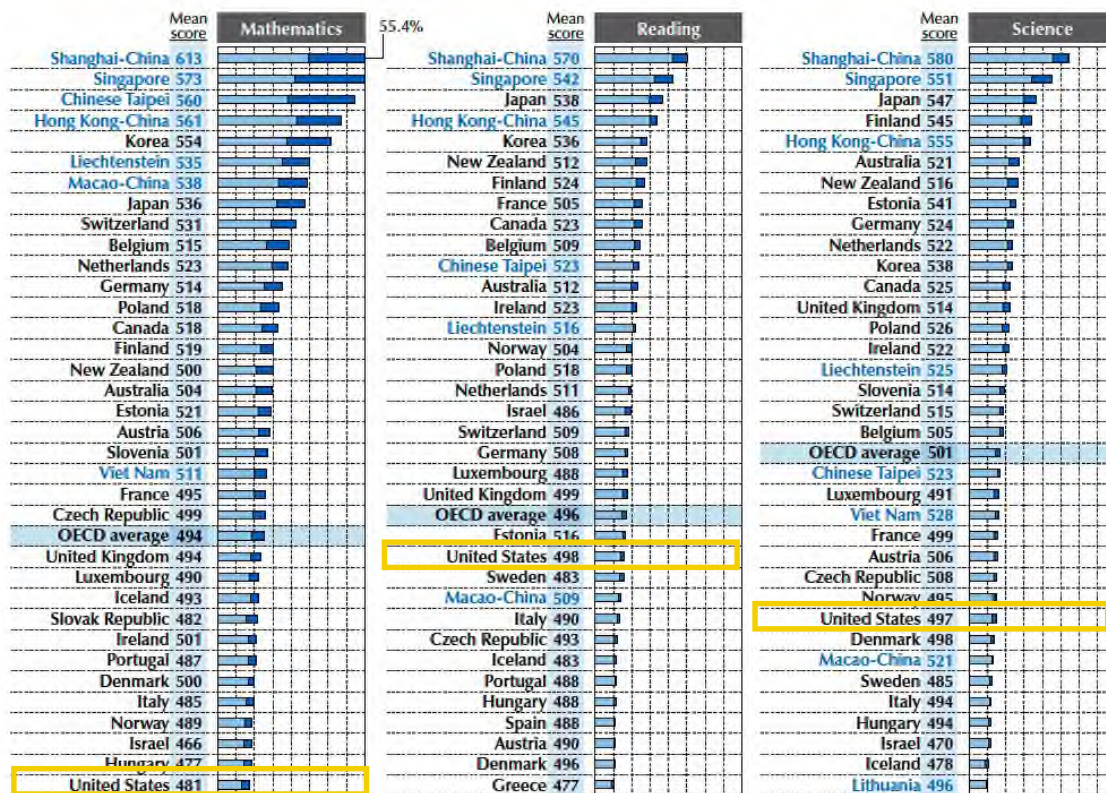
US Achievement Gap: Income-Related versus Racial-Related



Source: Sean F. Reardon, “The Widening Academic Achievement Gap Between the Rich and the Poor: New Evidence and Possible Explanations,” *Whither Opportunity? Rising Inequality and the Uncertain Life Chances of Low-Income Children*, New York: Russell Sage Foundation Press, 2011.

The U.S. spends the fifth highest amount in the world per capita on education from pre-kindergarten through college level, according to a 2012 report by the Organisation for Economic Co-operation and Development (OECD). Nevertheless, its academic outcomes have fallen behind many of the 34 developing countries in the OECD study. The Kennedy Forum believes the U.S. must reallocate its educational investments to maximize outcomes. “In the 1960s and 70s, the U.S. was way ahead of any other country... but other countries have done a lot better at getting their resources where they will make the most difference” says Andreas Schleicher, an education policy adviser to the OECD.

Snapshot of National Performance in Mathematics, Reading, & Science



Source: OECD, 2012 Program for International Student Assessment (PISA)

The countries in the OECD report, with better educational outcomes than the U.S., are investing far more in early childhood education interventions and are successfully flattening the achievement gap gradient of their children across socio-economic classes. This evidence supports the vital need for the U.S. to invest in early education as well. The Kennedy Forum believes we can maximize this investment by focusing on brain health and fitness interventions that support the neuronal and emotional processes that underlie all learning—a focus that until now has remained largely absent from the evolving public school approach.

Environmental Factors Affect the Achievement Gap

Pressures of Poverty on Performance

Given that the United States has one of the highest child poverty rates in the developed world, zeroing in on early childhood intervention is essential for closing the income-related achievement gap.

According to the National Center for Children in Poverty, of the 72 million children under age 18 in the U.S., 31.8 million live in low-income families and 15.8 million live below the federal poverty level (Jiang et al., 2015). Studies confirm that negative academic, social, health, and wellness issues are more common in children from low-income families. Consequently, these children are less likely to graduate from high school, which in turn, reduces lifetime earnings. This pattern perpetuates the cycle of poverty with a compounding effect. According to the National Center for Education Statistics' 2011 report, *Trends in High School Dropout and Completion Rates in the United States: 1972–2009*, "...in 2009, the event dropout rate of students living in low-income families was about five times greater than the rate of their peers from high-income families..." (Chapman et al., 2011).

A mounting body of evidence is showing a direct correlation between poverty, brain impairment and a resulting achievement gap. Studies highlight the difference in brain function between children of different socioeconomic classes. One study asserts that, "Event-related potentials (ERPs) and other electroencephalographic (EEG) evidence show that frontal brain areas of higher and lower socioeconomic status (SES) children are recruited differently during selective attention tasks. Lower-SES children used additional compensatory resources to monitor/control response inhibition to distracters, perceiving also more mental effort, as compared to higher-SES counterparts" (D'Angiulli, et al, 2012).

Recent work from a number of laboratories has demonstrated SES disparities in the neuroanatomic structure and function of the prefrontal and limbic cortical regions.

As Kimberly G. Noble, M.D. reports in her May 2014 article, *Rich Man, Poor Man: Socioeconomic Adversity and Brain Development*, "...socioeconomic disadvantage is associated with a decreased ability to regulate cognition and emotions, a critical aspect of school readiness that predicts grades and achievement test scores from elementary through high school. Recent work from a number of laboratories has demonstrated SES disparities in the neuroanatomical structure and function of the prefrontal and limbic cortical regions that support these skills" (Noble, 2014). Additionally, in 2015, Noble and her colleagues published a report on the brain

development of 1099 youth ages 3-to-20, finding that higher income levels correlate with increases in brain surface area. The report states, “differences in income were associated with relatively large differences in [brain] surface area...most prominent in brain regions supporting EF, reading, language, and spatial skills” (Noble et al., 2015).

In another recent study conducted by MIT’s Department of Brain and Cognitive Sciences using neuroimaging of public school children’s brains, 40 percent of the subjects were from low-income families and 60 percent from middle class backgrounds. Cortical thickness in all lobes of the brain was greater in the higher-income students. Greater cortical thickness, particularly in temporal and occipital lobes, was also associated with better performance on statewide standardized tests (Mackey et al., 2015).

Adverse Childhood Experiences Impact Learning

Not surprisingly, negative impact on brain development due to environmental stress is highly correlated with, though not exclusive to, lower income levels in the home. Child Trends, a nonprofit, nonpartisan children’s research center produced a report drawing on data from the 2011-2012 National Survey of Children’s Health (NSCH) regarding ACEs on U.S. children. Adult caretakers were asked if a child (birth through 17) within a given household had experienced any of nine adverse experiences, such as divorce, witnessing adult substance abuse, violence, economic hardship, and/or ethnic discrimination. Findings show that almost half (47.9%) of U.S. children endured at least one or more of the above ACEs. Economic hardship is the most common in the report, closely followed by divorce or separation of parents or guardians (Sacks et al., 2014). Additionally, the study shows that in adolescents aged 12-17, a greater number of ACEs is directly correlated to a poorer sense of well-being including low engagement in school, not staying calm and controlled, and high externalizing (lashing out) behaviors.

