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Child Care Policy as an Anti-Poverty Strategy: The Need to Address Neurophysiological Self-Regulation

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Abstract

High-quality early care and education can mitigate the short- and long-term effects of poverty on young children's development. Therefore, policies that expand access to high-quality early care and education can be an effective anti-poverty strategy. A number of programs demonstrably foster volitional processes of self-regulation—the capacity to control emotions, thoughts, and behaviors—among young children in poverty. However, relatively little is known about how the activity of the neurophysiological systems that form the interface between brain and body supports these processes of self-regulation in early care and education settings. Maximizing the efficacy of early care and education as an anti-poverty strategy requires adopting policies to advance three interrelated goals: understanding, accommodating, and reconfiguring young children's neurophysiological function in the early care and education environment.

Keywords

poverty, early education, child care policy, self-regulation, neurophysiological function

Tweet

How can we maximize the efficacy of early care and education programs as an anti-poverty strategy? Part of the answer might lie under children's skin. #neurophysiology #early education

Key Points

- High-quality early care and education programs mitigate the effects of poverty on young children's development, including the development of volitional processes of self-regulation.
- These processes include the ability to control one's emotions, thoughts, and behaviors, abilities that are essential for school readiness and early school success.
- Children's ability to control their emotions, thoughts, and behaviors depends, in part, on neurophysiological systems that interface between brain and body.
- For early care and education programs to realize their full potential as anti-poverty programs, policies must promote the understanding, accommodation, and reconfiguration of these systems in early care and education settings.

Introduction

Growing up in poverty has clear, negative impacts on young children's development (e.g., school readiness; Duncan et al., 2012) and long-term life outcomes (e.g., reduced earnings; Duncan et al., 2010). High-quality early care and education has been shown to buffer poverty's short- and long-term effects (Domond et al., 2020), with some early education programs demonstrably fostering volitional processes of self-regulation among young children in poverty (e.g., Raver et al., 2011). This is promising—the capacity to deliberately regulate one's emotions, thoughts, and behaviors is essential for school readiness and early school success (Brock et al., 2009; Eisenberg et al., 2010) and is particularly important for children in poverty, who are disproportionately likely to face challenge and adversity (Howse et al., 2003).

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However, effective self-regulation relies not only on top-down, volitional processes but also on the involuntary activity of bottom-up neurophysiological systems (Blair & Raver, 2012; Calkins & Keane, 2004). The activity of these systems may play an essential role in transmitting the effects of early care and education programs, and in influencing individual differences in these programs' effects. Therefore, in this article, we argue that maximizing the benefits of early care and education programs for young children—and thereby maximizing the potential of early care and education as an anti-poverty strategy—requires policies that promote three related goals: (a) understanding young children's neurophysiological function in early care and education contexts; (b) using that understanding to accommodate individual differences in the neurophysiological function of children raised in poverty; and, ultimately, (c) using the early care and education environment to help children reconfigure their neurophysiological function in ways that support their short- and long-term development.

Child Care Policy as an Anti-Poverty Strategy

Policies that expand access to high-quality early care and education can be an effective, multigenerational anti-poverty strategy. First, early care and education allows parents with young children to participate more fully in the workforce, which should allow parents to earn sufficient income to support themselves and their families (National Academies of Sciences, Engineering, and Medicine, 2019), although this is not always the case in practice (see Morrissey, 2017). Second, as over 50 years of research shows, high-quality early care and education programs can improve not only young children's school readiness but also their long-term education attainment and earnings (Domond et al., 2020; Heckman, 2011). Thus, early care and education is a two-generation anti-poverty intervention with the potential to impact a third generation: the children of parents who received early education when they were young (Heckman & Karapakula, 2019).

The goals of these early care and education programs for children in poverty shifted toward the end of the 20th century from an emphasis on children's overall well-being (U.S. Department of Health and Human Services, Office of Child Development, 1972) to a narrower focus on children's cognitive development in general and their academically oriented school readiness in particular (Bodrova, 2008). More recently, the pendulum has swung back toward a more holistic perspective focused on children's socio-emotional development. In recent years, one area of socio-emotional development—children's self-regulation—has emerged as an essential component of school readiness (Jones et al., 2011) and therefore a crucial goal for early care and education programs that serve young children in poverty.

Self-Regulation in Early Childhood

Top-Down Processes

In the context of socioemotional development, self-regulation refers to the ability to control one's emotions, thoughts, and behaviors in the pursuit of goals (Collaborative for Academic, Social, and Emotional Learning, 2021; McClelland & Cameron, 2012). In early childhood, self-regulation is often conceptualized as two sets of processes: executive functions, a set of core cognitive skills that includes working memory, inhibitory control, and cognitive flexibility (Willoughby et al., 2014), and emotion regulation, or the capacity to control emotional states and experience (Gross, 2014). Both of these forms of self-regulation are under deliberate or volitional control, and both predict school readiness and early school success (Brock et al., 2009; Eisenberg et al., 2010).

