Poverty and neuroethical implications for teaching, inclusion, and educational practices

Neuroscience is shedding new light on some long-standing ethical and social justice issues involving education and inclusion.

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Executive summary

- For decades socioeconomic status (SES) has been associated with intellect and brain size, with poor and low socioeconomic status associated with cognitive deficits. Cognitive neuroscience challenges this view.
- From the current state of the art, we can only conclude individuals from low SES show different neurocognitive pathways than middle and high SES individuals.
- We need to elaborate proper interpretation of such differences; these differences cannot be interpreted as deficits and could be adaptive.
- For effective teaching in low-SES populations, the conceptualization of differences must be central for teachers and the whole school culture.
- There needs to be a more critical and ethical consideration of the purpose and justification of interventions, especially early interventions, and on the evaluation of effective learning and neuroethical basis of inclusion.

> *"The biggest danger in neuroimaging is not what we can do or what the technology allows, but what society believes it can do. Society has been promised results that are greater than the reality. If neuroimaging is used as diagnosis, accuracy doesn't matter. The technology is accepted and policy is shaped, even if it is inaccurate—that is terrifying."*[1]

Historical background of childhood poverty

Social status has been studied for over 100 years in psychology and education. Originally, interest stemmed from the need to screen children to predict academic success in the formal school system in order to set up a national curriculum (i.e., French psychologist Binet's attempts in the late 1800s). There was also a desire to prepare capable and competent individuals for the workforce by assessing intellectual abilities, as shown in the efforts to create a measure for intelligence at the population level in Britain and the US.[2]

The different ways of thinking about this topic continue to be influenced by three underlying views that reflect how societies think of childhood. Drawing upon the work of French philosopher Jean-Jacques Rousseau, the *Romantic* discourse claimed that children are born innocent and pure which may be corrupted by the outside adult world. The romantic vision of the child ascribed children a spirituality that placed them close to God, nature, and all things good. Accordingly, it was believed that children's purity should be respected and protected in order for them to express themselves freely and creatively.

From an alternative view, the *tabula rasa* discourse draws upon the philosophy of John Locke, who developed the idea that children come into the world as blank slates who then develop into rational human beings with the proper guidance and training. Within this view, the child is always in the process of "becoming." They are an adult-in-the-making with specific educational needs that should be taken seriously. It is the adult's responsibility to provide the appropriate education and level of control to help children develop into mature and responsible citizens[3].

The romantic and tabula rasa discourses have been in opposition to, or mixed with, a third discourse—the *Puritan*—proposing that children are born with the potential to be wild, wicked, or evil, which can only be tamed if adults intervene with discipline and punishment. This view underpins many current discussions of the social status of childhood. Most important, the puritan discourse has been historically linked with lower social class and poverty[4], especially in Western countries but increasingly in non-Western countries.

Historically, some sections of experimental and educational psychology and biology focused on the relationship between social status and intelligence.[5] These research efforts attempted to explain the link between inheritance and social status. Some of the followers of this tradition of research, which are still currently well represented (mainly in psychology), have generated findings that they interpret as showing that individuals from lower social status have lower intelligence which determines a multitude of negative outcomes in health, education, and employment. These relationships are deemed to be virtually inevitable as they are passed on from one generation to the next. A group of researchers from this tradition has also attempted to link poverty to the size of the brain, arguing that brain size should be directly related with intelligence. It is further assumed that these associations are genetically determined.[2]

How we define poverty matters

Absolute poverty refers to the lack of access to clean water, food, and/or shelter. Children experiencing absolute poverty are struggling to survive as they do not have access to basic resources. Alternatively, relative poverty refers to earning less than is expected for the average individual in a given society. Children experiencing this form of poverty may be unable to participate in extracurricular activities, may not have suitable clothing or adequate food. The stigma associated with poverty can also lead to social isolation and exclusion. In scientific research, the term *socioeconomic status* (henceforth SES) is often used to refer to the family's living situation. The meaning changes depending on how the scientists choose to define it.

A challenge for scientists has been finding a concrete definition of poverty, with many researchers referring to the mother's educational status and/or the annual income of the family. These definitions fail to describe the child's experience with poverty adequately. They may lead to an oversimplification of the complexities involved with the environmental, cultural, and societal influences of social inequality.[6]

The effects of poverty on development have been widely studied, and this research often involves categorizing children into groups. In particular, when examining the effects of socioeconomic status and poverty on children's development, we often compare the extreme ends: Highest versus lowest, or rich versus poor. This makes differences more evident and simple, and suggests a simple linear relationship. The expectation is that the higher one is up the social ladder, the better the particular outcome. However, this approach does not give the full story; it is like reading the first and last chapter of a book, you may get the gist, but you do not know the details in the middle. Our understanding is inherently flawed because of such gaps in information.

