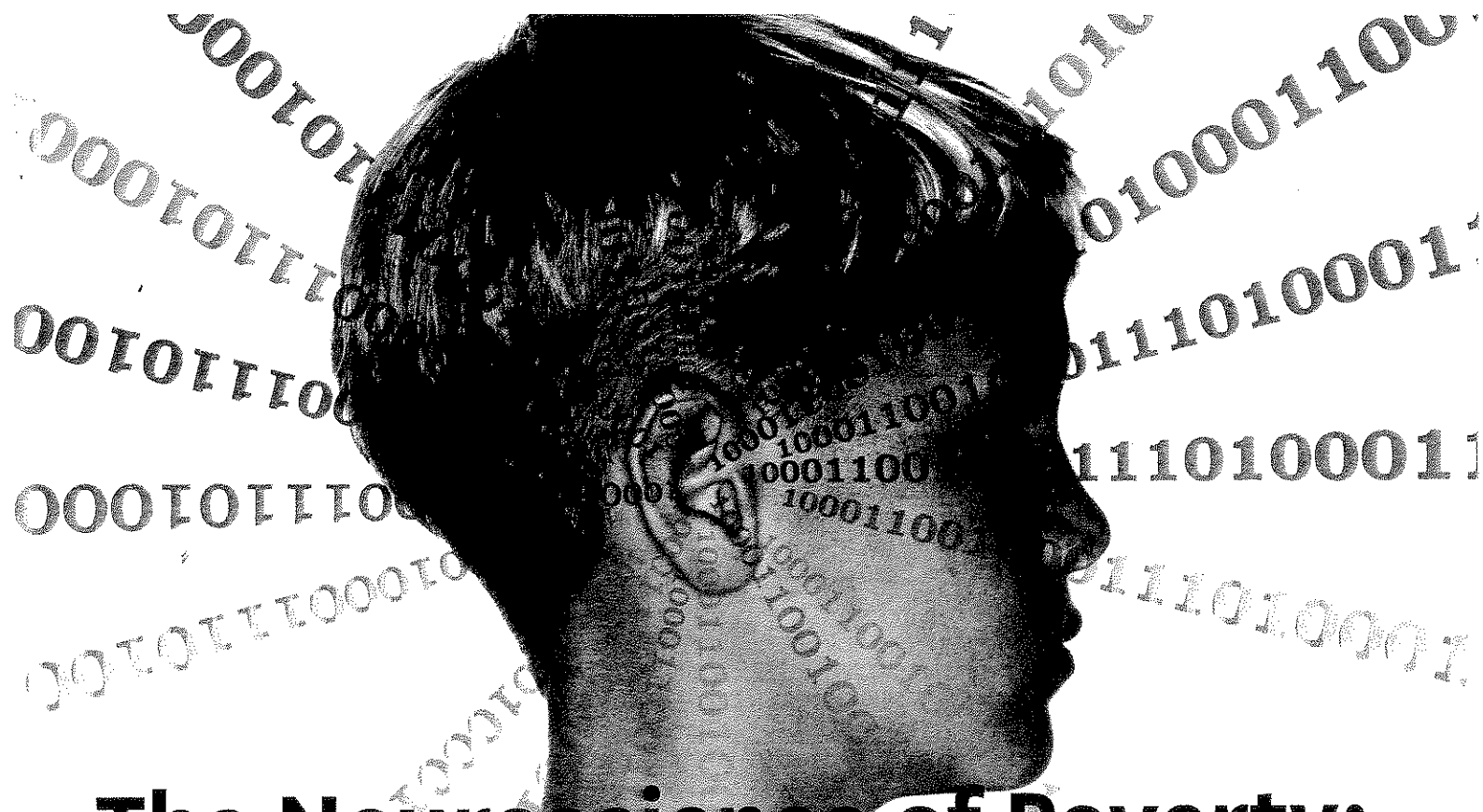


The Neuroscience of Poverty: IMPLICATIONS FOR TEACHING

KYLIE SCHIBLI AND AMEDEO D'ANGIULLI

We will ensure that Canada remains the best place in the world to raise a family.