Young children employ these processes continuously in early care and education settings, whether they are interacting with caregivers, teachers, peers, or other aspects of the environment. For example, consider the processes of volitional self-regulation required for a preschooler to comply with their teacher's instructions to clean up their toys after a period of free play: First, the child must focus their attention on the teacher to hear their instructions, and then shift their attention to the toys. Then, they must inhibit what is likely their preferred course of action—to continue playing with the toys—in favor of beginning to put them away. As they do so, they must remember which toys they have put away, which ones still need to put away, and which toys go where. As they are exercising these processes of executive functions, they must, in parallel, regulate their emotions. This may entail managing their disappointment upon hearing the teacher's instruction to clean up, their frustration as they attempt to fit a toy into a box in which it will not quite fit, and their anxiety about being able to complete the task in the time allowed.

Bottom-Up Systems

As this example illustrates, for the young child cleaning up is a complex task that places considerable demands on their volitional processes of self-regulation. The emotional, cognitive, and behavioral demands entailed by exercising those processes must be supported through the allocation of metabolic resources—in a word, energy—that permit and sustain activity in the child's brain and body. The exercise of top-down, volitional processes of self-regulation in early care and education settings is therefore made possible by the bottom-up, involuntary neurophysiological systems that supply these resources. There are three of these systems: the two branches of the autonomic nervous system—the parasympathetic (PNS) and sympathetic nervous systems (SNS)—and the hypothalamic–pituitary–adrenal (HPA) axis, and