There are concerns involved with the assumptions underlying this approach. First of all, there is no inclusion of a middle group, or the gradual change between the extremes of the range or *gradient*. In particular, this way of looking at the effects of SES on people's outcomes excludes the effects of individual differences within the defined groups. There are important differences even within low, middle, and high SES groups. This phenomenon has, for example, been shown for crucial neurocognitive aspects such as working memory and IQ.

In light of the above considerations, the best approach is to consider SES as a gradient that could shift according to changes in geographical, socioeconomic, and political settings, and historical periods. Depending on the conditions, low or even lower-middle SES can be defined as poverty in the gradient perspective; this approach includes a wider range of the SES distribution that is usually used in economics and social sciences, but maintains the lowest end. In this way, we consider the individual experience and recognize how SES influences that particular child—it is all relative to the everyday expectations of a given society in a specific time and place.

Neuroscientific findings and how they are explained

The descriptions of environmental and behavioral differences among children and adults from different SES have been "voluminous and encyclopedic." Previously, examining the effects of SES on brain development mainly focused on task performance. However, neuroimaging technologies have led to linking behavior to specific brain differences resulting in profiling people from low SES as lacking in cognition. Decades of research seems to have produced an agreed-upon interpretation where low SES is associated with cognitive and behavioral failings.

Stereotypes of the "implicit deficit attribution"[6] for individuals living in poverty have surfaced in the media over the years. However, the most recent addition of a relatively small body of neuroscientific evidence on SES seems to have made this central assumption even more persuasive for the popular imagination. As an example, consider the reporting of a quote from a prominent neuroscientist in an online article that in a few days circulated the globe with almost 7,000 links: "Kids from lower socioeconomic levels show brain physiology patterns similar to someone who actually had damage in the frontal lobe as an adult"[7]. In reality, the research featured in the article did not find "lesions" or any neurological injury in low-SES children to warrant such a comparison. Another example of sensational media headlines is reminiscent of the attempt to link brain size and SES: "Poverty shrinks brains from birth: Studies show that children from low-income families have smaller brains and lower cognitive abilities"[8]. In reality, the study found a difference in the spread of some small surface area in very specific regions of the cortex. This finding can hardly translate in terms of brain size and whether it is at all related to cognitive ability.

Generalizations like these may signify that we still do not have a clear understanding of which aspects of the interaction between the individual and the environment determine the range of behaviors, emotions, cognitions, and brain responses

across SES backgrounds. Cognitive neuroscience has been able to differentiate between brain networks for decision-making processes that involve higher-level, conscious control and those networks for automatic physiological responses that are mostly unconscious and driven by emotion. In view of that, cognitive neuroscience research has drawn on the brain's organization when attempting to explain behavior and outcomes that do not appear under the control of the individual. This relatively new approach needs to be monitored closely and calls for an emphasis on *neuroethics*, that is, the study of ethical issues as they apply to neuroscience research, data, and technology.

A call for neuroethics in research on child poverty

A key neuroethical concern is that simple explanations for findings showing differences within the brain between SES groups may advance the stigmatization of poverty. This has happened in the past, with research linking SES to brain size. *The implicit assumption that children from higher-SES backgrounds have typically developing brains, that they are the "norm" of reference and comparison, could suggest that differences in lower-SES children's structural and functional brain activity are deficits.*

However, the findings in neuroscience can be used to understand why explaining behavior linked with low SES in terms of deficit is not the only or the correct way of interpreting current scientific evidence. Differences in neural processing that lead to performance problems in laboratory tasks and the classroom could be useful adaptations in certain situations. Our past and present research shows that children from lower SES pay equal attention to distracting and relevant information, whereas children from higher SES selectively attend to salient information. Unexpectedly, both groups of children perform similarly on the task despite differences in brain activity.[6] Differences in brain activity as it relates to structure and function cannot be interpreted as failings when there is similar behavioral performance. Instead, these findings suggest that a different organization of the brain may be responsible for performance, and may indicate a reaction to experience. *Thus, neuroscience research suggests that in assessing and interpreting performance in low-SES students, we need to consider the context of performance and processing strategies and investigate the underlying reasons for possible strengths and weaknesses. That is, we need to adopt an ecological perspective that puts adaptation at the centre of the interpretation of performance and assessment. Such an approach must be the culture of the entire school, not isolated teachers. One of the reasons that enforce adopting such an approach is its alignment with the principles of evolution which inform not only neuroscience but also all biological sciences.*

Views of poverty being automatically linked with negative outcomes may place children from low SES at a disadvantage before completing school assignments and tests, as teachers may inadvertently follow practices designed to highlight developmental limitations. Historical analysis shows that there can be a hidden puritan bias in judging individuals living in poverty as "undeserving" since they are viewed as biologically inferior and responsible for their own situation.[9] Health psychology shows that well-off individuals may defer to this explanation when reading actions or performance.[9] *Therefore, as teachers, educators, policy makers, and researchers, it is critical we engage in self-reflection and question the stance we lean towards, even if unintentionally, when working with students coming from a low-SES background.*

