

# Socioeconomic Status and Reading Development: Moving from “Deficit” to “Adaptation” in Neurobiological Models of Experience-Dependent Learning

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**ABSTRACT**— Childhood socioeconomic status (SES) is one of the strongest predictors of student reading outcomes, and these disparities have persisted for decades. Relatedly, two underlying skills that are required for successful reading—oral language and executive function (EF)—are also the two neurocognitive domains most affected by SES. In this review, we summarize current knowledge on how SES influences the neurobiology of language, EF, and their intersection, including the proximal factors that drive these relationships. We then consider the burgeoning evidence that SES systematically moderates certain brain–behavior relationships for language and EF, underscoring the importance of considering context in investigations of the neurobiological underpinnings of reading development. Finally, we discuss how disparities in reading may be conceptualized as neurobiological adaptations to adversity rather than deficit models. We conclude that by harnessing children’s stress-adapted relative strengths to support reading development, we may address opportunity gaps both ethically and efficaciously.

Socioeconomic status (SES)—an index of an individual’s educational, financial, and social resources—is one of

the strongest predictors of a child’s reading development (Bradley & Corwyn, 2002). SES-related disparities in elementary reading scores grew by more than 40% in the second half of the 20th century (Reardon, 2011). Despite numerous policy reforms, income-related achievement gaps in reading scores (based on eligibility for free/reduced-price lunch) have remained remarkably consistent over the last 20+ years (National Assessment of Educational Progress, 1998–2019). Given how important literacy is for myriad life outcomes, it is critical to understand how these disparities arise to better inform efforts to ameliorate them.

Reading relies on the integration of many different cognitive skills. Two that are critically involved are oral language skills, including listening, understanding, and speaking, and executive functioning (EF), which includes attention allocation, working memory, and flexible updating (see Cirino, this issue, for review of the role of EF in reading). Oral language and EF are the two neurocognitive domains most affected by SES (Farah, 2017; Merz, Wiltshire, & Noble, 2019; Romeo, 2023), suggesting that differences in these early skills are at least partially responsible for reading disparities. Indeed, preschool oral language and EF skills partially explain SES effects on later reading performance in elementary grades (Durham, Farkas, Hammer, Bruce Tomblin, & Catts, 2007; Fitzpatrick, McKinnon, Blair, & Willoughby, 2014; Nesbitt, Baker-Ward, & Willoughby, 2013). This suggests that children’s early experiences, before they enter school, have long-lasting

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effects on their academic performance, and especially their reading skills.

In this review, we briefly summarize current knowledge on how SES-related experiences give rise to differences in EF and language development, arguing that children's environmental contexts are critical to understanding the neurobiological bases of reading development and reading impairment. We contend that by taking an adaptive (versus a deficit) approach to understanding disparities in language, EF, and reading, we may be able to best address achievement gaps—or as we would argue, opportunity gaps—by fostering children's relative strengths shaped by early experience.

### HOW SOCIOECONOMIC STATUS INFLUENCES LANGUAGE AND EF DEVELOPMENT

In recent decades, there has been a rapid growth of neuroimaging studies reporting pronounced SES effects on both the structure (neuroanatomy) and function (neurophysiology) of brain regions that support language, EF, and literacy functions, as well as the neural pathways connecting these regions. Why are language and EF so affected by SES? As the brain develops across childhood, the prefrontal and temporoparietal regions that support language, EF, and literacy functions exhibit the most protracted (i.e., slowest) course of development (Sowell et al., 2004). Because they are still developing during early life, these regions are thus most sensitive to environmental influences—both positive and negative—during early childhood (Tooley, Bassett, & Mackey, 2021).

According to the bioecological model of development (Bronfenbrenner & Morris, 2007), income and education per se do not directly affect brain development. Rather, these are *distal* factors that indirectly influence neurocognitive development through more *proximal*, day-to-day experiences. The social causation model (Conger & Donnellan, 2007) discusses two parallel pathways by which children's social conditions and early experiences lead to variations in brain and cognitive development. In the family investment pathway, socioeconomic disadvantage limits a family's ability to provide both material resources, such as learning materials, and cognitive stimulation, such as language exposure and opportunities for higher order thinking. Alternatively, in the family stress pathway, socioeconomic disadvantage leads to increased familial stress that affects parental sensitivity and nurturance, and ultimately, children's emotional and behavioral regulation (Conger & Donnellan, 2007).