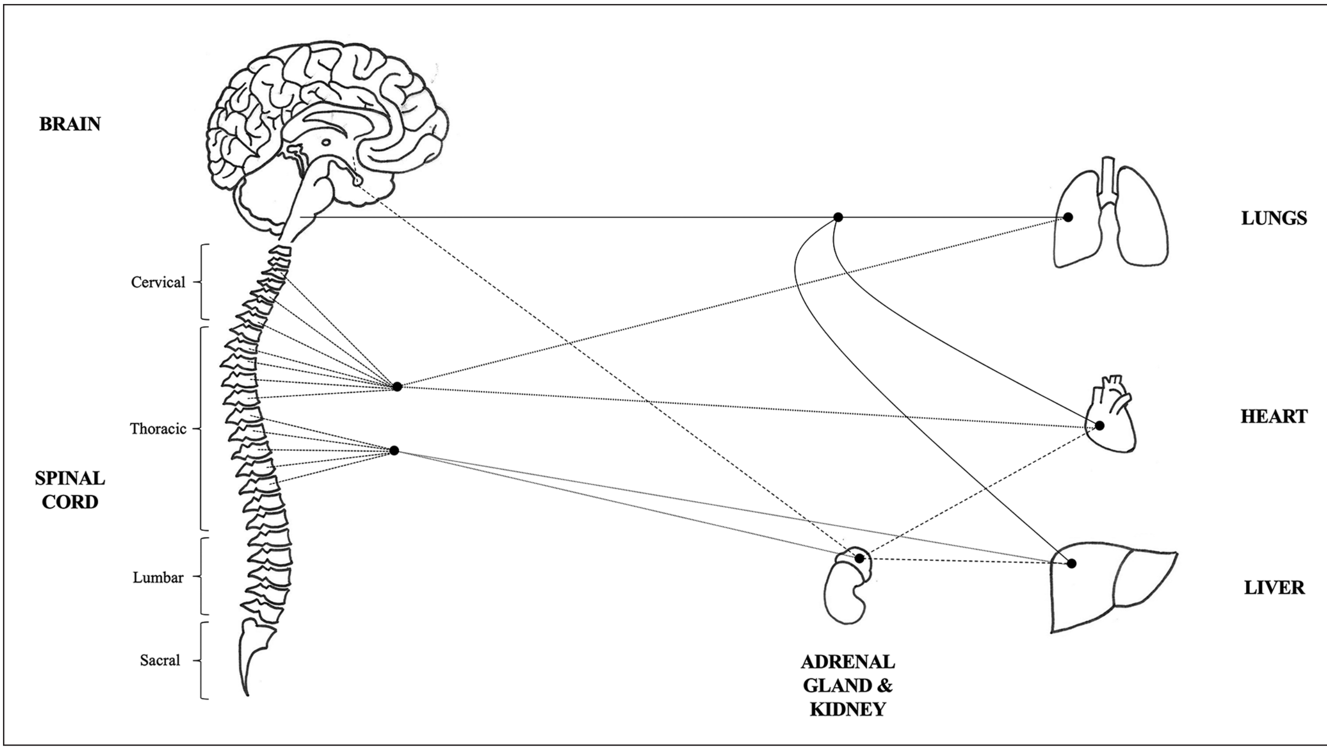

Figure 1. A simplified summary of select metabolism-modulating functions of the PNS (solid line), SNS (short dashed line), and HPA axis (long dashed line), including (1) parasympathetic projections from the Xth cranial nerve to the lungs, heart, and liver, which reduce blood oxygenation, lower heart rate, and promote the storage of glucose by the liver, respectively; (2) sympathetic projections from the spinal cord to the lungs, heart, and liver, which have broadly opposite effects to those of the PNS; (3) sympathetic projections to the adrenal glands, which prompts the release of the metabolism-enhancing neurotransmitter adrenaline into the blood; and (4) a series of signals that originates in the hypothalamus, continues to the pituitary, and terminates in the adrenal glands, which causes the release of the hormone cortisol into the blood.
When cortisol binds to receptors on the heart, it constricts the arteries, increasing blood pressure; when it binds to receptors on the liver, it stimulates the release of glucose.
Note. In the interests of clarity ganglia have been omitted and organs are not drawn to scale, and that unlike the PNS and SNS, which directly innervate the organs depicted, the HPA axis achieves its effects by releasing the hormone cortisol into the bloodstream. PNS = parasympathetic nervous system; SNS = sympathetic nervous systems; HPA = hypothalamic–pituitary–adrenal.

together, they modulate children's metabolic output to meet the situational demands imposed by their environment by sending signals to various organs and tissues throughout the body. In general, higher levels of PNS activity and lower levels of SNS and HPA axis activity will result in lower levels of metabolic output—less energy release and consumption—that are appropriate for situations of rest and reflection. In contrast, lower levels of PNS activity and higher levels of SNS and/or HPA axis activity will increase metabolic output, freeing energy stores to support "fight or flight" behaviors (Ulrich-Lai & Herman, 2009; see Figure 1).

When children are in early care and education settings, these three systems are constantly at work, adjusting children's metabolic output to support their volitional processes of self-regulation in response to all situational demands that the early care and education setting may impose, from sitting quietly, reading a book, to hurriedly exiting the building during a fire drill. Different situations will require that children exercise different volitional processes of self-regulation and, therefore, will impose different demands on the neurophysiological systems that support those processes. Sitting in circle time, listening as a teacher reads a book may place modest demands on children's executive functions (particularly working memory and cognitive flexibility) and emotional regulation, depending on the book's emotional content. The moment-to-moment modulation of metabolic output under these conditions will fall primarily to the PNS, as it is primarily this system that supports self-regulatory processes in situations that demand calm engagement (Holochwost et al., 2019; Porges, 1995).

The morning transition upon preschool arrival may place a considerably greater burden on children's volitional self-regulatory processes. The child needs to remember their arrival routine—hang up their jacket, wash their hands, sit down for breakfast—and inhibit their desire to do something else—go to their favorite center, for example. Their parent's departure may elicit strong emotions that will need to be regulated. In short, drop-off may constitute a mild stressor for the child, and accordingly, the SNS may become more active in satisfying the demands imposed by the situation (Cacioppo et al., 2017), although the PNS may still play a role.

In contrast, in a situation where the child perceives a threat—such as the sounding of the fire alarm or another child's angry outburst—the PNS will largely cede control to the SNS. The activity of the SNS will increase substantially, providing the resources necessary for the child to engage in fight or flight behaviors. Volitional processes of emotion regulation may be invoked as the child attempts to manage their anxiety or fear. The activation of the SNS may be supplemented by the slower-acting HPA axis, which provides these resources in greater quantities and for a longer period of time than those afforded by the SNS alone (Sapolsky et al., 2000).

As noted below, our understanding of children's neurophysiological function in early care and education environments is in its infancy. However, methods that permit the study of neurophysiological function in real-time in educational environments are becoming increasingly available. Understanding children's neurophysiological function in early care and education environments will reveal how the broader developmental environment—including the environment of poverty—leads to individual differences in neurophysiological function, and how those individual differences, in turn, lead to differences in developmental outcomes for children. That understanding is a necessary first step toward crafting policies and program to mitigate the effects of poverty on children's neurophysiological function and thereby reduce its impacts on their development.

Individual Differences in Self-Regulation

These situational scenarios featuring an abstracted "child" are offered as illustrative examples. Different children will perceive and respond to the same situation in different ways, and these differences will appear in their volitional processes of self-regulation and the underlying activity of neurophysiological systems. A child who has great difficulty sitting still may find that the book-reading example above imposes demands on their inhibitory control and emotion regulation as they grapple with feelings of frustration or even anger. Their pattern of neurophysiological function would reflect their perception of book-reading time as stressful, with reduced levels of PNS activity and increased SNS activity.

Moreover, the same child may respond differently to the same situation when that situation is encountered at different points in time. When asked to join circle time for book reading, a child who perceives sitting still as an undue imposition may refuse the request on one day; this will certainly draw on volitional processes and neurophysiological function in different ways than calm engagement. The next day they may attempt to run away. There is no preprogrammed approach for dealing with the book-reading situation or any other situation in the early care and education setting that applies to all children, all of the time. Rather, different children will attempt different strategies, until the solution that is most effective for them emerges and then stabilizes over time (Thelen, 1992). Whatever form it ultimately takes, that solution will feature a particular combination of volitional processes of self-regulation, supported by a particular pattern of neurophysiological function.

