ENCYCLOPEDIA on Early Childhood Development

Protective Role of Executive Function Skills in High-Risk Environments

Tralucia Powell, BS, Megan R. Gunnar, PhD

University of Minnesota, USA

April 2024, Éd. rév.

Introduction

There is growing evidence in the study of resilience for the protective role of executive functions in the school success of children facing adversity. Executive function (EF), also termed cognitive control, describes goal-directed abilities to control thought, behavior, and emotions.[1] These skills can be seen in the ability to retain information in working memory, sustain or shift attention, inhibit automatic responses to perform an instructed or goal-directed action, and delay gratification.

EF skills develop rapidly in the preschool period[2] and are thought to provide a foundation for cognitive and behavioural school readiness.[3] In the classroom, EF skills may manifest as the ability to pay attention, follow instructions, wait one's turn, and remember rules. These skills broadly promote positive development in multiple domains, with recent research suggesting that young children's EF skills predict resilient school and peer functioning above and beyond intelligence level and are related to better mental health outcomes.[2,4,5,6,7]

©2024-2026 ABILIO | RESILIENCE

These skills may be particularly important to promote adaptive functioning for children growing up in high-risk environments. However, the development of EF skills is vulnerable to exposure to trauma and chronic stress.[8] Children from various adverse backgrounds (e.g., homeless/highly mobile, poverty, early institutionalism, maltreatment, etc.) tend to perform worse on measures of executive function.[6,9,10,11] Taken together, these findings suggest a need to lower chronic stress exposure and target building executive function skills through intervention and prevention efforts with adversity-exposed children.

Subject

High-risk youth with more developed executive function skills show better cognitive and behavioural school readiness and performance.[3,12,13] These skills appear to enable children to navigate their constantly changing environment,[9,14] which may be especially key for children developing in environments characterized by harshness and unpredictability.[15]

However, recent research has shown that exposure high levels of adversity may undermine the development of some skills that support school readiness, including executive function.[6,7,9,10,11] These deficits may undermine children's abilities to succeed in academics and develop positive peer and teacher relationships.[12,16,17] This may have long-term implications for school success given that the achievement gap tends to persist and even widen throughout the school years.[18,19]

Given evidence that executive function skills are malleable to intervention and children who demonstrate poorer initial performance make greater gains,[20] efforts to improve high-risk children's transition to school have targeted building executive function skills prior to kindergarten.[4,21,22] Furthermore, research suggests that executive function skills are responsive to intervention across the school years.[20] It is also important to note that although children exposed to adversity tend to demonstrate lower EF skills on average, there is widespread heterogeneity, and many children manage to develop strong EF skills even in difficult circumstances.[23] Identifying and supporting existing sources of resilience, such as family and school support, that can bolster children's EF skills in high-risk environments is also essential.[24]

Problems

Studying the protective role of executive function presents several challenges. Until recently, there were few measures capable of fully capturing executive function abilities for children who are younger than four or are experiencing delays in the development of these skills. Since

©2024-2026 ABILIO | RESILIENCE

exposure to chronic early life stress has been linked with impaired executive function skills in some children,[8] it is critical to be able to measure a wide range in functioning to fully capture the variability in these skills. The NIH Toolbox Cognition Battery now contains two tasks with developmental extension (Dext) versions that effectively lower the floor of the standard tasks and have demonstrated concurrent, short-term, and longer-term validity.[5,13] Additionally, the Minnesota Executive Function Scale (MEFS) is an adaptive, tablet-based EF assessment that can be used with children as young as two years old.[25] Expanding the use of EF tasks that are developmentally appropriate for young children will aid in the advancement of our understanding of the protective role of these skills in early childhood.

Current interventions to improve executive function skills employ a variety of methods including training, classroom curriculum, physical activity, and mindfulness.[20,22] Though these programs suggest executive function skills are malleable, they also show varied success in skill improvements.[22,23,26,27,28,29] Programs that utilize computer-based training show promise in promoting short-term gains in targeted aspects of executive function skills; however, improvements are specific to the domain trained (e.g., working memory) and do not seem to expand to other areas of executive function more generally.[20,30] A recent meta-analysis suggests that although it is possible to foster short-term gains in children's EF skills, many of these effects may be relatively transient.[31] Approaches that involve *implicit* training of executive function, such as mindfulness training and biofeedback-enhanced regulation training, seem to be more effective than *explicit* approaches such as practice with computerized or non-computerized EF tasks.[31]

Key Research Questions

Developmental studies designed to understand the protective role of executive function often address the following questions:

- What are the mechanisms through which executive function prepares children for school success?
- What helps foster executive function skills in young children experiencing delays?
- What helps promote development of executive function skills in the context of adversity?