— Speech from the Throne, March 3, 2010

As Canadians, we pride ourselves on our values of justice and equality. After all, we have the Charter of Rights and Freedoms, and we have signed and ratified the United Nations Convention on the Rights of the Child. Yet according to the 2010 *Report Card on Child and Family Poverty in Canada*, one in ten children (610,000) and their families live in poverty.[1]

Poverty is a complex concept, but can be divided into two broad categories: absolute poverty and relative poverty. Absolute poverty describes a scarcity of basic necessities, such as shelter, running water, and food. This is uncommon in Canada, where the majority of poor families struggle with relative poverty – a more subjective concept referring to an income insufficient to reach the average standard of living in a given society.[2] Statistics Canada applies a relative measure, the low-income cut-off (LICO), whereby families must spend 20 percent more of their income than the average family on food, shelter, and clothing in order to be recognized as living in poverty. In 2007, 11 percent of the Canadian school-aged population (5- to 24-years-old) lived in such circumstances.[3]

In the specialized literature, LICO is generally referred to as low socio-economic status (SES), so for the purposes of this article, poverty is synonymous with low SES.

Risk factors associated with poverty have been shown to impact children's school readiness and academic achievement; the effects on children's behavioural and cognitive capabilities have been well documented. Recently, interest in the neurological effects of poverty on children's academic learning has been growing, and researchers are finding associations between SES and areas of the brain responsible for attention, inhibitory regulation, and language. The effects of stress on the brain have also been associated with low SES and pose a threat for children's learning.

At this point, however, it is important to distinguish the living conditions themselves from the frequently-observed family dynamics, stresses, etc. that accompany them. Not all children living in poverty or in a low-SES family will suffer negative outcomes or be stressed and unhappy, and SES is not a neurological condition that can be directly mapped onto genetic predispositions. Whatever the effects of SES on children's brains, they are brought about by the environmental living situations.

THE NEUROSCIENCE OF POVERTY

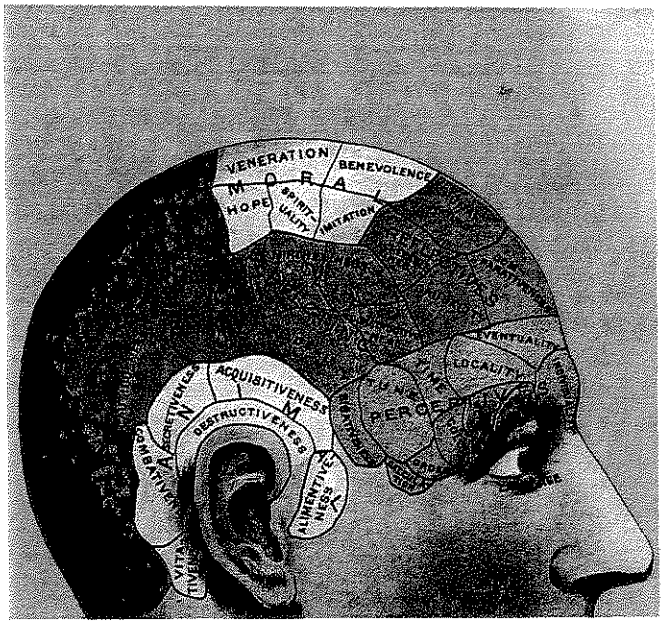
"Sit down and pay attention!" This is a common command in the school setting. But what if you pay too much attention?

Recent studies in cognitive neuroscience have demonstrated that lower-SES children pay as much attention to irrelevant information as to relevant information, whereas higher-SES children block out distracting information and focus on what is pertinent.[4] By comparing segments of electroencephalographic recordings of brain activity in response to target and distracting auditory stimuli, it was discovered that, on average, lower-SES children demonstrated more brain response to irrelevant information than did their more affluent counterparts.

These differences in brain activity did not, however, appear to affect the performance of relatively simple tasks. One experiment, for example, asked children to distinguish a target tone of a certain duration from three other similar tones.[5] Another required them to focus on a story played in one ear while ignoring a second story played in the opposing ear.[6] Their performance was tested by such tasks as pressing a button for certain tone frequencies and withholding for others or by answering comprehension questions related to the stories heard. Interestingly, in both studies, low- and high-SES children had similar speed and accuracy in completing the tasks.

