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HEALTHY EARLY CHILDHOOD DEVELOPMENT
Policy Brief
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Supporting the Development of Executive Functions in Young Children

Executive Functions Explained

The term "executive functions" encompasses a group of cognitive processes that enable people to carry out goal-directed actions central to everyday life, such as planning sequences of activities, staying focused, and following both explicit and implicit social rules.

Many researchers have broken executive functions down into three distinct components, including:

- *Working Memory* – the ability to hold and manipulate pieces of information in mind
- *Inhibitory Control* – the ability to inhibit a particular behavioral response or mental process
- *Cognitive Flexibility* – the ability to switch rules or change perspectives depending on context[1]

Individuals often use all three executive functions simultaneously, making it difficult to decipher where one begins and another ends. For example, when children play games like "Simon Says," they must use memory to hold the rules of the game in mind, flexibility to switch between them, and inhibitory control to remain still when "Simon says" does not preface an instruction. Given how blurry the lines between these three skills can be, some researchers have advocated for a more unitary, integrated construction of executive function.[2,3]

Executive Functions and Long-Term Outcomes

Supporting the healthy development of executive functions is critical to enable children to succeed in school and in the workforce. Skills associated with executive functions — such as attention control and self-regulation — are also necessary to build healthy and positive relationships with other people.

Researchers have found that executive functions are important to just about every aspect of life, many of which are listed in the table below compiled by Dr. Adele Diamond:[4]

Research Summary: Executive Functions and Various Aspects of Life

ASPECTS OF LIFE	RELEVANCE OF EXECUTIVE FUNCTIONS	REFERENCES
Mental Health	Executive Functions are impaired in many mental disorders, including:	
	- Addictions	Baler & Volkow 2006
	- Attention deficit hyperactivity (ADHD)	Diamond 2005, Lui & Tannock 2007
	- Conduct disorder	Fairchild et al. 2009
	- Depression	Taylor-Tavares et al. 2007
	- Obsessive compulsive disorder (OCD)	Penadés et al. 2007
	- Schizophrenia	Barch 2005
Physical Health	Poor Executive Functions are associated with obesity, overeating, substance abuse and poor treatment adherence	Crescioni et al. 2011, Miller et al. 2011, Riggs et al. 2010
School Readiness	Executive Functions are more important for school readiness than are IQ or entry-level reading or math	Blaire & Razza 2007, Morrision et al. 2010
School Success	Executive Functions predict both math and reading competence throughout the school years	Borella et al. 2010, Duncan et al. 2007, Gathercole et al. 2004
Job Success	Poor Executive Functions lead to poor productivity and difficulty finding and keeping a job	Bailey 2007
Public Safety	Poor Executive Functions lead to social problems (including crime, reckless behavior, violence, and emotional outbursts)	Broidy et al. 2003, Denson et al. 2011

Source: Diamond, A. (2013). Executive functions. *Annual Review of Psychology, 64*, 135-168.

Development of Executive Functions

Executive functions rely on neural networks in which a region in the front of the brain, known as the prefrontal cortex, plays a key role.[5] The prefrontal cortex is one of the most slowly developing regions of the brain and does not reach full maturity until the third decade of life.[6] Inhibitory control, working memory, and selective attention begin to develop as early as infancy, but more complex executive functions skills that build on these rudimentary abilities continue to improve throughout childhood and adolescence into early adulthood.[7,8,9]

Children typically experience a surge in executive functions skills between ages three and five. Inhibitory control, working memory, and cognitive flexibility all show rapid improvements in early childhood.[10]

The Role of Socioeconomic Status

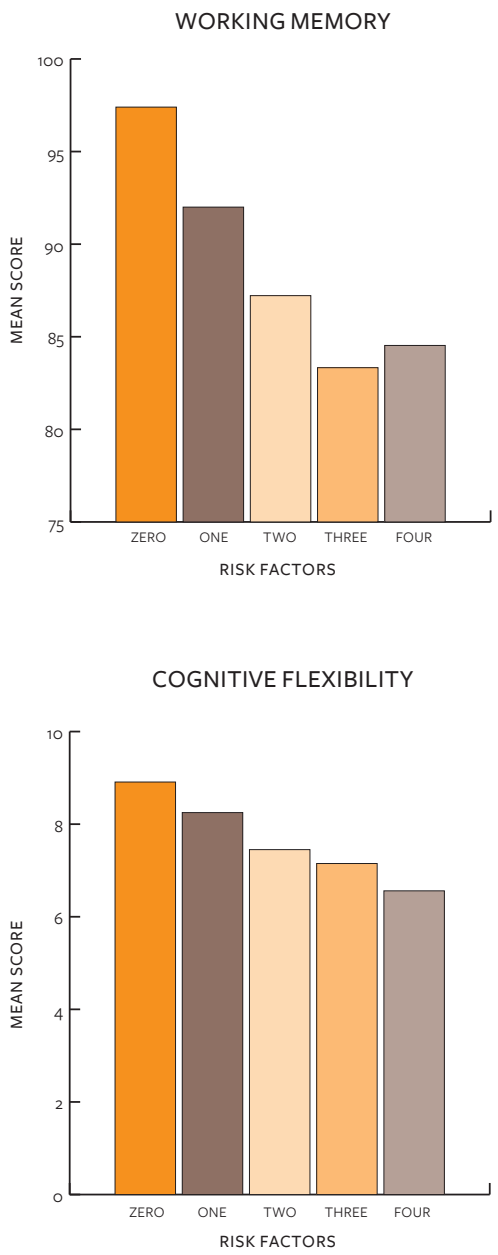
The slow growth of the prefrontal cortex makes executive functions particularly susceptible to environmental influences that shape development. A significant body of work suggests that factors related to low socioeconomic status (SES) impair children's development of executive functions.