A 2012 study by the Canadian Academy of Health Sciences Expert Panel states, “There is substantial evidence that the stress-response system is plastic and extensively shaped by early experiences of stress and parental care. Significant exposures to early adversity, especially those encountered in the context of family hardship and deprivation, ... alter the structure and function of brain circuitry involved in the regulation of physiological stress” (Boivin & Hertzman, 2012).

Another 2012 report published in the journal of the American Academy of Pediatrics similarly states, “The risk factors studied in the Adverse Childhood Experiences Study include examples of multiple stressors...that are capable of inducing a toxic stress response. The essential characteristic of this phenomenon is the postulated disruption of brain circuitry and other organ and metabolic systems during sensitive developmental periods. Such disruption may result in anatomic changes and/or physiologic dysregulations that are the precursors of later impairments in learning and behavior as well as the roots of chronic, stress-related physical and mental illness” (Shonkoff et al., 2012).

The Opportunity

Why Focus on Brain Health and Fitness?

Poverty and ACEs negatively influence health and well-being over a person's entire life cycle, beginning with the early impairment of brain health and learning and continuing across a range of social, emotional, and cognitive processes. With a significant percentage of American children living at or below the poverty level and with ACEs, the sub-par brain development poses an enormous loss of future national human capital – a risk far too great for the U.S. to bear in a global economy that is increasingly being shaped and influenced by innovative disrupters and flexible thinkers.

On the economic front, despite efforts to flatten the income gap in the U.S., the disparity of wealth in our country continues to rise. Even the most aggressive economic solutions will take years, if not decades, to take effect. Our nation's children deserve solutions that work immediately to counter the negative influences of ACEs and poverty on the brain. Brain interventions that can be implemented in schools today are the most effective and accessible tools for leveling the playing field in the classroom, an essential first step towards leveling it in the workplace and throughout society as well.

To counter ACEs, science shows that overcoming negative stressors requires key adaptive systems in the brain that, when developed in early childhood, have the enduring effect of increasing a child's inner-resilience (Williams and Hazell, 2011). As explained on the American Psychological Association's website, "resilience is the process of adapting well in the face of adversity, trauma, tragedy, threats or significant sources of stress...It involves behaviors, thoughts and actions that can be learned and developed in anyone."¹

Brain health and fitness interventions described later in this report can offset the cognitive, social, and emotional risks associated with poverty and ACEs, providing today's teachers with effective tools to improve academic performance, address social and emotional development, enhance classroom environments, and close the achievement gap. Furthermore, these interventions not only help children affected by poverty and ACEs, they also improve academic and social outcomes for all students.

¹ See www.apapracticecentral.org/outreach/building-resilience.aspx

The Economies of Early Intervention

Investing in early childhood development returns \$7-\$10 per dollar investment.

According to James Heckman, Nobel Memorial Prize winner in economics and an expert in the economics of human development, investing in early childhood development returns \$7-\$10 per dollar invested when considering the economics of productivity associated with increased school and career achievement. Early childhood investment is also effective at reducing costs associated with under achievement. These savings include spending less on healthcare, remedial education, the social programs that service those who have dropped out of school or enter the criminal justice system (Heckman, 2012).

According to the site www.heckmanequation.org, the Heckman Equation for “upstream solutions to the biggest problems facing America” is as follows:

$$\begin{array}{c}
 \textbf{Invest} \\
 \text{in educational and developmental resources for disadvantaged families} \\
 \text{to provide equal access to successful early human development.} \\
 + \\
 \textbf{Develop} \\
 \text{cognitive and social skills in children from birth to age five.} \\
 + \\
 \textbf{Sustain} \\
 \text{early development with effective education through adulthood.} \\
 = \\
 \textbf{Gain} \\
 \text{a more capable, productive and valuable workforce that pays} \\
 \text{dividends to America for generations to come.}
 \end{array}$$

As a matter of national financial security and global competitiveness, the U.S. clearly needs a strategy to fund early education interventions that boost academic and life outcomes for our nation’s youth, and the earlier we start, the better. Interventions described in detail below, which directly support brain health and fitness, offer the most leveraged ways of maximizing our country’s economic and academic return on its educational investment.

Understanding Brain Health and Fitness in Children

Experts agree that the brain is the master control center, or supercomputer, that manages the entirety of human function and experience. The brain is the very seat of behavior and cognition. Senses, mobility, speech, intelligence, perception, emotions, and autonomic functions all depend on a healthy, well-working brain. For young children in school, brain function includes a child's ability, cognitively and emotionally, to learn, reflect, achieve, engage socially, and self-regulate at age-appropriate levels. As children grow through the early years of life, brain development determines their cognitive and emotional ability to interpret, respond to, and interact with their environment.

Given the right interventions and tools, all children can have access to more effective brain development and the subsequent academic and social gains. For this reason, The Kennedy Forum's Race to Inner Space campaign starts with early childhood brain health and fitness intervention.

We further recognize that brain fitness can be improved at any age. The most effective impact will be seen with people who practice brain fitness throughout the life cycle.

Brain health and fitness in children can be generally divided into two interdependent parts:

1. The physical brain, its health and neural development; and
2. The cognitive abilities and behaviors of the child, including academic ability, intrinsic motivation, and self-regulation.

Scientists find that these two parts of the brain are interrelated. A healthy physical brain predisposes children to higher performance, and increased performance further develops neural pathways and governing centers in the brain, which leads to higher-level outcomes. Therefore, both aspects of the brain need to be addressed in any successful intervention.

Signs of a Healthy Brain: Executive Function and Emotion Regulation

In the same way that a healthy physical brain supports strong cognition and vice versa, so too do strong core cognition and healthy emotional processing support one another. With ever-more accurate and accessible neuroimaging technologies, such as EEG and functional magnetic resonance imaging (MRI), scientists are creating a window into brain function that allows them to more clearly see how neural networks work together to affect physical, emotional, and cognitive development.

Executive Function (EF) refers to those neural processes in the brain that are managed primarily by the prefrontal cortex (PFC). These processes include memory, focus, impulse control, planning, prioritizing, and the ability to take in other perspectives. EF manages the key cognitive skills needed to process information. The PFC and EF are associated with the higher-level brain functions essential for academic success – reasoning, analyzing, rationalizing, discerning, complex thinking, decision-making, and creativity.

To create higher-order cognition, EF relies predominately on the PFC for three foundational brain functions that work interdependently: working memory, inhibitory control, and mental flexibility (Zelazo et al., 2003). These core EF skills not only support learning but also are required for social and emotional growth. The Center on the Developing Child at Harvard University reports that EF includes a set of developed skills that increase learning, social connection, creativity, positive behavior and healthy choices in childhood and throughout a person's lifetime.

Working memory involves the ability to hold attention on a concept or task long enough to complete an association or to generate a conclusion or new thought. The term describes a combination of cognitive processes for managing information, including receiving and holding new information, integrating new information with existing memory/information, and collating results into new information. Working memory also involves using or processing information that is no longer perceptually present (Baddeley & Hitch, 1994; Smith & Jonides, 1999).

