
Socioeconomic status, developing brain, and mechanisms of learning: Implications for the classroom

Poverty can set the stage for cognitive and social difficulties at school and beyond, so what can educators do to help?

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Executive summary

- Absolute poverty refers to the lack of basic necessities for living whereas relative poverty refers to a quality of living that is below what is expected in a given society.
- Socioeconomic status (SES) is a term that encompasses all forms of poverty and recognizes the stigma attached to being poor.
- Scientific findings in cognitive neuroscience show that children from low-SES have a different learning preference in comparison to children from high-SES, which is adaptive but may lead to difficulties in the classroom setting.
- Educators can support children from low-SES by reducing stress in the classroom without lowering expectations.
- Children from low-SES need to be provided the opportunity to practice self-regulation skills (i.e. self-control) in the classroom.
- It is important that educators show understanding and sensitivity to the struggles faced by parents from low SES while encouraging them to be involved with their child's schooling.

The context of poverty and low socioeconomic status

Poverty can be absolute or relative. Absolute poverty indicates lack of basic needs like shelter, running water, or food. This is not frequent in Western countries, for example, Canada, which are considered "rich countries". In these countries, families usually struggle with relative poverty; that is, not reaching the quality of living expected in most homes.^[1] Poverty can occur in both ways in the same country. In Canada, many aboriginal families live in rural reserves with boiling water advisories, run-down housing, and little access to healthcare and education^[2]. A term used for poverty is low *socioeconomic status* (shortened as *SES*). This term does not make differences between relative and absolute poverty. Researchers use it to make clear that poverty is not just the issue of "not having" but also comes with having a social image or identity that puts people in a social group at risk and disadvantage.

Another important aspect of poverty is whether it is short or long term. Children born into poverty that is experienced for a long time are at a greater risk of ill-health. Long-lasting challenges that come with poverty may lead to chronic stress and a sense of helplessness.^[3] A great deal of evidence has shown that lasting stress can directly affect the immune system by lowering the body's defense to inflammation, cancer, and other diseases such as degeneration of the brain. People living in poverty have a higher probability of demonstrating all these health risks and also have shorter lives.

The neuroscience of attention in relation to SES

Imagine walking to school, constantly looking over your shoulder. There's a drug deal going on to your left, and prostitutes being dropped off to your right. The sound of a car alarm goes off, a homeless person asks you for change. You look down and try to look preoccupied but you are fully aware of everything taking place around you. You have to be.

The scenario described above is a daily reality for some children living in low SES and dangerous neighbourhoods. For these children, constant awareness of their surroundings may be very important. Being vigilant of what is going on around them may be adaptive and protective. Yet, being unable to focus attention in the school setting may lead to academic difficulties. There has been growing interest in the neurological aspects that come with low SES and how that can influence children's learning. Researchers are finding associations between SES and areas of the brain responsible for attention, self-control, and language.

Recent findings in cognitive neuroscience show that children with low SES often pay equal attention to both relevant and irrelevant information presented in a task. In contrast, children with higher SES focus mainly on information relevant for the task at hand.^[4] Low SES children tend to show more brain response to distractions than high SES children do, which suggests these children may be exerting more effort to selectively attend to valuable information. (see Supplementary Figure 1A and 1B)

Often, the differences in brain activity between low and high SES children are seen when the two groups do not differ in behaviour. This is the case for simple tasks which score accuracy of response with a button press. For example, this is true in studies that used tasks in which children had to attend and then identify a sound amongst other similar sounds^[4] (see Supplementary Figure 1A); and studies in which children had to focus and give answers to a story played in one ear, but at the same time ignore a second story played in the other ear.^[5] Although the tasks probed parts of auditory perception (attention, decision, and comprehension), low and high SES children responded similarly in terms of their behavior. What this suggests is that differences in brain response do not automatically equate with differences in behavior but may be a reflection of differences in learning preferences.

Greater brain response to irrelevant information and similar performance on simple tasks may indicate that learning preferences differ depending on SES background. Neuroscience findings indicate that low SES children hold onto irrelevant information for longer than their high SES peers. The choice (or selection) of what aspects are let in is much closer to the behavioral response. Dividing attention amongst all the information entering the brain at any one time overloads our *working memory*, i.e. that part of memory that allows us to hold information while we process the new incoming one. Taking it all in requires more mental effort than filtering out the important information early on. Thus, lower SES children must work harder to perform equally to high SES children. In simpler tasks, as those described above, this has not been found to be harmful. However, more complex tasks may easily overwhelm brain resources (see Supplementary Figure 1C).