Neuroplasticity, equipotentiality, and multiple-realizability

Perhaps one of the most important contributions of neuroscience is the idea of neuroplasticity. That is, the discovery that neural tissues and processes are very malleable, changeable, and regenerative/restorative. To a good extent, the brain can compensate, substitute, or reorganize based on interaction with the environment and in the face of impairment or damage—even when this is extremely serious. In neurocognitive terms, neuroplasticity implies two main aspects. Firstly, the same cognitive process leading to a particular type of performance can be applied or "realized" by the brain in many different ways using various neural pathways or systems (multiple-realizability). Secondly, the same neural pathway or system has the "potential" to be recycled or reused for many cognitive processes leading to performance in different tasks (equipotentiality). *One of the consequences of these affordances is that the differences between low- and high-SES children on some tasks or tests assessing ability do not necessarily or predominantly reflect differences in the assumed simple neurocognitive operations, and the differences may not be biologically or functionally fixed. Thus, it is imperative to look at the underlying process, even in the face of similar outputs.*

Another more challenging consequence is differences in performance, such as when a child's bad test performance indicates a developmental delay. It is possible that such an outcome actually reflects maturational plasticity ("late-blooming" effects) or that alternate pathways are being used. This phenomenon is especially apparent in adolescence and in bilingual children. The extent of rigidity in plasticity is currently a very hot topic. Specifically, it is being explored is determining the extent and time course according to which neural systems can reverse early harm and developmental stunting. The current understanding in the field is that even severe stunting in children, for example undernourishment, can be progressively reversed even if it occurs

after some critical periods (0-3 years of age is generally considered the most influential developmental period).

Many children living in poverty have accumulated a history of hardship, and from the teacher's perspective, it may seem best to invest time in students with a more promising outlook rather than exhaust efforts with students where the odds of academic success are stacked against them. However, if we take the message neuroscience suggests, then the teacher's role is to guide and nurture a pathway of recovery that is different from the one expected in the curriculum for a typically developing student. Realistically, the teacher cannot possibly be expected to fix a serious disadvantage. Rather, the teacher could have a role akin to a facilitator of resilience and persistence, for example when detailing a personalized plan with an accommodated set of goals geared to the student's observed progress. The understanding then becomes that if the plan is followed, then the course of the disadvantaged student should progressively become more similar to a typically developing classmate. This should be a core principle for guiding inclusion. To such end, there must be an emphasis on frequent curriculum-based assessment that focuses on effort and progress rather than just content.

Neurocognitive research confirms that children growing up in poverty have fewer opportunities for school-specific learning and stimulation. Children living in poverty tend to have fewer books and reading materials in the home and have less access to community services such as libraries. What children from low SES may be deprived of is the same kind of stimulation expected in middle-high SES children, one that will prepare them to do well in tests and school[10], and more recently knowing how to use the new digital media and technology. For example, let us consider vocabulary acquisition. It is not simply the number of words that parents exchange with their children or how often children practice vocabulary exercises in the classroom; it is also how and why language is shared. If words tend to be tied to concepts that match academic content, and the transmission occurs in a safe and caring setting where learning is presented as a valued outcome by the role models (i.e., parents and teachers), then the learning process and activities will support readiness to learn in the classroom. Children will feel motivated to learn. Again, the approach to fostering resilience and persistence must be a collective goal of the school culture.

Generally, low-SES students do not hold the same values as teachers and the school system, which is often reflected in high rates of absences and disobedience towards school rules. If children come from an environment where survival is more likely linked with nonacademic values (for example, making money rather than attending school), then it is likely they will have less time and interest in school. It is essential that the school's culture, including the teachers, acknowledges the setting from which these other values are formed and affirms positively the efforts to enrich and broaden them. Shared values should be built gradually, and recognize the achievement of many low-SES students in simply attending school. Any effort beyond coming to school and observing rules of conduct should be praised as much (or more) than actual content produced.

Interventions and curriculum

Studies of neurodevelopment in children and adolescents force us to face an ethical contradiction: High-SES children also experience forms of stress and challenges that can lead to problematic outcomes, but they are not automatically considered for intervention. These challenges are *different* from those experienced by low-SES children and more frequently related to the development of addiction and psychopathology.[11] However, children from wealthy backgrounds are not by default seen as eligible for intervention. This poses the question, why? This may be explained by the implicit deficit assumption attributed to children from low-SES and that children from wealthier backgrounds may be seen as the "normal" group.