Working memory is critical for learning, understanding, reasoning, solving, creating, and interpreting. For example, if we ask a child what his dog's name is, he might reply, "Spot." If we then ask, "If Spot went into the field, what would he do?" and the boy answers, "Run around," he is demonstrating the use of working memory. The boy is accessing existing memories of his dog, projecting a list of hypothetical actions for his dog in a field, choosing one in the moment, and declaring it. He has sorted through existing memory, evaluated an open-ended supposition, and then visualized to create a new outcome. He has also created a new "memory" – his imagined dog running around in an imagined field. Working memory is needed for learning letters of the alphabet, first phrases, etc., and it plays a key role in abstract and concrete learning throughout life.

Like all EFs, working memory can be taught, and some research finds that working memory is a more accurate predictor of academic success, particularly literacy and math, than IQ in grade school students (Alloway & Alloway, 2009).

Inhibitory Control, as described by developmental cognitive neuroscientist, Adele Diamond, “involves being able to control one’s attention, behavior, thoughts and or emotions to override a strong internal predisposition or external lure.” Inhibitory control involves the inhibiting (or suppressing) of attention from “distractors” in the environment in order to stay focused on the task at hand.

The net outcome of this control is the ability to stay focused and adapt one’s responses to stimuli with consideration rather than automatic reaction. For example, consider asking a child whose favorite number is 5 what $2 + 2$ equals. Without inhibitory control, she might blurt out the answer 5, or ask, “Why are you wearing that shirt?” if the shirt distracts her attention from the question. With inhibitory control, she is able to focus on the question, stay on task, resist acting impulsively, process information, and offer a calculated response. Inhibitory control has significant implications for civility. A child who has the ability to focus on what someone is saying, and who can pause when she hears something that offends her (inhibitory control), is much better able to get along well with others. This child is much more likely to use working memory to recall her mother’s advice to “use your words, not your body,” and thus deliver a learned, age-appropriate and thoughtful response.

Additionally, inhibitory control is required for any kind of self-discipline. In a study of middle school students, self-discipline accounted for more than twice the variance in final grades as did IQ. The study reports, “Highly disciplined adolescents outperformed their more impulsive peers on every academic performance variable...” (Duckworth & Seligman, 2005).

Mental Flexibility is the ability to shift between tasks and mental states. It is necessary for actions such as re-organizing priorities or thinking creatively about a problem. For example, if a teacher instructs her students to, “Pay attention to how I draw a star on the blackboard,” the children will enter a state of attentive observation, using inhibitory control to block out distractions as they watch the teacher draw the star. If the teacher then erases the star and asks them to “draw one on your own,” the children will use mental flexibility to shift from a state of attentive observation to a state of recall, using working memory to remember the shape of the teacher’s star. As the children begin to draw they will switch back to a state of inhibitory control to stay focused on their own drawing.

All of this cognitive switching and shifting is made possible by the students’ mental flexibility. Successful social interactions also involve mental flexibility, when students consider another’s perspective or when they acknowledge a personal mistake.

Executive Functions (EF) skills are stronger early indicators of academic performance than other measures of intelligence such as IQ.

EF skills predict school readiness as well as prosocial behaviors, and are stronger early indicators of academic performance over an individual's educational trajectory than are early academic markers or IQ (Alloway & Alloway, 2009; Blair & Razza, 2007; Duckworth & Seligman, 2005; McClelland & Homes, 2000; Bierman et al., 2008). Conversely, childhood deficiencies in EF predict not only compromised academic outcomes throughout school, but also subsequent problems later in life (Friedman et al., 2007; Moffitt, 2012; Moffitt et al., 2011).

Research supports the need to develop EF in children to close the achievement gap and ensure the future success of our nation's children. It follows, therefore, that any effective brain fitness program should center on strengthening EF skills--the core building blocks of learning.

As essential as they are, we aren't born with the skills that enable us to control impulses, make plans, and stay focused. We are born with the potential to develop these capacities – or not – depending on our experiences during infancy, throughout childhood, and into adolescence.

A paper published in 2011 by the Center on the Developing Child at Harvard University titled, *Building the Brain's "Air Traffic Control" System: How Early Experiences Shape the Development of Executive Function*, effectively summarizes the importance of developing EF. "As essential as they are, we aren't born with the skills that enable us to control impulses, make plans, and stay focused. We are born with the potential to develop these capacities – or not – depending on our experiences during infancy, throughout childhood, and into adolescence."

In addition to being the foundational skill sets for academic achievement, EF allows the PFC to regulate responses to stimuli, offering more discerned and appropriate consideration than if processed by the limbic or reptilian parts of the brain, which are more inclined to trigger emotional reactivity. For example, a child with low EF might strike out at another child for taking his or her toy, whereas a child with more developed EF might "up-regulate" and use words to resolve the situation, seek adult intervention, or even have empathy for the other child. EF works in concert with social and behavioral self-regulation skills. Researchers are finding cognitive and emotional processes to be inextricably linked.

Emotions Matter in Learning

Recent neuroscience research shows that healthy emotions are critical for supporting optimal brain states and effective learning. To simplify, there are three overarching ways that emotions play a significant role in academic achievement:

1. **Classroom culture**– The joint work of developmental cognitive neuroscientist Dr. M. Rosario Rueda and Developmental Psychologist Dr. Mary Rothbart underscores the correlation between cognitive and emotional processing:

“Part of the attention system of the brain is involved in the control of thoughts, emotions and behavior. As attention control develops, children are more able to control cognition and responses flexibly and to adjust their behavior in social interactions better...Attentional control plays a central role in several factors related to schooling, including socio-emotional adjustment and academic achievement” (Rueda et al., 2010).

With self-control of attention and emotions, students are much better able to:

- Focus on learning and recognize what they are feeling
- Use EF processes to respond with socially appropriate behaviors
- Foster trust and respect among peers and teachers.

These higher-order behaviors cultivate a safer and more effective learning atmosphere, as children learn better when the emotions of the class and the teacher are well-managed, both individually and collectively. A brain-friendly learning environment encourages healthy risk-taking, collaboration, communication, creative problem solving, and better decision-making. “Low or moderate reactivity together with good self-regulative skill leads to better chances for appropriate socialization and school success” (Rueda et al., 2010).

2. Stress Management– Neuroscience shows that when a child’s emotions are taxed, their bodies create hormones and neurochemicals that block higher-order processing and affect learning. As neurologist turned educator Dr. Judy Willis states:

“Neuroimaging and measurement of brain chemicals (neurotransmitters) show us what happens in the brain during stressful emotional states...These scans demonstrate that under stressful conditions information is blocked from entering the brain’s areas of higher cognitive memory consolidation and storage. In other words, when stress activates the brain’s affective filters, information flow to the higher cognitive networks is limited and the learning process grinds to a halt.” (Willis, 2007).

The hippocampus, the part of the brain associated with memory and emotion regulation, shows cell death and atrophy from prolonged exposure to toxic stress hormones.

Under stress, the hormone cortisol floods the body and triggers the flight-or-fight response. “Positive,” or moderate levels of stress help the body gather physiological resources and respond appropriately to urgent situations or perceived threats. Once the threat has passed, the body returns to a balanced hormonal state. This process of adaptation is called allostasis. However, if the threat trigger is chronic, as is the case in many students with ACEs, the body is unable to expel the excess cortisol. The build-up of cortisol in the bloodstream over time begins to breakdown the body and brain. The hippocampus, the part of the brain associated with memory and emotion regulation, shows cell death and atrophy from prolonged exposure to toxic stress hormones (McEwen, 2003).

Stress also is linked to cognitive impairment and negative social behaviors, such as reduced sociability and increased aggression (van der Kooij et al., 2014). A recent study at University of California, Berkeley finds that people suffering from chronic stress are at higher risk for depression, mood disorders, and mental illness, especially as they age. The study shows that chronic stress affects the hippocampus by decreasing neurons and by producing an excess of the myelin sheath surrounding axons – the fibers that connect neurons. The excess myelin help speeds up neuro signals in the limbic (reptilian) brain between the amygdala and the hippocampus. Faster limbic connections bypass the PFC, creating greater potential for an increase in the fear response (Chetty et al., 2014).