How SES may influence learning in the classroom

Divided attention can lead to difficulties in oral language and literacy development. Distractions within the classroom make listening and following directions difficult for children who cannot focus their attention.^[5] In addition, learning to read requires focus on specific letters, words, and sentences. The ability to stop previously learned responses is important when learning new words. For example, a child must resist reading *cat* when presented with the new word *cot*.^[5] Differences related to SES have been found in the regions of the brain associated with spelling and phonological knowledge and with visual word processing.^[6]

Educational research has documented well the importance of stimulating learning environments, parental engagement in developing early literacy skills, and the influence of SES on benefitting from such supports. Neuroscience finds that these same factors also influence brain development.

The effects of stress on the brain also play a significant role when it comes to children's learning. Some insight into these effects arise from animal studies that have demonstrated the direct impact of stress on maternal-pup interactions; emotional interaction has been shown to promote brain activity in young rats, who continued to display better learning and memory later in life.^[7]

In humans, family stress due to poverty often leads to harsher discipline and more authoritarian parenting. Chronic stress in children's lives leads to an increased complexity of neural networks in the amygdala (area of the brain involved with emotion). Emotional memories become more salient and easily available than factual knowledge and learning obtained in school. Hence, the former memories can overshadow and impair learning of new contents in the classroom.^[6] An excessive and erratic release of cortisol (the main stress hormone) affects the hippocampus and the prefrontal cortex regions of the brain, leading to impaired memory and learning, and impaired self-regulation (such as reduced ability for planning, attention, and organizing). Consistent with this evidence, low SES children tend to be more "turned off" than high SES children by tasks like those already mentioned (see Supplementary Figure 1D).

Implications for educators

Many of the difficulties that children living in poverty experience in school may be related to these recent findings in neuroscience. As previously mentioned, these children may demonstrate more difficulty paying attention and concentrating. Narrowing in on important aspects when it comes to reading and writing may also prove to be especially difficult. Material learned in class will be harder to remember for children who are faced with the extreme stress that is sometimes the result of poverty. Changes in the emotional centres and circuitry of the brain may result in higher emotional reactivity and may impact these children's ability to form peer relationships, this is especially true for children who have witnessed violence. The stigma associated with poverty also places these children at risk for bullying and isolation.^[8] Loneliness and depression may follow, leading to a sense of helplessness and hopelessness.^[9]

If poverty sets the stage for possible cognitive and social difficulties in school, what can educators do to help?

Helping low SES children how to learn: Clues for educational practice

Enhance "shift and persist" approach

The ability to cope in stressful situations may be important for overcoming the harmful influence of poverty. Coping skills are often defined by examining the level of control over one's environment. *Primary* coping skills refer to the ability to directly change the stressful event. *Secondary* coping skills refer to adjusting a personal response to a stressful event.^[10] Much of the stress related to poverty cannot be controlled. If children from low SES backgrounds attempt to change an environmental condition without the necessary resources and support, they may develop a sense of helplessness. Alternatively, if they learn to adapt to the challenges by adjusting their emotions to stressful events and by maintaining optimism, they are more likely to feel empowered.

"Shift and persist"^[11] is a way of coping with poverty-related stress that can be learned. "Shifting" is effort to adjust oneself to accept challenges and reframe them as less threatening. "Persisting" is effort to endure adversity while maintaining optimism about the future. Adolescents living in poverty are more likely to cope with stress through disengagement and withdrawal. This may lead to problematic behaviours expressed inward (e.g. depression, anxiety), and/or outward (e.g. aggression), and social difficulties. In contrast, those who cope by using problem solving or cognitive reappraisal in response to poverty-related stress show fewer adverse psychological symptoms.^[12] Providing children with the tools to improve their ability to selectively focus on coping and optimism can lead to empowerment. This can be done by supporting children's ability to self-regulate.

"Cooling off": Empower through self-regulation

Self-regulation refers to an individual's abilities to cool off. That is, the ability to monitor emotions, remain motivated and attentive, and problem-solve effectively in order to pursue goals.^[14] Self-regulation skills promote children's readiness for school, and are in part influenced by family environment depending on poverty status. Children entering kindergarten who are high in self-regulation show greater performance on tests assessing mathematics, literacy, and vocabulary skills when compared with children low in self-regulation.^[15] Self-regulation is also a protective factor for youth from low SES as they demonstrate more adaptive responses when faced with challenging stressful situations in the classroom. Interventions that allow children to practice a variety of self-regulation skills may lead to improved social competence and academic achievement for lower-income populations.