The combination of greater brain response to irrelevant information and similar performance on these tasks may indicate that children's learning styles differ depending on SES background; it is possible, for example, that lower-SES children "filter out" irrelevant information at a later stage in the response process than their more affluent peers. Since it is clear that paying attention to all information offered is more exhaustive and requires more mental effort than filtering it out immediately, the suggestion here is that lower-SES children must work harder to perform equally to higher-SES children. In simpler tasks, as those described above, this has not been found to be disadvantageous; however, more complex tasks requiring a multitude of information may more easily overwhelm brain resources. This is yet to be demonstrated in research.

Other potential learning challenges that may arise in association with the inability to block irrelevant information are delays in oral language and literacy development. Stevens et al. explain that distractions within the classroom environment may render listening



attention. In addition, learning to read requires that children focus on specific letters, words, and sentences. The ability to inhibit automatic responses from prior learning is also required when learning new words, such that a child must resist reading *cat* when presented with the new word *cot*.[7] This notion is supported by studies that have found differences in the areas of the brain associated with spelling and phonological awareness and with visual word processing in relation to SES.[8] While the importance of stimulating learning environments and parental engagement in developing early literacy skills – and the influence of SES on the availability of such supports – is well documented, these studies indicate that these same factors may also play an important role when it comes to neurological development.

The effects of stress on the brain also play a significant role when it comes to children's learning. Animal studies have demonstrated the direct impact of stress on parent-to-child interactions; emotional interaction has been shown to promote brain activity in young rats, who continued to display better learning and memory as adults.[9]

Chronic stress in children's lives... makes emotional memories more salient and easily attained than factual knowledge and learning obtained in school.

In humans, parental stress due to poverty often leads to harsher disciplining techniques and more authoritarian parenting styles,[10] which in turn may lead to neglect and, in more extreme cases, verbal and physical abuse.[11] Neglected and abused children experience extreme stress, which has been shown to alter brain development. The 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 executive functioning (such as planning, attention, and organizing). Chronic stress in children's lives leads to an increased complexity of neural networks in the amygdala (area of the brain involved with emotion), making emotional memories more salient and easily attained than factual knowledge and learning obtained in school; hence the former memories can overshadow and impair learning of new information in settings such as the classroom.[12]

nomique (SSE) sur la disponibilité de ces soutiens – est bien documentée. D'après des études récentes, ces mêmes facteurs pourraient aussi jouer un rôle important en matière de développement neurologique. Des études de cerveaux d'enfants de faible SSE ont démontré qu'ils sont moins en mesure de filtrer les informations non pertinentes dans une situation d'apprentissage. Quoique cela ne semble pas se répercuter sur l'exécution de tâches simples, cela laisse entendre qu'ils peuvent devoir travailler plus fort pour obtenir les mêmes résultats que d'autres enfants. Par contre, dans les bonnes conditions, les adaptations faites par les enfants exposés aux tensions d'un faible SSE pourraient même les aider à avoir d'excellents résultats. Ces études indiquent aux éducateurs des façons dont on peut aider les enfants défavorisés à profiter le plus possible de leurs possibilités d'apprentissage.

IMPLICATIONS FOR EDUCATORS

Many of the difficulties children living in poverty experience in school may be related to these recent findings in brain science. As previously mentioned, these children may demonstrate more difficulty paying attention and concentrating. Much like children with ADHD, children living with the stresses of low SES may be easily distracted by irrelevant information and may experience challenges blocking out classroom noise and visual distractors. 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. The stigma associated with poverty also places these children at risk for bullying and isolation.[13] Loneliness and depression may follow, leading to a sense of helplessness and hopelessness.[14]

We should change our view of lower-SES children's learning style as a deficit and recognize that it is simply a difference... Under the right conditions, the adaptations made by children experiencing the stresses of low SES may actually allow them to excel.

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

Jensen explains that it is important "to change the school culture from pity to empathy."[15] 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 learning styles that compensate for difficulties in filtering out irrelevant information, in remembering factual information, or in controlling emotional responses.