The research suggests that an inability to effectively regulate emotions, in combination with stress, especially the stress associated with exposure to ACEs, diminishes a student’s ability to process information – academic and emotional – and thereby to succeed in school.

3. Making Learning “Stick”—Neuroscience is showing that healthy emotions are what make learning stick. Neuroscientists Mary Helen Immordino-Yang and Antonio Damasio, from University of Southern California’s Brain and Creativity Institute, report that the neural networks that allow for learning are, in large part, aided by emotion, attention, and social processing. They state, “In particular, the neurobiological evidence suggests that the aspects of cognition that we recruit most heavily in schools, namely learning, attention, memory, decision making, and social functioning, are both profoundly affected by and subsumed within the processes of emotion...” (Immordino-Yang & Damasio, 2007).

Immordino-Yang and Damasio’s work looks at neurological patients who sustained lesions to their brains’ ventromedial prefrontal cortices. These subjects experienced a dramatic decline in their ability to socialize, making them “oblivious to the consequences of their actions, insensitive to others’ emotions, and unable to learn from their mistakes.” The subjects, however, showed no decline in knowledge, logical or ethical reasoning, or the ability to articulate social rules when within the context of a laboratory setting (Saver & Damasio, 1991). The researchers report that “...because these findings underscore the critical role of emotion in bringing previously acquired knowledge to inform real-world decision making in social contexts, they suggest the intriguing possibility that emotional processes are required for the skills and knowledge acquired in school to transfer to real life.”

Executive Function, along with social and emotional competencies, are the neural mechanisms that together underpin learning, higher order thinking, and balanced states of being.

Research shows that EF skills interdependently aid cognition and emotion management, building and reinforcing neural pathways that create healthier brains. This leads to higher intellectual and academic achievement and more effective social learning environments. While EF is usually credited with intellectual development, it cannot be well-developed independent of emotions. EF, along with social and emotional competencies, are the neural mechanisms that together underpin learning, higher-order thinking, and balanced states of being.

Brain Health and Fitness Interventions

In an effort to support our nation’s educational leaders towards implementing brain health and fitness initiatives in schools, The Kennedy Forum has summarized the interventions that promise the greatest impact and results, and are supported by research and/or successful trial in education curricula. Examples of specific programs associated with the description of each intervention listed below can be found in the Appendix.

1. Executive Function Training

What is Executive Function (EF) Training? - Tasks aimed at improving EF challenged children to use and practice higher-order mental processing. These tasks train the brain to perform better in the core EF areas of working memory, inhibitory control, and mental flexibility, as well as in more complex EFs such as attention, prioritization, planning, analyzing, goal persistence, and creative problem solving. EF task training is being implemented in pilot schools around the U.S. Some are using teachers to deliver an EF-focused curriculum, while others are using computer-based cognitive trainings that utilize game-type tasks for improving EF skills.

Executive Function training in students shows an increase in the brain activity needed to comprehend, process, recall, retain, and apply learning.

Why does EF training matter? – EF lays the foundation for school and career success. Even though EF involves the mental processes that underlie all learning, it is rarely intentionally developed in schools. EF training in students increases the brain’s ability to comprehend, process, recall, retain, and apply learning. Training the brain to develop enhanced cognitive functions benefits learning across all subject areas. EF training gives students the cognitive means to achieve greater academic outcomes and allows teachers to work smarter instead of harder. Research shows that the presence of early EF skills is a more accurate predictor of future academic success than are IQ and other academic markers. It also shows that early childhood deficiencies in EF predict cognitive problems later in life (Friedman et al., 2007; Moffitt et al., 2011). As Diamond summarizes, “...improving EFs early may have increasing benefits over time and may reduce needs for costly special education, societal costs from unregulated antisocial behavior, and the number of diagnoses of EF disorders [e.g., ADHD and conduct disorder]” (Diamond et al., 2007).

2. Social and Emotional Learning Activities

What is Social and Emotional Learning or SEL? According to the Collaborative for Academic, Social and Emotional Learning (CASEL) website, “Social and emotional learning (SEL) is the process through which children and adults acquire and effectively apply the knowledge, attitudes, and skills necessary to understand and manage emotions, set and achieve positive goals, feel and show empathy for others, establish and maintain positive relationships, and make responsible decisions.”²

CASEL explains core SEL competencies as:

- **Self-awareness** –Accurately recognizing one’s emotions and thoughts, and their influence on behavior.
- **Self-management** –Regulating one’s emotions, thoughts, and behaviors effectively in different situations.
- **Social awareness** –Taking the perspective of and empathizing with others.
- **Relationship skills** –Establishing and maintaining healthy and rewarding relationships with diverse individuals and groups.
- **Responsible decision-making** –Making constructive and respectful choices about personal behavior and social interactions.

Social and Emotional Learning (SEL) programs yield an average economic return of \$11 for every dollar invested.

Why does SEL matter? Successful SEL curriculums provide students with practical tools and ongoing coaching for gaining greater adeptness in social and emotional awareness and regulation. SEL skill development positively impacts students, teachers, school environments, and the community. Social and emotional competencies aid in managing chronic stress and improving student learning. They also promote self-regulation skills that improve school culture for students and teachers.

² See www.casel.org

A study by the Center for Benefit-Cost Studies in Education at Columbia University's Teachers College shows that SEL programs yield an average economic return of \$11 for every dollar invested. This savings is generated in part by lower teacher turnover. The return also reflects higher student engagement and academic achievement coupled with lower absenteeism and behavior management. To this point, a meta-analysis conducted in 2011 of 213 school-based, social and emotional learning programs involving more than 270,000 children and adolescents shows an eleven-percentile-point gain in academic achievement in SEL participants compared to control groups (Durlak et al., 2011). Long-term economic return is generated by SEL students' ability to pursue higher education and achieve higher earnings in the labor market, and from the resulting reduced crime and substance abuse issues in the community. (Belfield, et al., 2015). Additionally, numerous longitudinal studies show that SEL-related prosocial behaviors, similar to EF skills, are more accurate predictors of future academic and economic achievement, and well-being, than successful early academic performance (Hawkins et al., 2008; Capara et al., 2000; Oberle et al., 2014).

97% of teachers surveyed reported feeling that SEL benefits students from all socio-economic backgrounds, yet only 44% reported a school-wide SEL implementation where they work.

A national teachers' survey conducted by Civic Enterprises, Hart Research Associates, and CASEL in fall 2012 found that teachers are ready to embrace SEL initiatives. The report asserts, "Educators know these [SEL] skills are teachable; want schools to give far more priority to integrating such development into the curriculum, instruction, and school culture; and believe state student learning standards should reflect this priority." Ninety-seven percent of teachers surveyed reported feeling that SEL benefits students from all socio-economic backgrounds, yet only forty-four percent reported a school-wide SEL implementation where they work (Bridgeland, et al., 2012).

Research continues to prove that SEL and EF are interrelated. According to studies conducted by Diamond, EF programs that provide repeated practice and adaptive incremental challenge, while also cultivating joy, self-confidence, character development, and social bonding, seem to be the most effective (Diamond, 2012). SEL has a significant base of field and classroom research. The *2013 CASEL Guide: Effective Social and Emotional Learning Programs—Preschool and Elementary School Edition* evaluates 23 evidence-based SEL programs. CASEL's companion *2015 Guide* reviews 15 middle and high school SEL programs.