Many factors that account for individual differences in children's perceptions of a particular situation in an early care and education setting, how they exercise volitional processes of self-regulation in those situations, and how they recruit the metabolic resources afforded by neurophysiological systems to support exercising those processes. For example, temperament plays a role; children who prefer lower levels of activity and low-intensity sources of pleasure may be more comfortable with sitting and listening to their teacher read a book. However, children's life experience plays a vital role in shaping their volitional processes of self-regulation and patterns of neurophysiological activity (Ellis et al., 2009), and for many children, this experience includes exposure to poverty.

Poverty and Self-Regulation

In the United States, 14.8% of children below the age of 6 live in poverty; nearly half (40%) face economic hardship (U.S. Census Bureau, 2021). Due to systemic racism, nearly two thirds of children in poverty are either Black (29.8%) or Hispanic (30.8%; U.S. Census Bureau, 2021). Growing up in poverty increases the likelihood that young children will encounter risk and adversity across all levels of their developmental environment, from their home (Evans, 2004) to their neighborhood (Sampson et al., 1997). The early care and education environment is no exception: Children in poverty are more likely to attend early care and education arrangements that are, on average, of lower quality than their more affluent counterparts (NICHD Early Child Care Research Network, 1997; Tout et al., 2017) and are more likely to experience instability in those care arrangements (National Research Council and Institute of Medicine, 2010).

The cumulative weight of risk and adversity can hinder young children's development (Engle & Black, 2008), including the growth of volitional processes of self-regulation. Children raised in poverty perform worse on measures of volitional self-regulation in early childhood (Li-Grining et al., 2010). Indeed, the gaps in school readiness and early school achievement between children in poverty and their peers reflect, in part, the discrepancies in volitional processes of self-regulation in preschool (Duncan et al., 2012).

These discrepancies may, in turn, reflect underlying individual differences in the function of young children's neurophysiological systems. These differences are attributable, in part, to experiencing poverty, risk, and adversity early in life, just as these systems are developing rapidly and therefore are particularly sensitive to environmental influence (Fox et al., 2010). Exposure to poverty and adversity in early life is associated with higher resting or "baseline" levels of activity in the stress-responsive SNS and HPA axis, as well as altered patterns of reactivity in response to stressors (Holochwost et al., 2017; Zalewski et al., 2012). Although sensitive parenting behaviors may mitigate the effects of poverty on neurophysiological function, parents are also not immune to poverty's effects, and the accumulation of risk factors in the parent's environment can erode the capacity of even the most well-meaning parent to be sensitive in their interactions with their child (Holochwost et al., 2016; Popp et al., 2008).

The growing awareness of poverty's impacts on the development of volitional processes of self-regulation in early childhood (Li-Grining et al., 2010), the centrality of those processes for school readiness and success (Brock et al., 2009; Eisenberg et al., 2010), and their particular salience among children in poverty (Blair & Raver, 2012; Howse et al., 2003) have motivated the creation of programs designed to foster volitional self-regulation among children raised in poverty. Many of these programs demonstrably improve children's performance on measures of volitional processes of self-regulation (e.g., Raver et al., 2011), although to date these programs have generally not focused on reconfiguring children's neurophysiological function (see Brotman et al., 2011, for a notable exception).

This represents both a problem and an opportunity. Children carry their life experiences with them when they come to early care and education settings, including the experiences of poverty and adversity (Ellis et al., 2009). Those experiences influence their neurophysiological function both inside and outside the classroom, which in turn influences how children exercise their volitional processes of self-regulation. Ignoring young children's neurophysiological function in the early care and education environment will necessarily hinder the capacity of early care and education programs to reach their full potential as an anti-poverty strategy—indeed, the variable effects of programs that target volitional processes of self-regulation may, in part, be ascribed to individual differences in children's neurophysiological function. Ignorance of this function in early care and education settings is, therefore, a problem. However, embracing policies and programs that address children's neurophysiological function in early care and education settings provides an opportunity to maximize that potential.

Policy Insights

We recommend policies and programs that advance three interrelated goals: understanding young children's neurophysiological function in the early care and education environment, accommodating that function in this environment, and, ultimately, helping them to reconfigure that function in this environment. Achieving these goals will require engaging with policymakers who set the standards and budgets for early care and education, as well as program administrators who implement early care and education-relevant laws and policies.

Understanding Neurophysiological Function

It is remarkable how little we know about young children's neurophysiological function in early care and education settings, given the importance of that function for children's experience in those settings and the proportion of young children who spend time in those settings (approximately half of infants and toddlers and three quarters of preschoolers in the United States; U.S. Census Bureau, 2021). The small body of extant research on this topic has focused on HPA axis activity, revealing associations between the quality of care children receive in early care and education and their daily or diurnal HPA axis activity (see Holochwost et al., 2020, for a review), with more recent work demonstrating the impact of different risk factors on particular aspects of diurnal activity (Brown, Holochwost, Laurenceau, Garnett, & Anderson, 2021). Understanding these systems is both applicable basic science and principled applied science, both of which are useful.