These parallel pathways of cognitive stimulation and stress are reflected in several neurobiological models (e.g., Perkins, Finegood, & Swain, 2013; Ursache & Noble, 2016). In essence, these models largely propose that cognitive stimulation influences the development of perisylvian

association cortex, and ultimately language and literacy development, whereas increased family stress affects prefrontal and limbic development, and ultimately executive function and emotional regulation. However, there is increasing evidence that these are not fully distinct pathways and that the myriad social factors associated with socioeconomic disadvantage interact in complex ways to influence development.

The evidence that cognitive stimulation, and particularly language exposure, supports language development is plentiful. While early studies focused on the *quantitative* aspects of language exposure (e.g., the number of words heard; Hart & Risley, 1995; Huttenlocher, Haight, Bryk, Seltzer, & Lyons, 1991), recent studies have shown that *qualitative* features of input are even greater predictors of language development (e.g., Cartmill et al., 2013; Gilkerson et al., 2018; Hirsh-Pasek et al., 2015). Rowe and Snow (2020) propose three dimensions of input quality—interactive, linguistic, and conceptual—each of which scales in complexity across early childhood and supports language development in different, albeit interacting, ways. Several recent neuroimaging studies identify biological mechanisms through which language experience (and especially interactive experience) supports language development. These include increased activation in inferior frontal regions during passive language processing (Romeo et al., 2018), thicker cortex in superior temporal language regions (Merz, Maskus, Melvin, He, & Noble, 2020), and greater structural integrity of the white matter pathways that connect frontal and posterior language regions (Romeo et al., 2018). Recent evidence suggests that increases in the interactive quality of a child's language experience relate to thickening of inferior frontal and temporoparietal language regions, which in turn support increases in children's language and cognitive development (Romeo et al., 2021).

Children from lower SES backgrounds are, on average, exposed to less speech from caregivers, and this language experience often differs across certain qualitative metrics (Hoff, 2006; Rowe & Weisleder, 2020; Schwab & Lew-Williams, 2016). Several studies have used statistical mediation to suggest that differences in language experience explain SES-related differences in children's language and literacy skills (Hoff, 2003; Huttenlocher, Waterfall, Vasilyeva, Vevea, & Hedges, 2010; Lurie et al., 2021). Additional studies have used random assignment to interventions to show that modifications to children's language experience can result in improved language skills and language trajectories (Ferjan Ramírez, Lytle, & Kuhl, 2020; Leung, Hernandez, & Suskind, 2020; McGillion, Pine, Herbert, & Matthews, 2017). Although the methodology and conclusions of several of these studies have been questioned (e.g., Sperry, Sperry, & Miller, 2019), the general pattern of results has been replicated numerous times with a variety of methods across

many cultures (Golinkoff, Hoff, Rowe, Tamis-LeMonda, & Hirsh-Pasek, 2019). In sum, this is a robust body of literature suggesting that differences in children's language experience, whether SES-related or not, are strongly linked to variation in children's language development and the maturation of underlying brain structures.

Similarly, there is an abundant literature demonstrating that stress experienced by both caregivers and children influences EF development. The human stress response is partially coordinated by the interaction between the hypothalamus, pituitary gland, and adrenal glands, or HPA axis. In response to an acute stressor, the HPA axis stimulates the release of cortisol, which helps the body direct energy resources to deal with the stressor, after which cortisol returns to baseline (Arnsten, 2009). However, prolonged exposure to stress without protective buffers—termed “toxic stress”—can chronically elevate cortisol levels (National Scientific Council on the Developing Child, 2005). Hypercortisolism can then negatively affect several neurobiological systems associated with memory (hippocampus), emotion regulation (amygdala), and EF (prefrontal cortex) due to higher concentrations of glucocorticoid receptors (Arnsten, 2009). Indeed, studies have shown that higher cortisol levels are associated with reduced activation in prefrontal areas during EF tasks (Sheridan, Sarsour, Jutte, D'Esposito, & Boyce, 2012) and reduced prefrontal cortical thickness that is in turn associated with reduced EF performance (Feola, Dougherty, Riggins, & Bolger, 2020).