3. Mindfulness Training

What is Mindfulness? According to Jon Kabat-Zinn, Professor of Medicine Emeritus and founder of Mindfulness-Based Stress Reduction Clinic at the University of Massachusetts Medical School, “Mindfulness means paying attention in a particular way; on purpose, in the present moment, and nonjudgmentally, to the unfolding of experience.” This is often done by directing attention to one aspect of experience, or to an object, and by continually bringing the mind’s focus back to that same place of attention when it wanders. Variations on mindfulness training include breath awareness (paying attention to the breath entering and leaving the body), body scanning, mindful walking or moving, and intentional sense awareness (i.e. mindful tasting; listening to a tone fade away; visualizing an object, etc.).

Why does Mindfulness matter? Studies and systematic reviews of mindfulness interventions in schools show far-reaching benefits for children and adolescents, including improved attention and cognitive functioning, increased self-esteem, improved emotional self-regulation, self-control, and emotional intelligence, increased feelings of well-being, reduced behavioral problems, decreased anxiety and increased resilience, decreased blood pressure and heart rate, improved sleep behavior, and improved school climate (Rempel, 2012; Wisner, 2010; Zenner, 2014). Similarly, a groundbreaking study using MRI to measure brain activity and cerebral blood flow shows that in just eight weeks of mindfulness practice, the brain is actually reshaped. Increases in gray-matter density is seen in the hippocampus, with additional structural brain changes in areas associated with emotion regulation and perspective taking (Hölzel et al., 2011).

Mindfulness improves higher-order (top-down) processing control and reduces impulsive (bottom-up) reactivity.

With practice, mindfulness training uses the brain’s neuroplasticity – the ability to change and grow new neural pathways and synapses – to develop the networks that increase cognitive control, attention, and self-regulation. These are critical EF skills that enhance learning and behavior (Allen et al., 2012).

Mindfulness helps create stronger neural pathways between the limbic brain and the PFC, reducing reactivity and increasing more reflective responses to stimuli. With better attention and self-regulation, students are less susceptible to physical, emotional, and mental distractions, and the teachers are less focused on managing negative student behaviors. Additionally, mindfulness training interrupts the stress response and lowers cortisol levels in the blood. Mindfulness improves higher-order (top-down) processing control and reduces impulsive (bottom-up) reactivity.

Developmental psychologist and neuroscientist Phillip Zelazo writes, “From the perspective of research on the neurodevelopment of self-regulation, mindfulness training has considerable potential as an intervention because it targets both top-down and bottom-up influences on self-regulation. That is, mindfulness training may provide practice in reflective reprocessing (and exercise the prefrontal circuits on which this reprocessing depends) while also minimizing influences that interfere with prefrontal cortical function (e.g., cortisol/stress)…” (Zelazo & Lyons, 2011). For students, mindfulness training offers a portable and practical tool to help manage stress, upset, and aggression. The skill to manage experiences as they are occurring increases a student’s ability to succeed academically and socially.

With research on the effectiveness of mindfulness on the rise, the American Mindfulness Research Association was founded in 2013 to act as a repository for a growing collection of research and to set best practices for conducting and applying mindfulness research across industries. A number of excellent, evidence-based mindfulness programs exist today for school adoption.

4. Brain Literacy

What is brain literacy? Brain literacy, in education, includes an understanding of both the fundamental anatomical structures of the brain and the neuronal activities involved with learning. Brain literacy provides foundational knowledge of basic neuroanatomical parts of the brain, including the amygdala, hippocampus, and prefrontal cortex – key areas responsible for learning and emotion regulation.

More advanced brain literacy creates an understanding of brain cell parts and how neurons communicate with each other to process information, build memories, and establish neural networks for learning. It also includes teaching students how their senses develop, and how each sense is connected to different parts of the brain. For older students, brain literacy incorporates an understanding of how neurotransmitters and neuro-hormones aid and inhibit neuron-to-neuron communication. Existing programs are proving that brain literacy can be successfully introduced as early as pre-kindergarten, and built upon through grade school and high school.

Knowledge of their own brains enables students to better self-regulate. When threatened, upset, or excited, students can use basic mindfulness tools to bring their brains back to a receptive state for learning.

Why does brain literacy matter? Teachers interact with the brains of their students every day, yet licensing standards for teachers do not require training in how the brain takes in and works with information. By understanding the basics of how the brain collects, processes, and retrieves information, and by knowing how common inhibitors such as stress affect neurochemistry and the brain’s physiology, teachers are empowered with skills and strategies to more effectively help their

students learn. Similarly, knowledge of their own brains enables students to better self-regulate. When threatened, upset, or excited, students can use basic mindfulness tools to bring their brains back to a receptive state for learning. Students can also be taught how their behavior is affecting not only their own ability to learn, but their classmates' as well, reinforcing SEL skills. Equipped with an awareness of how their brains function, students will gain greater self-agency over their own learning.

Educators are increasingly seeing the importance of acquiring and teaching brain basics. Faculty who wish to teach themselves about brain fundamentals can access free online resources that support the integration of brain science and literacy into their school curricula. These resources are provided on the websites of organizations such as the Dana Foundation³ and the University of Washington's Neuroscience for Kids.⁴ Professional trainings exist as well.

5. Neurofeedback

What is NEUROFEEDBACK? Neurofeedback uses reward systems built into a digital interface to indicate when an intended brain state is achieved. Individuals use real-time feedback to focus and shift their brainwave rhythms. Over time, the brain's plasticity builds stronger neuronal networks for an intended brain activity and improves EF in targeted regions of the brain.

When brain cells (neurons) communicate with one another they create an electrical signal. The frequency of this signal produces a brainwave. The brain has different brainwave patterns that correspond to different states of alertness. Alertness when drowsy or in deep relaxation (theta) or in sleep (delta) is different than when highly focused (beta). Using EEG, electrical activity in the brain is tracked through electrode sensors placed on the scalp. This produces instant feedback on a screen so the individual can “see” the state of his or her brain activity. Sensors can be positioned to track activity in parts of the brain associated with EF, such as working memory, attention, and impulsivity.

A 2012 report, *Neuromodulation Training Technology, Bringing Neuroscience to the Classroom to Enhance Learning Capacities in Children*, by neuroscientist Lindsay De Base and Psychologist Ed Pigott, explains that “cognitive performance...improves when individuals successfully learn to control their brain activity during neurofeedback and are able to practice the desired patterns of brain activity” (DeBase & Pigott, 2012).

3 See www.dana.org/educators

4 See www.faculty.washington.edu/chudler/neurok.html

Why does NEUROFEEDBACK matter? The ability to influence brainwaves helps everyone, particularly those struggling academically, to improve cognitive functions such as attention, working memory, emotional regulation, and mental flexibility. Neurofeedback has been shown to improve EF skill in children and adolescents with and without learning disabilities or mental health disorders (Arns et al., 2009; Gruzelier, et al., 2005).

Neurofeedback mitigates ADHD and the impact of ACEs while promoting brain activity most optimal for learning.

For students with learning disabilities and mental health disorders, neurofeedback helps address patterns of dysregulation associated with the irregular brainwave activity found in a range of conditions including ADHD, depression, anxiety, behavioral issues, and sleep disorders. The Centers for Disease Control and Prevention (CDC) report that ADHD alone affects approximately one in ten school-aged children, with approximately three million U.S. children medicated for unfocused behaviors. Neurofeedback mitigates ADHD and the impact of ACEs while promoting brain activity most optimal for learning. Neurofeedback is an engaging, computer-based challenge for students, which increases ease of adoption and participation.