The lack of understanding of children's neurophysiological function is due, in part, to the challenges inherent in conducting applied research, in general, and in collecting data on children's neurophysiological function in applied settings, in particular. But it is also due to the way research is funded. For example, in the United States, research on young children is typically funded by one of two agencies: the National Institutes of Health (NIH) and the U.S. Department of Education's Institute of Education Sciences (IES), although private foundations also play a role. Although the NIH funds a great deal of research on young children's neurophysiological function, it does not typically fund work on early care and education (the NICHD Study of Early Child Care and Youth Development being perhaps the most notable exception). And, although IES funds research on early care and education, that research does not generally feature data on children's neurophysiological function.

Given this, research on young children's neurophysiological function in early care and education settings is likely to fall into a gap between the respective purviews of major funding agencies. This merits a policy adjustment that could take a number of different forms, including acting on the recommendations of committees focused on health disparities when and where those disparities begin: in early childhood, and, in part, in the context of early care and education. For example, the National Academy of Sciences, Engineering, and Medicine's Committee on Applying Neurobiological and Socio-Behavioral Sciences from Prenatal Through Early Childhood Development recommended that "funders should support research that advances the state of the science in several critical ways to advance health equity," and should, in particular, "expand research into individual differences (heterogeneity) in response to adversity and treatment" (National Academies of Sciences, Engineering, and Medicine, 2019, p. 24).

Accommodating Neurophysiological Function

Once we understand more about young children's neurophysiological function in early care and education settings, we can use that understanding to better accommodate that function. One way to do this is to incorporate modules on neurophysiological function into existing professional development opportunities for early educators who work with children raised in poverty, such as those provided by ZERO to THREE, the National Association for the Education of Young Children (NAEYC), Teaching Strategies, HighScope, Teachstone, and others. The goals of these modules would be to explain: (a) the association between children's observed behavior in early care and education settings and their underlying neurophysiological function; (b) how experiences of poverty and adversity can impact that function; and (c) that a child whose behavior in the early care or education setting appears deliberately difficult or disruptive may, in fact, merely reflect the extent to which that child's neurophysiological function has been affected by their life experience. Thus conceived, these modules would represent an important next step in educator training that moves beyond linking brain regions to particular cognitive processes (e.g., the prefrontal cortex to volitional self-regulatory processes) to a more nuanced understanding of how environmental influences across settings—such as home and school—and over time are reflected in individual differences in young children's neurophysiological function. This deeper understanding, may, in turn, lead educators to reconsider how they see certain children in their classrooms, and how they respond to those children's behavior. For example, an educator who initially views a child's aggressive behavior as a deliberate provocation may be prompted to redouble their efforts to diffuse that behavior when they understand that it is a manifestation of involuntary neurophysiological activity evolved to support defensive behaviors.

Understanding young children's neurophysiological function in early care and education settings can also help create settings that are supportive for all children. There is evidence that the experience of early care and education may be particularly stressful for children of color and children from other marginalized groups (see, for example, Gilliam & Reyes, 2018). To the extent that this stress is manifest in children's neurophysiological function—and there is some evidence that it may be (Roisman et al., 2009)—monitoring that function would be one additional way to ensure that early care and education programs are supporting children from diverse backgrounds, and that the potential for those programs to benefit children's volitional processes of self-regulation (and, thereby, their school readiness and achievement) are not being undermined by countervailing, negative influences on children's neurophysiological function.

Reconfiguring Neurophysiological Function

Of course, the ultimate goal of early care and education policy that is informed by an understanding of children's neurophysiological function is not merely to avoid making things worse for young children raised in poverty—it is to make things better. Making things better requires policies that capitalize on the tremendous potential for early care and education interventions and curricula to reconfigure the neurophysiological function of children who have experienced poverty and adversity.

This potential is borne of the confluence of three facts: first, young children's neurophysiological function is exquisitely sensitive to environmental input (Fox et al., 2010); second, as noted above, many children (including many children in poverty) spend many hours in early care and education settings; and third, children's experiences in early care and education settings—and, in particular, their interactions with their caregivers and teachers (see Hanno et al., in press, for the importance of these interactions)—have the potential to influence their neurophysiological function, although to date the evidence of this potential is largely restricted to the function of the HPA axis (Holochwost et al., 2020). As such, the first point of intervention is to work with caregivers and early educators to explore how deliberate efforts to promote sensitive and supportive behaviors may reconfigure children's neurophysiological function, shifting it away from patterns that support vigilance and defensive behaviors and toward those that support calm engagement and learning.

Such interventions may take the form of professional development experiences that build upon those described above but place their emphasis on educators' capacity to reconfigure children's neurophysiological function, rather than merely accommodating it. However, interventions may comprise or include curricula that seek not only to foster children's volitional processes of self-regulation but also, in so doing, reconfigure their neurophysiological function. That may be accomplished most efficiently by adjusting the design and targeted outcomes of curricula for students (e.g., the Chicago School Readiness Project; Raver et al., 2011), but may expand to include curricula designed for parents (e.g., Getting Ready: Sheridan et al., 2014; Incredible Years: Webster-Stratton et al., 2011; ParentCorps: Brotman et al., 2011).