Children growing up with socioeconomic disadvantage are more likely to experience chronic physical stressors (e.g., housing instability and violence exposure) as well as psychosocial stressors (e.g., family turmoil and limited caregiver availability; Evans, 2004; Evans & Kim, 2013). Many studies have shown associations between children's SES and cortisol levels (Dowd, Simanek, & Aiello, 2009; Lupien, McEwen, Gunnar, & Heim, 2009; Shonkoff, Boyce, & McEwen, 2009). This is presumed to partially underlie the robust effects of SES on a variety of EF measures (for review, see Lawson & Farah, 2017; Mooney, Prady, Barker, Pickett, & Waterman, 2021; Sheehy-Skeffington, 2020). Similar to language exposure, several studies have used statistical mediation to suggest that stress physiology and the experience of stressful life events partially explain effects of poverty/low SES on EF performance and related brain structure (Blair et al., 2011; Evans & Schamberg, 2009; Hanson et al., 2012; Luby et al., 2013). Additionally, many intervention programs have been designed to improve EF skills in children from lower SES backgrounds, especially through direct training of emotional regulation and cognition (for reviews, see Diamond & Lee, 2011; Scionti, Cavallero, Zogmaister, & Marzocchi, 2020). Additionally, interventions on stressful caregiving environments, such as foster care, institutionalization, and poverty, have been found to reduce children's

stress and cortisol levels (for review, see Slopen, McLaughlin, & Shonkoff, 2014). In sum, the increased physiological stress associated with lower SES environments appears to be robustly related to children's neural and cognitive development, which underlie executive functioning skills.

Additionally, there is increasing evidence that the stress/EF and cognitive stimulation/language pathways are not entirely distinct. For example, several studies report that variation in cognitive stimulation, and specifically language exposure and social interaction with caregivers, partially explains SES-related differences in EF development (Hackman, Gallop, Evans, & Farah, 2015; Rosen et al., 2020; Sarsour et al., 2011) and EF-related brain structure and function (Rosen, Sheridan, Sambrook, Meltzoff, & McLaughlin, 2018). Additionally, recent work suggests that SES differences in children's EF skills may be partially explained by earlier differences in their language skills (Romeo, Flournoy, et al., 2022). This is not entirely surprising, given that both language and EF are supported by overlapping/adjacent frontotemporal brain regions that undergo rapid maturation during the preschool years (Brown & Jernigan, 2012). Furthermore, there is recent evidence that increased parental stress, and specifically stress associated with financial scarcity, reduces parents' child-directed speech (Ellwood-Lowe, Whitfield-Gabrieli, & Bunge, 2021). Also, emerging evidence suggests that poverty reduction causes changes to patterns of childhood brain functioning in ways that have been previously linked to higher language and cognitive skills (Troller-Renfree et al., 2022).

In sum, there is robust evidence supporting multiple pathways through which SES influences cognitive development. This includes affecting the frequency and quality of children's cognitive stimulation as well as stress experienced by both caregivers and children. However, while these are hypothesized to be distinct pathways, increasing evidence suggests that they are intertwined, such that there is no single explanation for SES differences in language and EF development. One thing that is consistent across all studies reviewed thus far is that SES is positively correlated with neurocognitive functioning, such that higher SES is associated with better outcomes, while lower SES is associated with worse outcomes. However, as the field of SES neuroscience grows, there is growing evidence of a much more complex relationship between children's early experiences and neurocognitive development that necessitates evolving theories and models.

#### HETEROGENEITY IN NEUROCOGNITIVE DEVELOPMENT—WHAT IS “OPTIMAL”?

The majority of neuroscience studies examining individual differences report variation in brain structure or function

that correlates either positively or negatively with differences in performance on a cognitive task, completed either during brain imaging or separately. Thus, a brain pattern emerges that is associated with better cognitive performance, such as higher language skills or better EF. When SES is found to correlate with performance, it is thus assumed that higher SES participants exhibit better cognitive skills because they recruit more neural processing resources than lower SES participants (Farah, 2018). This is inherently a *deficit perspective*, suggesting that there is an optimal pattern of neurocognitive functioning (that was likely identified in higher SES convenience samples), and children from lower SES backgrounds exhibit deficient versions of these neural patterns. However, as Farah (2017) writes, “it is possible that higher and lower SES participants are performing the task in different ways, and, therefore, that high-SES participant’s success is correlated with one pattern of activity and low-SES participants’ success with a different one” (Farah, 2017, p. 58). Indeed, there is a growing body of literature finding that SES systematically moderates brain–behavior relationships in the domains of EF, language, and literacy.