Recent Research Results

©2024-2026 ABILIO | RESILIENCE

Research consistently indicates that children with more developed executive function skills prior to kindergarten experience greater school success.[6,7] For academic achievement, these skills may scaffold language and mathematic success.[12] In fact, in a low-income sample of children, researchers have found that executive function skills prior to kindergarten predict growth in both numeracy and literacy skills across the kindergarten year and into third grade.[12,13] In addition to providing a cognitive foundation for learning, executive function skills may also support academic success by promoting appropriate classroom behavior.[3] Many kindergarten teachers report that it is more important for children to control themselves in the classroom, follow directions, and not be disruptive than it is to know the alphabet or how to count to 20.[3] Furthermore, executive function skills may promote the development of positive teacher and peer relationships.[32,33] Studies suggest that there is overlap between the development of executive function and Theory of Mind (ToM), which is the ability to identify that others' desires and knowledge differ from one's own. These skills are associated with lower levels of aggression, better problem-solving skills, and positive social skills.[34,35]

Recent research suggests that the nature of adversity experienced may be relevant to understanding the development of children's EF in high-risk contexts. For example, cognitive skills appear to be particularly impacted for children exposed to deprivation, such as institutional rearing or neglect, as opposed to children exposed to threat, such as child abuse or violence exposure.[36] Further, the recently articulated "hidden talents" approach advocates for a strengths-based perspective that acknowledges the development of stress-adapted skills in adversity-exposed children.[37] For example, children raised in unpredictable home environments appear to demonstrate enhanced task switching abilities, particularly under stress.[37] Additionally, children exposed to violence and poverty performed worse than their non-adversity exposed peers on EF tasks using traditional abstract stimuli, but performed equally well when more ecologically valid stimuli were used.[38] This suggests that apparent EF "deficits" may be ameliorated when children are more familiar with task stimuli. Finally, recent work has demonstrated that neighborhood resources also contribute to EF skills in preschool-aged children, over and above the effect of family resources.[39] This suggests that it may be important to consider the broader contexts where children spend time, which may present additional opportunities for interventions and policy efforts.

Research Gaps

©2024-2026 ABILIO | RESILIENCE

First, much of the research on hidden talents in adversity-exposed youth has been conducted with older school-aged children and adolescents.[37] More work is needed to understand how adversity impacts the development of EF in early childhood, when domains of EF such as working memory and inhibitory control appear to be less differentiated.[40] Additionally, there is currently limited research on the effectiveness of interventions to sustain long-term gains in executive function skills with very high-risk children. It will be important to remember that intervention needs and responses of children with different experiences may differ. For children currently experiencing chronic stress (e.g., homeless/highly mobile), it is unclear whether it is feasible to target executive function skills without first reducing stress and building coping skills. Finally, researchers have begun to emphasize the role of upstream social factors, such as class- and race-based structural disadvantage, on the development of children's EF skills.[41] Efforts to mitigate structural inequality and support parents' access to resources that promote their children's development may be just as effective as directly targeting children's EF skills through intervention. Future research will be needed to learn how best to tailor interventions and policy efforts to account for the needs of adversity-exposed children.

Conclusions

Studies consistently suggest that exposure to trauma or chronic early life stress may impact the development of executive function skills.[6,7,9,10,11] These skills appear to provide the foundation for school readiness through cognition and behaviour.[3,5,12] Because early school success is so important for later school success, it is essential to identify sources of strength that can bolster early EF skills in adversity-exposed young children.[16,17,23,24]

For this reason, there has been increased attention to interventions that promote executive function. Although there is evidence that executive function is malleable,[18,42] few interventions have attempted to boost skills in children currently experiencing toxic levels of stress. Efforts to design interventions that promote executive function in these children may need to address current levels of stress exposure and simultaneously work to reduce these to gain maximum benefit.