Of course, the efficacy of policies that support new programs of professional development or curricula will be limited until we adopt policies that adequately support early educators. Many early educators themselves live in or near poverty (McLean et al., 2021), and the experience of poverty can limit any adult's capacity to interact with children in a sensitive and supportive fashion (Holochwost et al., 2016; Popp et al., 2008). Moreover, experiences of poverty impact the neurophysiological function of adults (Evans, 2016), just as they do children, and children's neurophysiological function comes to reflect that of their caregivers over time (Feldman, 2012). Therefore, by paying early educators poverty-level wages, we sabotage the capacity for early care and education to achieve its full potential as an anti-poverty strategy, both by restricting the capacity of early educators to engage in sensitive and supportive caregiving and by inculcating dysregulated patterns of neurophysiological function in early educators.

Conclusion

Young children's neurophysiological function is an essential component of their broader self-regulatory capacities in early childhood (Blair & Raver, 2012; Holochwost et al., 2019, 2021). On one hand, the sensitivity of neurophysiological function to environmental input in early childhood (Fox et al., 2010) renders that function vulnerable to poverty's deleterious influence; however, in this sensitivity lies the promise for interventions in early care and education settings to benefit young children's neurophysiological function. Therefore, maximizing the benefits of early care and education for children raised in poverty requires adopting policies that promote the understanding, accommodation, and reconfiguration of young children's neurophysiological function. Our understanding of neurophysiological function in these settings is in its infancy, and specific program recommendations regarding accommodation and reconfiguration must await further growth in this understanding. As our understanding grows, so too will our capacity to recommend policies to maximize the efficacy of early care and education programs as an anti-poverty strategy.

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References

Blair, C., & Raver, C. C. (2012). Child development in the context of poverty: Experiential canalization of brain and behavior. *American Psychologist*, *67*, 309–318. https://doi.org/10.1037/a0027493

Bodrova, E. (2008). Make-believe play versus academic skills: A Vygotskian approach to today's dilemma of early childhood education. *European Early Childhood Education Research Journal*, *16*, 357–369. https://doi.org/10.1080/13502930802291777

Brock, L. L., Rimm-Kaufman, S. E., Nathanson, L., & Grimm, K. J. (2009). The contributions of "hot" and "cool" executive function to children's academic achievement, learning-related behaviors, and engagement in kindergarten. *Early Childhood Research Quarterly*, *24*, 337–349. https://doi.org/10.1016/j.ecresq.2009.06.001

Brotman, L. M., Calzada, E., Huang, K. Y., Kingston, S., Dawson-McClure, S., Kamboukos, D., & Petkova, E. (2011). Promoting effective parenting practices and preventing child behavior problems in school among ethnically diverse families from underserved, urban communities. *Child Development*, *82*, 258–276. https://doi.org/10.1111/j.1467-8624.2010.01554.x

Brown, E. D., Holochwost, S. J., Laurenceau, J. P., Garnett, M. L., & Anderson, K. E. (2021). Deconstructing cumulative risk: Poverty and aspects of instability relate uniquely to young children's diurnal cortisol. *Child Development*. 1–16. https://doi.org/10.1111/cdev.13512

Cacioppo, J. T., Tassinary, L. G., & Berntson, G. G. (2017). *Strong inference in psychophysiological science*. In J. T. Cacioppo, L. G. Tassinary, & G. G. Berntson (Eds.), *Cambridge handbooks in psychology. Handbook of psychophysiology* (pp. 3–15). Cambridge University Press.

Calkins, S. D., & Keane, S. P. (2004). Cardiac vagal regulation across the preschool period: Stability, continuity, and implications for childhood adjustment. *Developmental Psychobiology*, *45*, 101–112. https://doi.org/10.1002/dev.20020

Collaborative for Academic, Social, and Emotional Learning. (2021). *SEL: What are the core competence areas and where are they promoted?* https://casel.org/sel-framework/

Domond, P., Orri, M., Algan, Y., Findlay, L., Kohen, D., Vitaro, F., Tremblay, R. E., & Côté, S. M. (2020). Child care attendance and educational and economic outcomes in adulthood. *Pediatrics*, *146*(1), Article e20193880. https://doi.org/10.1542/peds.2019-3880

Duncan, G. J., Magnuson, K., Kalil, A., & Ziol-Guest, K. (2012). The importance of early child- hood poverty. *Social Indicators Research*, *108*, 87–98. https://doi.org/10.1007/s11205-011-9867-9

Duncan, G. J., Ziol-Guest, K. M., & Kalil, A. (2010). Early-childhood poverty and adult attainment, behavior, and health. *Child Development*, *81*, 306–325.