Establishing Strategic Goals

During The Kennedy Forum Brain Health and Fitness Workgroup, which was held in March 2015, participants identified the following key considerations related to curating and implementing effective brain fitness interventions:

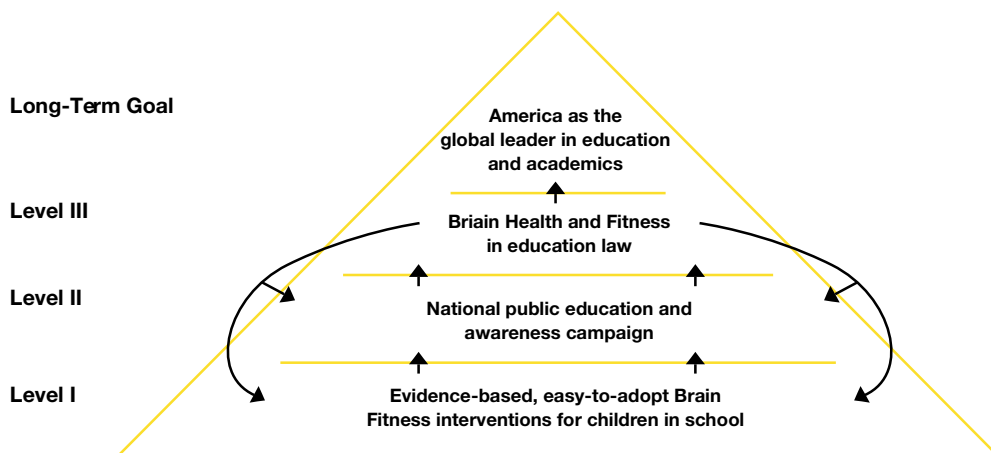
- 1. Early Childhood Interventions:** The developing brain of children and adolescents are most positively impacted by brain fitness interventions and are at greater risk to be under-developed if interventions are not present. Therefore, it is essential for initiatives to target early childhood centers and primary and secondary schools for successful, scalable delivery of tools that best leverage a national investment in brain health and fitness.
- 2. Accessible:** Interventions, and their implementation and delivery, need to be practical and accessible to students, educators, and other stakeholders such as parents, caretakers, coaches, and guidance counselors.
- 3. Realistic:** Timing of design and implementation needs to be realistic and manageable.
- 4. Feedback Loops:** Pre- and post-programmatic assessment is needed to track outcomes; interventions must demonstrate improvements in key school-based metrics.
- 5. Effective Measures:** Outcomes need to be predictable and measurable, both short- and long-term.

- 6. Covering Behavioral Health Issues:** While interventions should be aimed at improving brain fitness for all children, many of the same tools can assist students who have a range of mental health and substance use disorders. However, therapeutic application of these interventions should be left to health professionals.
- 7. Education:** Necessary to the implementation of brain-based interventions is accompanying brain literacy education for children, educators, and families, including basic brain biology, functions, and relevant neuroscience related to proposed interventions and outcomes.
- 8. Life-long Benefits:** While early stage interventions are critical, people of all ages will benefit from brain fitness practices and brain fitness should be utilized through the life cycle.

Since the initial Workgroup session, The Kennedy Forum has continued to reach out to a number of other experts in the fields of education, neuroscience, mental health, public policy, and social entrepreneurship to gather additional information about national adoption of brain fitness initiatives in our public schools. The resulting dialogs and debates created a consensus on the above key considerations, and they also helped generate a multi-tiered approach for achieving the desired outcomes of a) improved national brain fitness and b) transformed educational and behavioral performance of our country's youth.

Moving forward, The Kennedy Forum recommends a three-level strategic approach:

- I. National leadership to facilitate mass adoption of evidence-based, brain fitness interventions that address Executive Function and integrate Social Emotional Learning and brain literacy through the development and dissemination of easy-to-adopt programs, tools, and resources for schools and communities.
- II. A national, brain health and fitness public awareness and advocacy campaign that extends into schools, communities, research and politics.
- III. State and federal policy initiatives that fund required brain health and fitness implementation plans in early education through high school, including teacher training and special funding to high-need districts for implementation and assessment.



We need to be clear and strategic to be successful. We have identified the problem of underperformance in the U.S. and the global arena, and highlighted co-factors of this underperformance in the areas of education, economics, society and the home. Our solutions must be effective, accessible, and national in scale in order to affect the change we seek.

Level I: Mass Adoption of Brain Health and Fitness Interventions

The Kennedy Forum strongly believes that the foundational step in the Race to Inner Space is a national brain health and fitness movement that includes mass adoption of core interventions targeted at improving EF and emotional mastery in schools. The following interventions must become part of school curriculum, and be developed, reinforced, and implemented from early education through high school:

1. Executive Function Training
2. Social and Emotional Learning
3. Mindfulness Training
4. Brain Literacy
5. Neurofeedback.

To reestablish America's academic advantage, ensure our economic competitiveness, and improve society on cognitive and emotional levels, school administrators must implement proven measures to improve outcomes. Interventions do not replace, but rather integrate with and support performance in core subjects and existing curriculum. Time invested in brain fitness interventions generates returns of:

- Increased cognitive functioning
- Decreased behavioral management
- Improved classroom environments
- Increased academic performance.

All of these benefits help alleviate the burdens and inefficiencies that currently exist for public school teachers and curricula.

Interventions do not replace, but rather integrate with and support performance in core subjects and existing curriculum.

Federal Support

At the Kennedy Forum's gathering in Hyannis Port, MA during the spring of 2015, and in the ensuing conversations, experts agreed that if brain fitness interventions are to be successfully adopted nationally, they must be fully supported by policy at the federal level.

While there are schools across the country that have already adopted brain fitness interventions, scaling these practices and fully integrating brain health and fitness into the education curriculum will require national leadership. Federal leaders, including the U.S. Departments of Education and Health and Human Services, working in partnership with the education and educator advocacy community, should develop and disseminate guidance and resources to support national implementation.

First, these resources should include easy-to-adopt brain health and fitness programs that can be implemented in all school settings, urban and rural, low-income and high. The federal government should further commit to providing the necessary technical assistance and teacher training tools that will help ensure the success of these programs on the ground.

In order for brain health and fitness to be a part of every child's education and a sustained practice

in our nation's schools, we need federal support to develop best practices to integrate Executive Function training, Social Emotional Learning, and brain literacy into current curriculum. Brain health and fitness can be taught and integrated into all courses and will improve student performance across academic subjects.

Effective national guidance should also include best practices in measurements to assess students' brain fitness strengths and weaknesses annually (similar to the yearly physical), rather than emphasizing additional testing and curricula requirements.

The Kennedy Forum believes these interventions, supported by federal policy, will greatly enhance our nation's ability to thrive – academically, economically, and socially. ***Not only are brain fitness interventions critical for our students and our nation to succeed, but they will also ultimately make teachers' jobs easier as students will be significantly better prepared to improve academically and socially. These early positive educational outcomes ultimately lead to greater college and career success.***

Combining Interventions

While the goal must be to implement brain fitness interventions nationally, it is also important that states and school districts have the flexibility they need to develop and adopt measures that complement current curricula, methodology and infrastructure.

Schools should be equipped to choose any number of the evidence-based interventions outlined above to increase impact on academic and behavioral outcomes. Brain-based interventions work in concert with one another, strengthening EF and prosocial skills. Some programs available to schools today have already integrated several of the above-mentioned interventions.

A serious national effort to close the achievement gap demands a commitment to school-wide brain fitness interventions. Research suggests that when one or more of the above interventions are implemented in schools, they not only promote better academic and social outcomes for all students, they also remediate and reverse the cascading negative impact of poverty and ACEs on children's brains.