Studies have shown that family income is predictive of children's performance on planning, inhibitory control and working memory tasks, with children from higher-income families outperforming children from families with lower incomes.[11] Researchers have found, for example, that 3- to 5-year-old children from low-SES backgrounds show worse performance on tasks involving goal-setting, cognitive flexibility and working memory compared to their higher-SES peers.[12,13]

Research suggests that differences in exposure to stress are in part responsible for this problematic gap in the development of executive functions. Low-SES increases the likelihood of children experiencing adverse environments in which they suffer from neglect, exposure to violence and toxic stress.[14] Experiencing chaotic environments can impair children's development of self-regulation and impulse control. Stress can also cause lasting changes to the brain's chemical responses that are implicated in the circuits underlying executive functions.[15]

Children from low-SES homes may also not have as much exposure to enriching activities, like attending preschool programs, visiting museums and libraries, and hearing rich and varied conversations.[16,17] These experiences may give children the opportunity to develop the cognitive skills necessary to maintaining abstract rules, like understanding and applying the rule that one can talk loudly outside but must remain quiet while watching a play or a concert.[18]

Executive Function Skills at Kindergarten Entry by Number of Socioeconomic Risk Factors



The Early Childhood Longitudinal Study Kindergarten Class of 2010 -11 collected information about, and performed cognitive assessments of, roughly 15,000 first-time kindergarteners. The researchers identified four risk factors that may negatively affect a child's long-term academic achievement, including living in a home in which: (1) there is only one parent, (2) the child's mother has less than a high school education, (3) the household income falls below the poverty line, and (4) the primary language spoken is not English. At kindergarten entry, children with more risk factors demonstrated impaired performance on tasks that measured cognitive flexibility and working memory.[19]

Improving Executive Functions in Early Childhood

Though stress and differential access to enriching opportunities have created an SES gap in executive functions development, research points to intervention strategies that may help close the divide.

One study found, for example, that low-income children enrolled in preschool programs using a particular curriculum — *Tools of the Mind* — performed significantly better on measures of executive functions skills than their counterparts in other classrooms.[20] Other add-ons to existing curricula may also effectively enhance executive functions, perhaps to an even greater extent than *Tools of the Mind*. For example, training teachers to help children with their self-control skills can enhance children's inhibitory control.[21] Though executive functions can be improved through targeted training, more research is still needed to determine the most effective components of these curricula as well as the duration of any observed benefits.

Rhode Island Landscape

With 21% of children under age six living below the poverty line, Rhode Island has a large population of individuals who may be particularly vulnerable to impaired executive functions development.[22] Developing and implementing executive functions-targeted interventions and reducing family stress levels could dramatically improve both these children's academic progress and later life outcomes.

Access to High-Quality Early Learning Programs:
Access to high-quality early childhood education is limited, particularly for children from low-income families. In 2013, public investments in Head Start, state pre-k and special education programs served only 12% on the state's 3-year-olds and 18% of the state's 4-year-olds.[23] Though other opportunities exist for children to receive high-quality early education, many children, particularly those living below the poverty line, are not enrolled in early education programs. These children are likely missing out on a crucial opportunity to learn and develop the cognitive skills that would support their later academic success. Publicly funded pre-k and preschool programs could be a powerful mechanism through which vulnerable children could gain opportunities to acquire executive functions skills, but only if they have the opportunity to attend them. Given the emergence of executive functions in infancy, policies and programs should also be developed to support the healthy development of these skills in infants and toddlers.

Public Awareness and Knowledge:
State leaders and policymakers recognize the importance of executive functions skills. The Rhode Island Early Learning and Development Standards include "executive function" as an "essential practice" and list memory, inhibitory control and cognitive flexibility as three key components of the "cognitive development" domain.[24] State leaders should continue to recognize the importance of these skills in policy and practice.

Policy Recommendations

Policy strategies to improve the development of executive functions in young children include:

- Expand access to high-quality early childhood education programs for low-income children and families.
- Enhance professional development programs for early childhood educators with specific strategies to support the development of self-regulation and executive functions.
- Create incentives for researchers to focus their work on determining cost-effective and easily implemented intervention strategies to support the development of executive functions in the state's most vulnerable children.
- Support efforts to evaluate the effects of early environmental differences on the executive functions of infants and toddlers, as well as on interventions that may counteract any of these early differences.
- Advocate for social welfare policies that work to reduce common sources of extreme stress in families' lives (e.g. poverty, food insecurity, domestic violence, homelessness) and those that expand access to enriching extracurricular opportunities for young children from low-SES homes.

Practice Recommendations

There is no "magic bullet" to improve children's executive functions. Like language or motor skills, executive functions develop over long periods of time. But educators and parents can give their children opportunities to flex and strengthen their executive function muscles through the use of certain strategies, many of which can be found on the Rhode Island Early Learning and Development Standards (RIELDS) website, www.rields.com.

Strategies RIELDS recommends include:

- "Provide opportunities for toddlers and preschoolers to follow short two and three step directions. For example, wash your hands and then have a seat at the table."
- "Provide children with space, time, and a variety of interesting, culturally- and age-appropriate toys and materials to explore. Allow them to use toys and materials in their own ways and to repeat actions and activities."[25]

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