Eisenberg, N., Valiente, C., & Eggum, N. D. (2010). Self-regulation and school readiness. *Early Education and Development*, *21*, 681–698. https://doi.org/10.1080/10409289.2010.497451

Ellis, B. J., Figueredo, A. J., Brumbach, B. H., & Schlomer, G. L. (2009). The impact of harsh versus unpredictable environments on the evolution and development of life history strategies. *Human Nature*, *20*, 204–268. https://doi.org/10.1007/s12110-009-9063-7

Engle, P. L., & Black, M. M. (2008). The effect of poverty on child development and educational outcomes. *Annals of the New York Academy of Sciences*, *1136*, 243–256.

Evans, G. W. (2004). The environment of childhood poverty. *American Psychologist*, *59*, 77–92. https://doi.org/10.1037/0003-066X.59.2.77

Evans, G. W. (2016). Childhood poverty and adult psychological well-being. *Proceedings of the National Academy of Sciences*, *113*, 14949–14952. https://doi.org/10.1073/pnas.1604756114

Feldman, R. (2012). Bio-behavioral synchrony: A model for integrating biological and microsocial behavioral processes in the study of parenting. *Parenting*, *12*, 154–164. https://doi.org/10.1080/15295192.2012.683342

Fox, S. E., Levitt, P., & Nelson, C. A., III. (2010). How the timing and quality of early experiences influence the development of brain architecture. *Child Development*, *81*(1), 28–40. https://doi.org/10.1111/j.1467-8624.2009.01380.x

Gilliam, W. S., & Reyes, C. R. (2018). Teacher decision factors that lead to preschool expulsion. *Infants & Young Children*, *31*, 93–108.

Gross, J. J. (2014). *Emotion regulation: Conceptual and empirical foundations*. In J. J. Gross (Ed.), *Handbook of emotion regulation* (pp. 3–20). The Guilford Press.

Hanno, E. C., Jones, S. M., & Lesaux, N. K. (in press). The active ingredient: Centering educators to drive children's development and quality improvement in early education and care settings. *Policy Insights from the Behavioral and Brain Sciences*.

Heckman, J. (2011). The economics of inequality: The value of early childhood education. *American Educator*, *35*, 31–47.

Heckman, J. J., & Karapakula, G. (2019). *Intergenerational and intragenerational externalities of the Perry Preschool Project* (HCEO Working Paper No. 2019-033). University of Chicago.

Holochwost, S. J., Gariépy, J. L., Mills-Koonce, W. R., Propper, C. B., Kolacz, J., & Granger, D. A. (2017). Individual differences in the activity of the hypothalamic pituitary adrenal axis: Relations to age and cumulative risk in early childhood. *Psychoneuroendocrinology*, *81*, 36–45. https://doi.org/10.1016/j.psyneuen.2017.03.023

Holochwost, S. J., Gariépy, J. L., Propper, C. B., Gardner-Neblett, N., Volpe, V. V., Neblett, E., & Mills-Koonce, W. R. (2016). Sociodemographic risk, parenting behaviors, and the development of executive function in early childhood: The role of ethnicity. *Early Childhood Research Quarterly*, *36*, 537–549. https://doi.org/10.1016/j.ecresq.2016.02.001

Holochwost, S. J., Kolacz, J., & Mills-Koonce, W. R. (2021). Towards an understanding of neurophysiological self-regulation in early childhood: The need for a new approach. *Developmental Psychobiology*, 63, 734–752. https://doi.org/10.1002/dev.22044

Holochwost, S. J., Propper, C. B., Rehder, P. D., Wang, G., Wagner, N. J., & Coffman, J. L. (2019). Parasympathetic function: Relevance and methodology for early education research. *Journal of Research in Educational Effectiveness*, *12*, 728–749.

Holochwost, S. J., Towe-Goodman, N., Rehder, P. D., Wang, G., & Mills-Koonce, W. R. (2020). Poverty, caregiving, and HPA-axis activity in early childhood. *Developmental Review*, *56*, 100898.

Howse, R. B., Lange, G., Farran, D. C., & Boyles, C. D. (2003). Motivation and self-regulation as predictors of achievement in economically disadvantaged young children. *The Journal of Experimental Education*, *71*, 151–174. https://doi.org/10.1080/00220970309602061

Jones, S. M., Brown, J. L., & Aber, J. L. (2011). Two-year impacts of a universal school-based social-emotional and literacy intervention: An experiment in translational developmental research. *Child Development*, *82*, 533–554. https://doi.org/10.1111/j.1467-8624.2010.01560.x

Li-Grining, C. P., Votruba-Drzal, E., Maldonado-Carreño, C., & Haas, K. (2010). Children's early approaches to learning and academic trajectories through fifth grade. *Developmental Psychology*, *46*, 1062–1077. https://doi.org/10.1037/a0020066

McClelland, M. M., & Cameron, C. E. (2012). Self-regulation in early childhood: Improving conceptual clarity and developing ecologically valid measures. *Child Development Perspectives*, *6*, 136–142. https://doi.org/10.1111/j.1750-8606.2011.00191.x

McLean, C., Austin, L. J. E., Whitebrook, M., & Olson, K. L. (2021). *Early childhood workforce index—2020*. Center for the Study of Child Care Employment, University of California, Berkeley.