Implications for Parents, Services and Policy

Research to date underscores the importance of executive function skills for school success, especially for children living in high-risk environments. Programs designed to boost executive

©2024-2026 ABILIO | RESILIENCE

function have shown mild short-term gains across multiple levels, including school curriculum, computer-based training, and even physical activities, like martial arts.[20,43,44] Interventions that promote implicit skill gains such as teaching self-regulation strategies, self-distancing, and mindfulness may be particularly fruitful.[31,45] Additionally, parents can play a key role in fostering children's EF development. For example, autonomy-supportive parenting practices, such as providing children with choices, can promote children's EF and support their sense of self-efficacy, encouraging them to engage in more challenging tasks.[46] Furthermore, sensitive caregiving may promote EF skills by shielding children from some of the chaos they are experiencing.[47] As such, supporting parents may be an important way to indirectly bolster children's EF in high-risk contexts.[23] Executive function skills also have been successfully targeted through school-based curriculum in preschool and Head Start classrooms.[4,35] Experimental evidence suggests early childhood classrooms, like Head Start, can successfully build executive function skills by providing more self-regulatory support in a classroom (e.g., implementing clear rules and routines, redirecting or rewarding children's behaviour).[35] Increasing attention to executive function skills in early childhood programs and increasing accessibility of these programs for adversity-exposed children may reduce the achievement gap that is apparent before school begins and persists throughout the school years.

References

1. Miyake A, Friedman NP, Emerson MJ, Witzki AH, Howerter A, Wager T. The unity and diversity of executive functions and their contributions to complex "frontal lobe" tasks: A latent variable analysis. *Cognitive Psychology*. 2000;41(1):49-100. doi:10.1006/cogp.1999.0734
2. Zelazo PD. Executive Function and Psychopathology: A Neurodevelopmental Perspective. *Annual Review of Clinical Psychology*. 2020;16:431-454. doi:10.1146/annurev-clinpsy-072319-024242
3. Blair C. School readiness: Integrating cognition and emotion in a neurobiological conceptualization of children's functioning at school entry. *American Psychologist.* 2002;57(2):111-127. doi:10.1037//0003-066x.57.2.111
4. Bierman KL, Nix RL, Greenberg MT, Blair C, Domitrovich CE. Executive functions and school readiness intervention: Impact, moderation, and mediation in the Head Start REDI program. *Development and Psychopathology*. 2008;20(3):821-843. doi:10.1017/S0954579408000394

©2024-2026 ABILIO | RESILIENCE

5. Kalstabakken AW, Desjardins CD, Anderson JE, Berghuis KJ, Hillyer CK, Seiwert MJ, Carlson SM, Zelazo PD, Masten AS. Executive function measures in early childhood screening: concurrent and predictive validity. *Early Childhood Research Quarterly*. 2021;57(1):144-155. doi:10.1016/j.ecresq.2021.05.009
6. Masten AS, Herbers JE, Desjardins CD, Cutuli JJ, McCormick CM, Sapienza JK, Long JD, Zelazo P. Executive function skills and school success in young children experiencing homelessness. *Educational Researcher*. 2012;41(19):375-384.
7. Obradovic J. Effortful control and adaptive functioning of homeless children: Variable-focused and person-focused analyses. *Journal of Applied Developmental Psychology.* 2010;31(2):109-117. doi:10.1016/j.appdev.2009.09.004
8. Pechtel P, Pizzagalli DA. Effects of early life stress on cognitive and affective function: An integrated review of human literature. *Psychopharmacology (Berl).* 2011;214(1):55-70. doi:10.1007/s00213-010-2009-2
9. DePrince AP, Weinzierl KM, Combs MD. Executive function performance and trauma exposure in a community sample of children. *Child Abuse Neglect*. 2009;33(6):353-361. doi:10.1016/j.chiabu.2008.08.002
10. Loman MM, Johnson AE, Westerlund A, Pollak SD, Nelson CA, Gunnar MR. The effect of early deprivation on executive attention in middle childhood. *Journal of Child Psychology and Psychiatry, and Allied Disciplines*. 2012;54(1):37-45. doi:10.1111/j.1469-7610.2012.02602.x
11. Evans GW, Li D, Whipple SS. Cumulative risk and child development. *Psychological Bulletin* . 2013;139(6):1342-1396. doi:10.1037/a0031808
12. Welsh JA, Nix RL, Blair C, Bierman KL, Nelson, KE. The development of cognitive skills and gains in academic school readiness for children from low-income families. *Journal of Educational Psychology*. 2010;102(1):43-53. doi:10.1037/a0016738
13. Distefano R, Palmer AR, Kalstabakken AW, Hillyer CK, Seiwert MJ, Zelazo PD, Carlson SM, Masten AS. Predictive Validity of the NIH Toolbox Executive Function Measures with Developmental Extensions from Early Childhood to Third Grade Achievement. *Developmental Neuropsychology.* 2023;48(8):373-386. doi:10.1080/87565641.2023.2286353

©2024-2026 ABILIO | RESILIENCE

14. Willcutt, EG, Brodsky K, Chhabildas N, et al. The neuropsychology of ADHD: Validity of the executive function hypothesis. In: Gozal D, Molfese DL, eds. *Attention deficit hyperactivity disorder: From genes to patients.* 3rd ed. Totowa, NJ: Humana Press; 205:185-213.