In other words, we should change our view of lower-SES children's learning style as a deficit and recognize that it is simply a difference. This perspective was first proposed by David Elkind in his pioneering work on the interpretation of intelligence tests in low-SES adolescents.[16] Today, new advances in conditions such as ADHD show that deficits may be best interpreted as adaptive or regulative difficulties.[17]

For children living in poverty it is especially important that the classroom be as stress-free as possible. At the same time, however, it is imperative not to lower the bar; the expectations of achievement and behaviour 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 low SES 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]

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. Lower-SES parents also face the stigma attached to poverty and may feel uncomfortable becoming involved in their children's school. 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.

At the same time, because – unarguably – poor families deserve respect, understanding, and appreciation, teachers should be sensitive to the struggles these families face on a daily basis, without condescension. As one of the writers (who grew up as a low-SES child) can testify, teachers' acts of empathy may appear very small in the context of a classroom, but they can be very large in the context of a students' life. ●

KYLIE SCHIBLI is an honours student in the Child Studies program at Carleton University.

AMEDEO D'ANGIULLI is an Associate Professor and Coordinator of Child Studies at Carleton University. He is cross-appointed between the Institute of interdisciplinary Studies, the Department of Neuroscience, and the Department of Psychology.

NOTES

1 Campaign 2000, *2010 Report Card on Child and Family Poverty in Canada: 1989 – 2010*. Retrieved January 7, 2011 from www.campaign2000.ca/reportcards.html

2 Definitions from E. Jensen, *Teaching with Poverty in Mind: What Being Poor Does to Kids' Brains and What Schools Can Do About It* (Alexandria: ASCD, 2009).

3 Statistics Canada, *School-age Population Living in Low-income Circumstances, December 2009*. Retrieved January 7, 2011 from www.statcan.gc.ca/pub/81-599-x/81-599-x2009004-eng.htm

4 A. D'Angiulli, A. Herdman, D. Stapells, and C. Hertzman, "Children's Event-related Potentials of Auditory Selective Attention Vary with their Socioeconomic Status," *Neuropsychology* 22, no. 3 (2008): 293-300; C. Stevens, B. Lauinger, and H. Neville, "Differences in the Neural Mechanisms of Selective Attention in Children from Different Socioeconomic Backgrounds: An Event-related Brain Potential Study," *Developmental Science* 12, no. 4 (2009): 634-646.

5 D'Angiulli et al.

6 Stevens et al.

7 Ibid., 643.

8 D. A. Hackman and M. J. Farah, (2008). Socioeconomic Status and the Developing Brain, *Trends in Cognitive Sciences 13*, no. 2 (2008): 65-73.

9 D. A. Hackman, M. J. Farah, and M. J. Meany, "Socioeconomic Status and the Brain: Mechanistic Insights from Human and Animal Research," *Science and Society* 11 (2010): 651-659.

10 D. E. Kohen, T. Leventhal, V. S. Dahinten, and C. N. McIntosh, "Neighborhood Disadvantage: Pathways of Effects for Young Children," *Child Development* 79, no. 1 (2008): 156-169.

11 Jensen.

12 Ibid.

13 L. M. Robinson, L. McIntyre, and S. Officer, "Welfare Babies: Poor Children's Experiences Informing Healthy Peer Relationships in Canada," *Health Promotion International* 20, no. 4 (2005): 342-350.

14 H. Ursin and H. Eriksen, "The Cognitive Activation Theory of Stress: A Review," *Psychoneuroendocrinology* 29, no. 5 (2004): 567-592.

15 Jensen.

16 David Elkind "Borderline Retardation in Low and Middle Income Adolescents," in *Theories of Cognitive Development: Implications for the Mentally Retarded*, eds. R. M. Allen, A. D. Cortazzo, and R. P. Toister (Coral Gables: University of Miami Press, 1973).

17 Amadeo D'Angiulli and Sebastian Lipina, "Cognitive Sciences and Child Poverty: Facts and Challenges." Available from *Nature Proceedings* http://dx.doi.org/10.1038/npre.2010.4679.1 (2010).

18 see Theodore D. Wachs and Gary W. Evans "Chaos in Context" in *Chaos and Its Influence on Children's Development: An Ecological Perspective*, eds. Gary W. Evans and Theodore D. Wachs (Washington, DC: American Psychological Association, 2010).