Morrissey, T. W. (2017). Child care and parent labor force participation: A review of the research literature. *Review of Economics of the Household*, *15*, 1–24. https://doi.org/10.1007/s11150-016-9331-3

National Academies of Sciences, Engineering, and Medicine. (2019). *Vibrant and healthy kids: Aligning science, practice, and policy to advance health equity*. National Academies Press. https://doi.org/10/17226/25466

National Research Council and Institute of Medicine. (2010). *Student mobility: Exploring the impact of frequent moves on achievement: Summary of a Workshop*. The National Academies Press. https://doi.org/10.17226/12853

NICHD Early Child Care Research Network. (1997). The Effects of infant child care on infant-mother attachment security: Results of the NICHD Study of Early Child Care. *Child Development*, *68*, 860–879. https://doi.org/10.1111/j.1467-8624.1997.tb01967.x

Popp, T. K., Spinrad, T. L., & Smith, C. L. (2008). The relation of cumulative demographic risk to mothers' responsivity and control: Examining the role of toddler temperament. *Infancy*, *13*, 496–518. https://doi.org/10.1080/15250000802329446

Porges, S. W. (1995). Orienting in a defensive world: Mammalian modifications of our evolutionary heritage. A polyvagal theory. *Psychophysiology*, *32*(4), 301–318. https://doi.org/10.1111/j.1469-8986.1995.tb01213.x

Raver, C. C., Jones, S. M., Li-Grining, C. P., Zhai, F., Bub, K., & Pressler, E. (2011). CSRP's impact on low-income preschoolers' pre-academic skills: Self-regulation as a mediating mechanism. *Child Development*, *82*(1), 362–378. https://doi.org/10.1111/j.1467-8624.2010.01561.x

Roisman, G. I., Susman, E., Barnett-Walker, K., Booth-LaForce, C., Owen, M. T., Belsky, J., Bradley, R. H., Houts, R., Steinberg, L., & NICHD Early Child Care Research Network. (2009). Early family and child-care antecedents of awakening cortisol levels in adolescence. *Child Development*, *80*, 907–920.

Sampson, R. J., Raudenbush, S. W., & Earls, F. (1997). Neighborhoods and violent crime: A multilevel study of collective efficacy. *Science*, *277*, 918–924. https://doi.org/10.1126/science.277.5328.918

Sapolsky, R. M., Romero, L. M., & Munck, A. U. (2000). How do glucocorticoids influence stress responses? Integrating permissive, suppressive, stimulatory, and preparative actions. *Endocrinology Review*, *21*, 55–89. https://doi.org/10.1210/edrv.21.1.0389

Sheridan, S. M., Knoche, L. L., Edwards, C. P., Kupzyk, K. A., Clarke, B. L., & Kim, E. M. (2014). The efficacy of the Getting Ready intervention and the role of parental depression. *Early Education and Development*, *25*, 746–769.

Thelen, E. (1992). Development as a dynamic system. *Current Directions in Psychological Science*, *1*, 189–192. https://doi.org/10.1111/1467-8721.ep10770402

Tout, K., Magnuson, K., Lipscomb, S., Karoly, L., Starr, R. H. Q., & Wenner, J. (2017). *Validation of the quality rating used in Quality Rating and Improvement Systems (QRIS): A synthesis of state studies*. Department of Health and Human Services.

Ulrich-Lai, Y. M., & Herman, J. P. (2009). Neural regulation of endocrine and autonomic stress responses. *Nature Reviews Neuroscience*, *10*, 397–409. https://doi.org/10.1038/nrn2647

U.S. Census Bureau. (2021). *POV-08. Primary families with related children under 6 by number of working family members and family structure*. https://www.census.gov/data/tables/time-series/demo/income-poverty/cps-pov/pov-08.2019.html

U.S. Department of Health and Human Services, Office of Child Development. (1972). *Recommendations for a head start program*

Webster-Stratton, C. H., Reid, M. J., & Beauchaine, T. (2011). Combining parent and child training for young children with ADHD. *Journal of Clinical Child and Adolescent Psychology*, *40*, 191–203.

Willoughby, M., Holochwost, S. J., Blanton, Z. E., & Blair, C. B. (2014). Executive functions: Formative versus reflective measurement. *Measurement: Interdisciplinary Research and Perspectives*, *12*, 69–95. https://doi.org/10.1080/15366367.2014.929453

Zalewski, M., Lengua, L. J., Kiff, C. J., & Fisher, P. A. (2012). Understanding the relation of low income to HPA-axis functioning in preschool children: Cumulative family risk and parenting as pathways to disruptions in cortisol. *Child Psychiatry & Human Development*, *43*, 924–942. https://doi.org/10.1007/s10578-012-0304-3