15. Frankenhuis WE, Panchanathan K, Nettle D. Cognition in harsh and unpredictable environments. *Current Opinion in Psychology.* 2016;7:76-80. doi:10.1016/j.copsyc.2015.08.011

16. Liew J. Effortful control, executive functions, and education: Bringing self-regulatory and social-emotional competences to the table. *Child Development Perspectives*. 2011;6(2):105-111. doi:10.1111/j.1750-8606.2011.00196.x

17. McClelland MM, Cameron CE, Connor CM, Farris CL, Jewkes AM, Morrison FJ. Links between behavioral regulation and preschoolers' literacy, vocabulary, and math skills. *Developmental Psychology*. 2007;43(4):947-959. doi:10.1037/0012-1649.43.4.947

18. Cutuli JJ, Desjardins CD, Herbers JE, Long JD, Heistad D, Chan CK, Hinz E, Masten AS. Academic achievement trajectories of homeless and highly mobile students: Resilience in the context of chronic and acute risk. *Child Development.* 2013;84(3):841-857. doi:10.1111/cdev.12013

19. Herbers JE, Cutuli JJ, Supkoff LM, Heistad D, Chan C-K, Hinz E, Masten AS. Early reading skills and academic achievement trajectories of students facing poverty, homelessness, and high residential mobility. *Educational Researcher*. 2012;41(9):366-374. doi:10.3102/0013189X12445320

20. Diamond A, Lee K. Intervention shown to aid executive function development in children 4-12 years old. *Science*. 2011;333(6045):959-964. doi:10.1126/science.1204529

21. Blair C, Razza RP. Relating effortful control, executive function, and false belief understanding to emerging math and literacy ability in kindergarten. *Child Development.* 2007;78(2):647-663. doi:10.1111/j.1467-8624.2007.01019.x

22. Zelazo PD, Forston JL, Masten AS, Carlson SM. Mindfulness plus reflection training: Effects on executive function in early childhood. *Frontiers in Psychology.* 2018;9:324033. doi:10.3389/fpsyg.2018.00208

23. Masten AS, Lucke CM, Nelson KM, Stallworthy IC. Resilience in development and psychopathology: Multisystem perspectives. *Annual Review of Clinical Psychology*. 2021;17:521-549. doi:10.1146/annurev-clinpsy-081219-120307

©2024-2026 ABILIO | RESILIENCE

24. Yule K, Houston J, Grych J. Resilience in children exposed to violence: A meta-analysis of protective factors across ecological contexts. *Clinical Child and Family Psychology Review*. 2019;22(3):406-431. doi:10.1007/s10567-019-00293-1

25. Carlson SM, Zelazo PD. *Minnesota Executive Function Scale: Test manual*. St Paul, NM: Reflection Sciences; 2014.

26. Holmes J, Gathercole SE, Dunning DL. Adaptive training leads to sustained enhancement of poor working memory in children. *Developmental Science*. 2009;12(4):F9-F15. doi:10.1111/j.1467-7687.2009.00848.x

27. Klingberg T, Fernell E, Olesen P, et al. Computerized training of working memory in children with ADHD- a randomized, controlled trial. *Journal of the American Academy of Child and Adolescent Psychiatry.* 2005;44(2):177-186. doi:10.1097/00004583-200502000-00010

28. Bergman-Nutley S, Söderqvist S, Bryde S, Thorell LB, Humphreys K, Klingberg T. Gains in fluid intelligence after training non-verbal reasoning in 4-year-old children: a controlled randomized study. *Developmental Science.* 2011;14(3):591-601. doi:10.1111/j.1467-7687.2010.01022.x

29. Bodrova E, Leong DJ. Tools of the Mind: The Vygotskian approach to early childhood education. 2nd ed. New York: Merrill/Prentice Hall; 2007.