These investments have immediate and lifelong benefits. Brain health and fitness interventions improve academic performance, emotional self-regulation, social confidence, peer acceptance, and long-term success in career and relationships. Interventions that target whole-child brain fitness foster integrated neural functioning between limbic (emotional) and cortical (higher-order processing) brain structures. The results are smarter, more empathetic and responsive children and students, as well as happier and more effective teachers. Incorporating brain health and fitness training into the national school curriculum will not only ensure our country's academic fortitude,

but when learning is approached in this way – by addressing EF and SEL skills – the payoff is the development of children with increased capacities to be effective and compassionate people and leaders.

By enhancing core cognitive skills and advancing social and emotional competencies, America will endow our children with the most essential requirement for a happy, healthy, integrated, and inspired life: a high-functioning and well-balanced brain.

Level II: National Public Awareness and Advocacy Campaigns

The Kennedy Forum recommends the initiation of a comprehensive public awareness campaign to help our nation scale the adoption of brain health and fitness interventions from early childhood through adulthood. This campaign must work to ensure that the American public understands the benefits and necessities of brain health and fitness, starting with the paradigm-shifting role that brain fitness is poised to have in evolving our national approach to public education.

Partners in Building Awareness

Both public and private supporters are needed for an effective public awareness campaign. A successful awareness campaign needs the partnership of professionals across industries to gain optimal traction, working with business leaders and foundations to reach the goal of a national discourse. U.S. military leaders, elite athlete training programs, and high-powered multinational corporations, who have already embraced brain health and fitness to support performance, have a unique ability to influence public discourse and engage new, unlikely audiences. These efforts should include national ad campaigns followed by innovative and interactive outreach measures, including town hall meetings, public art installations, and “awareness crowd-sourcing” on social media. All directed at capturing the nation’s attention about brain health and fitness.

A Nation of Advocates

An awareness campaign, however, is not enough. Diverse constituencies eager to engage in advocacy efforts are essential in helping bring about a transformation in how our country educates its children. For a national implementation of brain fitness interventions in our public schools to succeed, we need advocates who are educated on the issues of brain fitness, excited about the potential impact these interventions promise, and ready to make a difference.

The goals of an advocacy campaign are fourfold:

1. **Stimulate discussion and debate** among key stakeholders, including policymakers, educators, healthcare providers, parents, and business leaders across the country about the elements of brain health and fitness, as well as the risks of inaction, and the rewards of national adoption.
2. **Inform and empower the public** to influence decision makers and lawmakers and call for the policy changes we need.
3. **Influence lawmakers** at the local, state, and federal levels to promote brain fitness measures and interventions, especially in early education.
4. **Provide resources**, studies, examples and maps for implementation to key groups.

It Starts with a Conversation

The Kennedy Forum challenges individuals to start a conversation in their circles of influence. We envision conversations about the Race to Inner Space recommendations taking place at congressional hearings, national superintendent and principal conferences, teacher's unions, faculty and healthcare provider professional development days, academic policy committee meetings within teacher colleges, national educational research and assessment conferences, parent/teacher association gatherings, student advocacy group meetings, and among social entrepreneurs and venture philanthropists.

These conversations will have the greatest impact when they discuss the significant risks from inaction and the significant gains from adoption of brain health and fitness interventions. These discussions should stress that these interventions are the most effective, evidence-based, and easy-to-implement strategies available, which contain within them the great promise of alleviating pressing social issues. The Kennedy Forum intends for this report to assist advocates in these critical conversations.

Level III:

More Educational Funding Needed to Promote Brain Health

To really make an impact, brain fitness must be part of federal and state education funding and standards, not as an added hoop for districts and states to jump through. We must position brain fitness as a high-priority and well-positioned solution to some of the greatest shortcomings and stressors in the current education system at the state and federal level.

To scale these interventions and reach our most disadvantaged students and schools, we will need additional federal funding authorized to support state and local education agencies in the implementation of brain health and fitness interventions and teacher training.

Investment in brain fitness interventions are needed now. According to the National Center for Education Statistics, approximately one million U.S. students drop out of high school annually (NCES 2013, 2014). The OECD's, Education at a Glance 2014 report lists the U.S. high school graduation ranking at a dismal 23rd out of 30 developed countries. In addition, U.S. college graduation rates were marginally better, ranking 18 out of 27 countries.

One study assigns a \$4.75 trillion aggregate lifetime social burden cost for dropouts when factoring in lost tax revenue from lower wages, higher reliance on government programs such as Medicaid, Medicare and welfare, and higher rates of incarceration and criminal activity (Belfield et al., 2011). Additionally, the majority of students leaving school early are from low-income families.

Reversing the U.S. dropout trend is both an economic and moral imperative.

Clemson University's National Dropout Prevention Center's website (dropoutprevention.org) confirms the importance of early brain-based interventions:

High-quality early childhood education has the greatest positive effect on children from lower socioeconomic status, children who are at risk because of other circumstances, and children with disabilities and special needs (Stegelin, 2004). Recent brain research has verified the importance of cognitive and social development in the early years (Begley, 2000).

Given the importance of brain fitness interventions in closing the achievement gap and preparing our children for better futures, Congress and state legislatures should support the funding for their implementation.

Influential Federal Legislation

Advocates and policymakers have many opportunities to pursue funding for brain health and fitness through current law and pending reauthorizations of federal education legislation.

The recently adopted Every Student Succeeds Act (ESSA) will now become the blueprint for federal education policy. Replacing No Child Left Behind, this law returns much of the decision-making power to the states and deemphasizes standardized assessment scores as sole indicators of school, teacher, and student performance. This also creates new opportunities to add brain health and fitness measures to existing academic factors as school accountability is reimagined under the new law. Under ESSA, states will be required to use at least one indicator of school success or student support in measuring school performance other than grades and national test scores. Improved EF and SEL skills could be an optional marker of leveraged student success.

The Individuals with Disabilities Education Act (IDEA), was first enacted in 1975 to ensure that children with disabilities have access to free and appropriate educational opportunities that are equal to those of any child. IDEA also is due for reauthorization. Advocates can lobby for amendment language to support brain health and fitness in schools, with the understanding that every child with a disability has different capacities, needs, and education goals. Brain fitness interventions for different segments of this population will in some cases need to be implemented at the discretion of mental health and medical providers who work in concert with school curriculum delivery.

In addition to changes within IDEA, Congress will be taking up a reauthorization of the [Child Nutrition and WIC Reauthorization Act of 2004](#). While healthy nutrition in childhood has long been identified as a necessary building block for lifelong physical health and wellness, it is now also known to be essential for supporting optimal brain health and fitness. Adding language to this act that explicitly connects nutrition to brain fitness will aid the national strategy to mandate an integrated brain health and fitness focus in our schools.

Conclusion

The Kennedy Forum concludes that there is an opportunity to stimulate a shift in the American education paradigm by adding the needed and previously missing pieces of brain health and fitness to existing academic curricula. The Race to Inner Space will bring brain health and fitness into the nation's educational pedagogy, and cultivate a new generation of Americans with the intrinsic skills and abilities needed to succeed not only academically, but also in their careers, relationships, communities, and lives.

We propose that the implementation of brain fitness in education will be a force multiplier to our national education investments. In a grander context, we believe the best way to meet our generational responsibility for preparing our children to succeed and flourish in the modern, diverse, fast-paced, tech-dominated world that we have created for them, is to educate them with the best science has to offer.

In addition, The Kennedy Forum will expand the recommendations in this Issue Brief to all Americans, regardless of age and socio-economic status, to optimize the promotion of brain health and conditioning. By doing so, we can help improve the lives of Americans and restore our nation's status as a global leader in education and other targeted areas.