Within the EF domain, SES has been found to moderate associations between brain activation and multiple EF components. For example, in middle schoolers (age 14) completing a working memory task, higher SES children performed better when they exhibited *greater* frontotemporal recruitment, while lower SES children performed better when they recruited these regions *less* to perform the task (Finn et al., 2017). Similarly, in a study of adolescent males (age 16–17) completing a response inhibition task (go/no-go), SES was correlated with activation differences in the classic inhibitory network (right inferior frontal gyrus + subthalamic nucleus + globus pallidus), despite no effect of SES on task performance (Cascio, Lauharatanahirun, Lawson, Farah, & Falk, 2022). Analogous relationships are seen in studies of brain structure. In a large sample of children ranging from 3 to 21 years old, cognitive flexibility was associated with white matter microstructure and macrostructure in children from lower SES backgrounds, but no such relationship was seen in children from higher SES backgrounds (Ursache, Noble, & Study, 2016). Other studies find similar patterns of SES moderating relationships between brain structure/function and performance on EF more broadly, reasoning, and attention-based rule learning (Brito, Piccolo, & Noble, 2017; Demir-Lira, Prado, & Booth, 2021; Ellwood-Lowe et al., 2021; Leonard et al., 2019; Sheridan et al., 2012).

SES also moderates brain–behavior relationships for language and reading skills. In a study of 5-year-olds completing an auditory rhyme judgment task, higher SES children exhibited positive relationships between phonological processing and activation in right superior temporal regions, while lower SES children exhibited similar relationships but

with left-lateralized activation (Younger, Lee, Demir-Lira, & Booth, 2019). Similarly, in a diffusion imaging study of 7–13-year-olds, higher SES children exhibited positive relationships between reading scores and integrity of multiple left hemisphere frontotemporal white matter tracts, while lower SES children exhibited relationships with reading skill in right hemisphere homologues (Gullick, Demir-Lira, & Booth, 2016). Additional studies find that lower SES children exhibit stronger brain–behavior correlations for language/reading skills than their higher SES peers (Conant, Liebenthal, Desai, & Binder, 2017; Noble, Wolmetz, Ochs, Farah, & McCandliss, 2006; Ozernov-Palchick, et al., 2019), suggesting that higher SES environments may protect against the potential negative outcomes associated with lower baseline language skills, while the lack of resources associated with lower SES may exacerbate negative outcomes. However, a recent study of SES-diverse children with and without reading disorders found that different neurocognitive mechanisms were predictive of reading status depending on SES (Romeo, Perrachione, et al., 2022). Specifically, for higher SES children, reading disorders were more strongly predicted by differences in neural responses to phonological processing—often considered the “core deficit” of the reading disorder dyslexia. However, for lower SES children, reading disorders were more strongly predicted by neural responses to orthographic processing. This suggests that differences in children’s early environments affect not only the neurocognitive systems called upon for typical learning and cognitive functioning but also the systems that break down in the context of learning disabilities. This has important implications for screening, diagnosis, and treatment approaches and may further contribute to SES disparities in academic skills.

Moreover, these findings point to the importance of diverse SES representation in developmental neuroscience research studies, and human subjects research more generally. Historically, both developmental psychology and neuroscience research have disproportionately relied on convenience samples of participants (as well as convenience methodology, see below), which in turn disproportionately represent WEIRD (western, educated, industrialized, rich, and democratic) populations (Henrich, Heine, & Norenzayan, 2010; Nielsen, Haun, Kärtner, & Legare, 2017). In many Western contexts, participant samples are often also not representative of the racial and ethnic diversity present in the population and vastly overrepresent White and non-Hispanic participants (Ricard et al., 2022; US DHHS, 2018–2021). This often leads to an assumption that the neural patterns found in these specific subsamples generalize to the whole population, and thus, any deviations are seen as deficient versions of the same pattern rather than altogether different patterns (Roberts & Mortenson, 2022). As aptly noted by Roberts, “how diversity is dealt with

in psychology both reflects and affects the ideologies of psychologists” (Roberts, 2022, p. 10). These ideologies then become self-fulfilling, as scholars attempting to publish non-WEIRD developmental research are met with barriers and biases in publication (Draper et al., 2022; Roberts, Bareket-Shavit, Dollins, Goldie, & Mortenson, 2020). Critically, the implicit or explicit assumptions of the White and WEIRD experience as normative may dangerously reify structural advantage while simultaneously obscuring the unique assets and developmental trajectories taken by children growing up in other contexts. Thus, not only might we have a relatively limited understanding of multiple neuropsychological phenomena—including quantitative and qualitative trajectories of language and EF development—but more importantly, we as a field are likely not even fully aware of the limitations of our knowledge base. If we had a broader characterization of cognitive development and a fuller picture of heterogeneity in patterns of developmental brain and behavior changes, we might be in a much better position to understand how and why two brains might differ from one another, rather than automatically assuming that one is a deficient version of the other. Beyond informing theory and reducing stigmatization, this could have significant real-world implications; for example, in informing clinical decisions of true developmental disabilities/impairments as opposed to natural variation within the broad, normal range of development in context.