Accordingly, it is often the case that observed neural differences are used to argue that low-SES children have neurocognitive failings even if we are not sure what these weaknesses really are "…even when performance differences do not emerge between lower and higher SES individuals, there are differences in the degree to which specific neural systems are recruited…"[12] and this by default needs intervention/remediation "…to protect and foster the neurocognitive development of low SES children…"[12]. There are, however, several considerations that should be made to build an ethical case for intervening in groups of students. Nevertheless, cognitive neuroscience interventions tend to be poorly supported due to small sample sizes[13] or effects that are too small[14] to grant credibility for automatically interfering with children from low SES. There appears to be an acceptance for fewer participants in neuroimaging studies even though the aim is to link these measures with behavioral performance on standardised language and cognition tests that require larger sample sizes—especially when conducting research with young children.[13] No intervention has been put in connection with neurocognitive improvement given a lesion or neural injury in low-SES individuals. If the research claims there is something clearly wrong with the brains of children from low SES, why don't interventions target the supposedly observed impairment? For example, interventions that build in monetary incentives for children and families are not intervening on the brain but on cognition and behavior. They may well impact the brain, but the link is at best indirect as the intervention targets environmental factors. For example, we

could intervene on cognition via neurotraining exactly as we would by using drugs, changing the brain's organization through direct intrusion—but this is not the approach of all existing school-related or educational interventions or experimental programs. Understandably this would lead to a host of other ethical issues. Still, the point here is that making claims that children from low SES require intervention due to brain differences should then result in interventions that target the brain. Therefore, the dialogue around research with children from low SES should focus on the environmental factors responsible for these differences IF the course of action is to improve living situations.

In addition, the link between genetic susceptibility and SES is misleading since when including all environment-gene interactions that can mimic and account for genetic effects, the association with SES is no longer substantial.[15] The only certainty is that simple inheritance from genetics cannot account for the level of complexity included in the fast, multiple-characteristics of the family related to SES.[16]

Finally, decades of research show that not all interventions aimed at SES student populations can be lumped in the same basket. Interventions that have proven to be effective in the long term have not been "one shot" or included a "single ingredient." Successful and effective interventions are complex. They include context by involving the entire family and its lifestyle as well as the neighbourhood and the community surrounding the school, such as The Carolina Abecedarian Project[17] and The High Scope Perry Preschool Project.[18] The old saying "it takes a village…." seems an appropriate way of describing the type of approach successful interventions, especially early interventions, generally entail. Evidently, we should expect no less than to have a real impact in promoting effective learning in low-SES student populations.

What is the basis on which we can really justify interventions on low-SES children? If—following the evidence from neuroscience—children adapt to their environment, the idea of deficit can be redefined as environmental settings experienced by low-SES students, which may become harmful and prevent optimal brain development.[19] It is also essential not to set apart children from low SES when examining developmental outcomes and instead to focus on the expected progress of learning. In this sense, serious neurocognitive difficulties that are irreversible will be "red-flagged," such as in the case of traumatic brain injury. This description does not underestimate the possibility of "real" impairment that sometimes can result in neurological problems. The proposed approach also allows experimental interventions to measure the alleged impairment in a *normative* way rather than relying on guidelines of *normality*. The former refers to the typical regularities observed in development and learning, the latter refers to pathology or disease in the sense of the medical-oriented models. *Normativity does not presuppose deficits; hence, it is a more positive stance for teachers and educators to take to promote the inclusion of low SES and other groups of students.*

Experimental interventions could be the main tool to determine the extent of reversibility, and conversely, plasticity, since with the appropriate intervention a low-SES child's performance could catch up with that of the higher-SES child. In this way, it would be possible to identify real and essential deficits as a miss or breakdown of adaptation. Accordingly, possible neurocognitive impairments could be identified without sidestepping ethical and social justice issues of inclusion. Experimental interventions may be offered to children from all SES backgrounds as a precautionary form of support, and without relying on criteria deriving from the discourses underlying how our societies view childhood. Furthermore, such an approach would permit us to properly assess the extent of the impairment in instances of extreme early or chronic deprivation and disadvantage, for example some forms of malnutrition whose effects are at least partially reversible with early intervention.

What I have called experimental intervention has much in common with curriculum design, assessment, and implementation. In intervention, the researcher alters the person's natural environment or group studied by introducing an experimental change in one or more areas. The logic is the same when we introduce changes in policy, programs, or services and the curriculum. These changes are interventions as well, in that they are attempts to replace aspects of the naturally occurring student-teacher relationship to understand the primary learning processes. In this vein, curricula, policies, and programs are natural experiments and planned interventions for students or institutions. The crucial difference is that the "context" is the classroom. As educational neuroscience will continue to inform and be more heavily involved in the evaluation of curricula and interventions, the basic and applied aspects of the learning science will be joined together. Consequently, there will be more and more opportunities to integrate ethical and social justice issues to enhance educational practices and inclusion.

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