About The Kennedy Forum

The Kennedy Forum was founded in 2013 as a way to convene cutting-edge thinkers who are united by the potential for reform in behavioral health service delivery made possible by new laws, new technologies and an enhanced understanding of effective services and treatments. Our inaugural event in October of that year brought a call for The Forum to develop a platform to advance the best thinking across a host of issues in our field. To meet this demand, The Kennedy Forum is organized as a think tank, poised to drive real, lasting and meaningful policy change, bringing the nation closer to fulfilling President Kennedy's vision as outlined in the 1963 Community Mental Health Act.

Today, The Kennedy Forum's work is not singular in its focus. We are promoting mental health coverage through a series of initiatives, which include:

- Ensuring health plan accountability and compliance with the letter and spirit of the parity law, in large part by educating consumers, providers, and regulators, so that each group holds themselves and others accountable for enforcing it.
- Establishing ways to promote provider accountability through evidence-based outcome measures that are validated and quantifiable.
- Implementing proven collaborative practice models that promote the integration of mental health and substance use disorder services into mainstream healthcare.
- Using technology to optimize electronic/digital communications and enhance assessment/treatment tools.
- Promoting brain fitness and wellness, which includes identifying opportunities to translate neuroscience research findings into preventative and treatment interventions.

Please monitor our website, [The Kennedy Forum](#) to track our ongoing activities in support of these five initiatives and other activities central to The Kennedy Forum's mission.

Appendix

Recommended Intervention: Evidence-based and Classroom Trial Examples of Success

Executive Function Training

Tools for the Mind – This teacher-delivered early childhood program is inspired by the work of Russian psychologist Lev Vygotsky, and fosters the mastery of a set of 40 mental EF tools required for intentional and self-regulated learning. According to the organization’s website (toolsofthemind.org), the curriculum “is being used in a wide range of settings, from large urban school districts to small rural Head Start programs. These programs serve diverse student populations in public, charter, and private schools.” A study conducted in an urban school district tests the effectiveness of Tools of the Mind curriculum with 147 preschoolers from low-income families in the same neighborhood. The study demonstrates EF improvements in preschoolers at minimal expense (Diamond et al., 2007).

ACTIVATE™ – From Dr. Bruce Wexler’s work at Yale University comes ACTIVATE™ – a cognition cross-training program that includes computer-based EF training followed by specific physical exercises that engage the same neurocognitive systems, in the context of whole body movement and social interaction. Aiming to improve brain fitness, the program enhances core cognitive skills such as memory, attention, self-control, sequencing, categorizing, and task-switching. Students participate in 20-to 30-minute interactive game-like sessions on the computer three to five times a week, followed by similar length intervals of group physical exercise. The computer adjusts the training for progressive challenges. Educators assess the data for cognitive strengths and weaknesses, and generate neurocognitive profiles for each student. Implemented in more than 200 elementary and middle schools, and in afterschool learning centers and psychology clinics across the country, this program is showing significant preliminary results in positive academic outcomes. Using National Institute of Health (NIH) Toolkit metrics, students who participated in ACTIVATE™ for four months showed EF gains equivalent to a year in a typical classroom (Wexler, 2013). The program improves EF skills for all students, and a \$3 million NIH grant was recently awarded to study the use of ACTIVATE™ for treating ADHD and associated learning challenges. According to parental ratings to date, children with ADHD who participate in ACTIVATE™ are twice as likely as children in the control group to have reduced symptoms, and those same children show significant improvement on the NIH toolbox tests for EF skills.

Social and Emotional Learning Activities

The Responsive Classroom— More than 10,000 teachers and administrators from across the nation and around the world are trained annually in the Responsive Classroom approach. Training focuses on increasing teacher effectiveness in the classroom by promoting skills in interactive lesson planning, use of language that fosters academic and social growth, meaningful choice options for the class, student autonomy, community building, and EF skills. Six elementary schools in an urban district in Connecticut participated in a study over three school years (2001–2004). The average student body was made up of approximately 50% minority children, 30% children who spoke English as a second language, and 30% children from poor families. Three schools receiving the Responsive Classroom intervention reported higher reading and math results on state standardized tests compared to the three control schools (Rimm-Kaufman et al., 2007).

Neurofeedback

Establishing Feedback Loops— Naomi J. Steiner, MD, director of the Center for Mind-Body Pediatric Research at Tufts Medical Center, and her colleagues are working with 104 second-through fourth-grade students diagnosed with ADHD in 19 elementary schools in the greater Boston area. After being assessed for impulsivity and attention deficit, children were randomly assigned to neurofeedback or a different intervention. Both interventions were targeted to improve memory and attention span. The group that received neurofeedback showed significant improvement in attention and other EF skills (Steiner et al., 2011). In a similar study conducted by Dr. Steiner, children with ADHD from two middle schools also showed favorable outcomes from neurofeedback (Steiner, Sheldrick et al., 2011).

Mindfulness

Mindful Schools – This curriculum has reached more than 300,000 youth worldwide in public, private, and charter schools. During the 2011-2012 academic year, the organization partnered with University of California, Davis to conduct a randomized-controlled study on mindfulness and children. More than 930 children and 47 teachers from three Oakland public elementary schools in high-crime areas participated in the study. Results show statistically significant improvements in paying attention and social compliance after only four hours of mindfulness training over a four-week period. In another study with 400 students, using this same curriculum but over five weeks for three times per week, results show improvements in areas of paying attention, self-control, classroom participation, and respect for others. Gains were still present in participants seven weeks later (Black & Fernando, 2013).

Brain Literacy

Brain Matters— Focusing on brain-based learning from the latest neuroscience research, educators in Brain Matters workshops learn the basic biology associated with the making of memories, and receive introductory instruction in brain anatomy and physiology. This training is offered by the Upside Down Organization (UDO), which trains more than 13,000 child-serving professionals annually. Punahou School in Hawaii conducted their first Brain Matters workshop in 2010. The school continues to adopt brain-based learning strategies and hosts an annual Brain Symposium, open to all teachers in the state. More recently, UDO worked with the Cecil County Public Schools in Maryland, by partnering with the principals at six Title I elementary schools to provide brain-based learning and intervention strategies for students with economic challenges. Each school prepared extensive Action Plans to create the necessary changes to both macro and micro school environments for better alignment with brain-based educational approaches.

The UDO is an external training arm of the Children's Guild, which serves thousands of children and their families in Maryland with special education services, charter schools, school-based mental health services, foster care, group care, and training and consultation. The Children's Guild has taken a creative approach to brain literacy by instituting impressive "Brain Paths" in their charter schools, specifically three-dimensional, interactive, hallway art installations that simulate the anatomy and neural pathways of the brain. As teaching tools for educators and as reinforced learning environments for students, these Brain Paths offer innovative ways for students, staff, and faculty to learn more about the brain and its role in the learning process. School leaders across the state are visiting these Brain Paths with the intention of implementing similar displays in their home districts.

Combining Interventions

MindUP™— Developed by educators, neuroscientists, and psychologists, this program has been delivered to more than 400,000 children in the U.S. and abroad. MindUP™ offers 15 lessons for pre-K through 8th grade students taught by their teachers. MindUP™ teachers are required to go through a training to help them incorporate SEL, mindfulness, and brain literacy basics into their existing curriculums. In a study conducted on MindUP™, four classes of 4th and 5th graders were randomly assigned either MindUP™ or a regular social responsibility program. The 99 students who participated in the study were measured for growth across the areas of EF, stress, well-being, prosocial behavior, peer acceptance, and math achievement. Relative to the control group, children who participated in MindUP™ "(a) improved more in their cognitive control and stress physiology, (b) reported greater empathy, perspective-taking, emotional control, optimism, school self-concept, and mindfulness, (c) showed greater decreases in self-reported symptoms of depression and peer-rated aggression, (d) were rated by peers as more prosocial, and (e) increased in peer acceptance (or sociometric popularity)" (Schonert-Reichl & Lawlor, 2010).

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