Children from low SES tend to have limited physical resources such as books and access to public libraries or quiet spaces for studying which all benefit learning. They are more likely to live in crowded and noisy living spaces and are unable to influence their external environment. Teaching them how to reframe and adjust to challenge is an effective way to improve academic outcomes. Self-regulation is key for successful implementation of "shift-and-persist" as it involves the ability to control one's emotional and behavioral response in order to reframe and adjust to the stressful event.^[11] Cognitive developmental neuroscience has highlighted the role of a brain area, known as the dorsolateral prefrontal cortex, in controlling emotions. In self-regulation, this region supports the "cool executive functions," in contrast to the "hot executive functions" of emotions. Role models help foster children's development of their "cooling off" ability from the beginning of early childhood to adulthood.^[13]

There has been increased attention on the role of self-regulation in the classroom, and some Canadian schools are finding ways to put the responsibility in the hands of the students. For example, a principal in a school in West Vancouver, BC, provided sound-proof headphones for children who were easily distracted by noise.^[16] Furthermore, our research with a community music program demonstrated changes in children from low-SES indicating more coordination between brain regions and a heightened level of awareness during an auditory task assessing attention and impulse control,^[17] suggesting the program was conducive to improving self-regulation. Educators are in an optimal position to influence children's ability to self-regulate through effective role modeling. Reducing family stress may also improve parents' ability to model appropriate behavior and self-control to their children.

Minimize stress without lowering expectations

For children from a low SES background, responses to learning and classroom challenges interact with unusual stress outside the classroom. At the same time, however, it is imperative not to lower the bar; the expectations of achievement and

behavior should be the same across the social ladder, since there is no evidence to suggest that low SES children are, in the end, less capable of achieving at a high level. Indeed, evidence suggests that, under the right conditions, the adaptations made by children experiencing the stresses of a low SES environment may actually allow them to excel. Older research shows that low SES children may perform better than or similar to their high SES counterparts if they receive the appropriate level of social, cognitive, and environmental stimulation.^[18] In other words, we should not view low SES children's learning preferences as deficits but as differences.

It is important "to change the school culture from pity to empathy".^[1] Pity leads to lowered expectations resulting in learned helplessness, whereas empathy leads to understanding of challenges as differences and demonstrates respect rather than creating stigma. In the case of children living in poverty, this means recognizing that the conditions of their lives may have led to information processing and learning preferences that compensate for difficulties in filtering out irrelevant information, in remembering factual information, or in controlling emotional responses. It is crucial that educators praise children's efforts and not characteristics like intelligence. This is important for all students, but especially for those who fear confirming negative stereotypes.

The fear of validating negative stereotypes associated with race and gender, known as "stereotype threat," affects the ability to perform in testing situations.^[19] More recently, stereotype threat has been associated with SES with children in the first and third grade. As early as the first grade children start believing high SES is associated with improved academic ability, which translates into decreased performance on intelligence tests for children from low-SES.^[20] Empowering students by recognizing the process rather than the end product, and emphasizing the importance of effort will promote resilience as children will feel in control of their work. It is important for children, especially those from low SES, to know that educators have confidence in their abilities in order to counteract the effect of stereotype threat.

Support the family and be respectful of differing values

Last but not least is the importance of supporting the family and keeping open the lines of communication between the school and the home. This is especially important for children living in poverty. For example, absenteeism and withdrawal are major contributing factors to the learning difficulties experienced by low SES children, in part because they are stigmatized by their peers.^[21] Lower-SES parents also face the stigma attached to poverty and may feel uncomfortable becoming involved in their children's school. It is possible that parents have personally had negative experiences with school, and may hold different values than those promoted by educators. Yet we know that parents' participation is one of the most powerful predictors of their children's success. This is why it is crucial that teachers have an open-door policy that invites parents to participate in the classroom or to become involved with the school in ways that they are comfortable with. Teachers need to work with parents so that valued outcomes remain consistent at home and are reinforced.

At the same time, because poor families also deserve respect, understanding, and appreciation, educators should be sensitive to the struggles these families face on a daily basis, without condescension.

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