Importantly, many scholars actively advocate for greater representation in neuroscience research and to stop automatically labeling experiential differences as deficits, especially when outcomes are still within a functionally typical range (Garcini et al., 2022; Girolamo, Parker, & Eigsti, 2022; Green et al., 2022; Nketia, Amso, & Brito, 2021; Ricard et al., 2022; Rowley & Camacho, 2015; Tuck, 2009). Such practices will allow for a more thorough characterization of the heterogeneity in human brain functioning and how early experiences shape brain development processes. They may also result in better translation of findings to policy and clinical/educational practice and, ultimately, to better strategies for reducing inequitable outcomes for students from diverse backgrounds. Thus, a more representative neuroscience field is critical for advancing both basic science and translational outcomes.

#### TOWARD ADAPTIVE MODELS OF EXPERIENCE-DRIVEN NEUROCOGNITIVE DEVELOPMENT

Just as our human ancestors adapted to varying environments to ensure their survival, present-day humans adapt to their unique environments over the course of development (Werchan & Amso, 2017). Thus, we are likely to invest in attributes and skills that support our survival—in our specific

context—at the expense of other skills (Nketia et al., 2021). Adaptive models of adversity recognize this tradeoff and help to explain why certain neurocognitive disparities along the SES continuum exist in the first place. One prominent theory, the stress-acceleration hypothesis, posits that exposure to significant early-life adversity is associated with hastened maturation of brain regions associated with threat and emotion processing, such as the amygdala, hippocampus, and prefrontal cortex (Callaghan & Tottenham, 2016). Although this may advantage survival in the short term (e.g., by prioritizing associative learning and memory), it can have long-term consequences on health and later neuroplasticity underlying certain skills, such as academic knowledge. Tooley et al. (2021) expand on how SES specifically affects the pace of brain development, such that high SES provides opportunities for rare and positive events (e.g., enriching family vacations) that trigger surprise, delay brain maturation, and ultimately enhance plasticity. Meanwhile, chronic negative experiences (e.g., illness, financial hardship) increase allostatic load, encourage faster maturation, and potentially restrict plasticity. This restricted plasticity may ultimately affect language and EF skills that underlie reading achievement.

Adaptive models not only help to explain performance disparities in cognitive tasks but also help to contextualize them. For example, a classic inhibition-based measure of executive function is a Flanker task, in which participants are presented with a set of symbols (letters, arrows, etc.) and are tasked with reporting the identity of the middle symbol. If the surrounding (“flanking”) symbols are congruent with the middle symbol (e.g., same letters, arrows pointing in the same direction), then response time is typically faster than if the symbols are incongruent (e.g., different letters, arrows pointing in the opposite direction; Ridderinkhof, Wylie, van den Wildenberg, Bashore, & van der Molen, 2021). Children from lower SES backgrounds typically show a greater performance reduction in the incongruent condition, often considered to be a deficit in the ability to inhibit distracting information (St John, Kibbe, & Tarullo, 2019). However, Frankenhuis, Panchanathan, and Nettle (2016) argue that for children raised in harsh and unpredictable environments, enhanced vigilance may be a *stress-adapted skill* that allows children to navigate situations with varied and potentially intense environmental input. Indeed, increased vigilance to the periphery could be considered a form of adaptive intelligence in such environments (Ellis et al., 2022).

Importantly, though, such stress-adapted skills are only brought forth in environmental contexts and conditions involving a lack of predictability, which contrast with highly controlled laboratory environments (Frankenhuis et al., 2016). This is consistent with recent findings that lab-based measures of executive function are more strongly related to real-world academic performance measures

for children from higher SES backgrounds, yet these relationships are weaker for children of lower SES backgrounds (Ellwood-Lowe, Irving, & Bunge, 2022). Thus, the decontextualized nature of these tasks may help to explain the presence of observed SES disparities, highlighting the importance of using context-rich measures for maximum predictive validity and suggesting a deeper consideration of measures selection during experimental design (Doebel, 2020). Certain tools, such as Naumann and colleagues' Multidimensional Assessment of Research in Context (MARC), may help developmental scientists evaluate the ecological validity of measures throughout the cycle of a given research study (Naumann et al., 2022).