30. Thorell LB, Lindqvist S, Bergman-Nutley S, Bohlin G, Klingberg T. Training and transfer effects of executive functions in preschool children. *Developmental Science*. 2009;12(1):106-113. doi:10.1111/j.1467-7687.2008.00745.x

31. Takacs ZK, Kassai R. The efficacy of different interventions to foster children's executive function skills: A series of meta-analyses. *Psychological Bulletin*. 2019;145(7):653-697. doi:10.1037/bul0000195

32. Riggs NR, Jahromi LB, Razza RP, Dillworth-Bart JE, Mueller U. Executive function and the promotion of social-emotional competence. *Journal of Applied Developmental Psychology*. 2006;27(4):300-309. doi:10.1016/j.appdev.2006.04.002

33. Holmes CJ, Kim-Spoon J, Deater-Deckard K. Linking executive function and peer problems from early childhood through middle adolescence. *Journal of Abnormal Child Psychology*. 2016;44(1):31-42. doi:10.1007/s10802-015-0044-5

©2024-2026 ABILIO | RESILIENCE

34. O'Toole SE, Monks CP, Tsermentseli S. Executive function and theory of mind as predictors of aggressive and prosocial behavior and peer acceptance in early childhood. *Social Development*. 2017;26(4):907-920. doi:10.1111/sode.12231

35. Capage L, Watson AC. Individual differences in theory of mind, aggressive behavior, and social skills in young children. *Early Education and Development*. 2001;12(4):613-628. doi:10.1207/s15566935eed1204_7

36. McLaughlin KA, Sheridan MA, Humphreys KL, Belsky J, Ellis BJ. The value of dimensional models of early experience: Thinking clearly about concepts and categories. *Perspectives on Psychological Science*. 2021;16(6):1463-1472. doi:10.1177/1745691621992346

37. Ellis BJ, Abrams LS, Masten AS, Sternberg RJ, Tottenham N, Frankenhuis WE. Hidden talents in harsh environments. *Development and Psychopathology*. 2022;34(1):95-113. doi:10.1017/S0954579420000887

38. Young ES, Frankenhuis WE, DelPriore DJ, Ellis BJ. Hidden talents in context: Cognitive performance with abstract versus ecological stimuli among adversity-exposed youth. *Child Development.* 2022;93(5):1493-510. doi:10.1111/cdev.13766

39. Cubides-Mateus DM, LoCasale-Crouch J, Turnbull KL. Do neighborhood resources mitigate family risk to preschool children's executive function skills growth? *Prevention Science*. 2023;24(1):115-125. doi:10.1007/s11121-022-01480-3

40. Lerner MD, Lonigan CJ. Executive function among preschool children: Unitary versus distinct abilities. *Journal of Psychopathology and Behavioral Assessment*. 2014;36(4):626-639. doi:10.1007/s10862-014-9424-3

41. Nix RL, Gill S, Hostetler ML, Feinberg ME, Francis LA, Stifter CA, McNeil CB, Kidder SM, Jones DE, Park YR, Kim CN. Promoting toddlers' self-regulation and healthy eating habits among families living in poverty: A randomized controlled trial of Recipe 4 Success. *Child Development*. 2024;95(2):354-367. doi:10.1111/cdev.14006

42. Zelazo PD, Carlson SM. Hot and cool executive function in childhood and adolescence: Development and plasticity. *Child Development Perspectives*. 2012;6:354-360. doi:10.1111/j.1750-8606.2012.00246.x

43. Raver CC, Jones SM, Li-Grining C, Zhai F, Bub K, Pressler E. CSRPs impact on low-income preschoolers' preacademic skills: Self-regulation as a mediating mechanism. *Child Development.* 2011;82(1):362-378. doi:10.1111/j.1467-8624.2010.01561.x

©2024-2026 ABILIO | RESILIENCE

44. White RE, Carlson SM. What would Batman do? Self-distancing improves executive function in young children. *Developmental Science.* 2016;19(3):419-426. doi:10.1111/desc.12314

45. Distefano R, Galinsky E, McClelland MM, Zelazo PD, Carlson SM. Autonomy-supportive parenting and associations with child and parent executive function. *Journal of Applied Developmental Psychology*. 2018;58:77-85. doi:10.1016/j.appdev.2018.04.007

46. Castelo RJ, Meuwissen AS, Distefano R, McClelland MM, Galinsky E, Zelazo PD, Carlson SM. Parent provision of choice is a key component of autonomy support in predicting child executive function skills. *Frontiers in Psychology.* 2021;12:773492. doi:10.3389/fpsyg.2021.773492

47. Lewis-Morrarty E, Dozier M, Bernard K, Terraciano SM, Moore SV. Cognitive flexibility and theory of mind outcomes among foster children: Preschool follow-up results of a randomized clinical trial. *Journal of Adolescent Health.* 2012;51(2 Suppl):S17-S22. doi:10.1016/j.jadohealth.2012.05.005

©2024-2026 ABILIO | RESILIENCE