Although many behavioral measures suffer from limited contextual relevance, many modern neuroimaging techniques directly affect our understanding of the diversity of human development. For example, several scholars have recently drawn attention to racially exclusionary neuroscience methods that disproportionately affect Black communities (Ricard et al., 2022; Webb et al., 2022). Specifically, for cap-based neuroimaging techniques such as electroencephalography (EEG) and functional near-infrared spectroscopy (fNIRS), signal quality can be affected by coarser, curlier Afro-textured hair and higher levels of melanin in the skin, and many common protective hairstyles include metallic elements that are contraindicative for magnetic resonance imaging (MRI). Such methodological limitations, coupled with historic discrimination, deception, and exploitation, contribute to valid mistrust in research and further exacerbate the issue of sample representation discussed above (Smirnoff et al., 2018). Additional limitations are encountered during analysis. To fully understand the effects of context on development, one must consider both proximal micro-contexts that are nested in macro-contexts, as well as potentially confounding relationships between contextual factors (e.g., race and socioeconomic status). Such complex models require large sample sizes to be adequately powered, which creates a circular issue coupled with exclusionary practices and recruitment difficulties. This is not a problem that can be fixed easily. In addition to developing more inclusive imaging methodologies, researchers may consider incorporating community-engaged research methods and broader community-partnership efforts. These relationship-oriented approaches disrupt hierarchical researcher-subject dynamics and honor the expertise and lived experiences of communities that may not be represented in a given research group (Mikesell, Bromley, & Khodyakov, 2013).

However, better measures and methods are only the start. An evaluation of the *underlying assumptions* behind mainstream measures and tools is also critical to advancing our knowledge of experience-dependent brain development and maximizing translational its impact on education. When

considering a body of evidence largely normed to WEIRD brains, the very notion of differences as disparities maintains oppression by upholding the privileged context as the aspirational norm. This perspective leads to intervention programs largely designed to bolster the specific neurocognitive mechanisms that have been shown to be advantageous for children growing up in higher SES environments. However, as reviewed above, the "optimal" neurobiological path toward cognitive and academic success is context dependent. What if, instead of continuously trying to usher lower SES students on the neurocognitive path taken by their higher SES peers, we aim to harness their stress-adapted relative strengths to support their own unique learning?

In many ways, this may require a radical reimagining of education that focuses on each child's unique skill sets and the contexts in which they were developed. It envisions equity in *learning opportunities* rather than just equivalent *outcomes*. Such an approach may add neurobiological evidence to existing scholarship on culturally relevant and culturally sustaining pedagogy (Ladson-Billings, 2014; Love, 2019; Paris, 2021; Waitoller & King Thorius, 2016) to ultimately yield more just educational environments. For example, in interpreting the relevance of different neurobiological mechanisms predicting reading disorders on opposite ends of the SES spectrum, Romeo, Perrachione, et al. (2022) suggest that this may inform adaptive reading interventions that aim to harness potential visuospatial strengths (while also addressing critical areas of need) to acquire literacy. Such approaches would likely also require modifications to cognitive and educational assessments by increasing their contextual relevance, both in terms of the contexts in which skills were developed/are developing and the future real-world relevance of these skills.

In this way, honoring developmental heterogeneity in science and practice may ultimately reduce educational "achievement gaps" by addressing the underlying opportunity gaps. As argued by Lindsey, Karns, and Myatt (2010), "While we may not be able to solve the socioeconomic disparities of class within our country, we do have the moral responsibility to believe our students, make certain they understand our belief in their capacity to learn, and militate within our schools and districts for an equitable distribution of resources" (p. 51), which we believe includes the resource of neurobiologically supported learning opportunities. In sum, it is critical to further explore and seek to honor diversity in brain development, not only to expand scientific validity but also to push toward greater educational equity by viewing young learners from an adaptive, asset-based perspective as opposed to a deficit-based one.

#### CONFLICT OF INTEREST

The authors have no conflicts of interest to report.

## INFORMED CONSENT

This manuscript is a review article and does not rely on human subjects data, so there was no informed consent to report.

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