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POVERTY AS A DETERIORATION OF HUMAN RIGHTS: STRESS, AND PSYCHOBIOLOGY

Poverty can physically impair brain through stress

by

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Having presented two commissioned papers in previous Pugwash International Conferences (Lahti Finland 1996, and Jurita Mexico 1998) on Poverty and on Stress respectively (Ramirez, 1998, 2001), my present lines try to show the linking of those concepts to my academic field, the Psychobiology, putting it within the general frame of poverty as a deterioration of human rights. More specifically, it is suggested that chronic stress from growing up in poverty can physiologically impact children's brains, reducing their working memory and diminishing their ability to develop language, reading and problem-solving skills, in few words, impairing their ability to learn. Hopefully, a better knowledge of the mechanisms linking stress to cognitive development - there are some cognitive responses to physiological stress in children who live in poverty - may help in preventing such deterioration.

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I do not pretend that brain research might be the key to explaining why people are poor, but merely to present some interesting correlations related to a factor that seems to be contributing in certain conditions. In fact, establishing cause and effect or correlation is quite tricky, and I have to admit that there may yet be a random correlation between poverty, stress, and short-term memory. However, here we have a start that can be built on, in the hope that it might lead to some deep rethinks of social policy.

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That the children of the poor underachieve in later life, and thus remain poor themselves, is one of the enduring problems of society. Sociologists have studied and described it. When John Kenneth Galbraith wrote on this topic half a century ago, he suggested that islands of poverty (the inner cities) existed and were perpetuated by a refusal of the public to provide the education, health, and community services necessary to allow future generations to escape their environment. Poverty may impact educational attainment, health outcomes and crime but it is not the cause and should not be treated like some great misfortune that condemns future generations to the same.

Nobody has truly understood what causes poverty. Most researchers perhaps seem keener toward some psychosociological explanations, such as that persistence of poverty through generations is associated with the inability of uneducated parents to pass assets to their children. Poor school performance, a violent environment, undernourishing, bad influence of peers, crime and drugs might also make it tough to rise from poverty. But this vast literature is silent on underlying biological explanations. Very little, if any, is known about either neurocognitive or biological mechanisms that might account for it. A quite recent article on *The Economist* (April 2nd 2009), quoting lyrics by Paul Simon, pretends to seriously consider an eventual relationship with our biology, or even to explain how poverty passes from generation to generation is now becoming clearer, suggesting that "the answer lies in the effect of stress on two particular parts of the brain."

We tend to forget that all aspects of our beings are chemical and that if researchers find that depression, obesity, an inclination towards addictions, or violence can be handed down biologically, why not poverty? It is a very disconcerting idea to believe that all persons can achieve whatever their talents can manage, given the means and opportunity. DNA is inescapable. Society will not produce a Mozart or an Einstein just by raising income levels amongst the poor. Our animal nature as social organisms has more effect on our lives than we'd like to believe (Ramírez, 2003).

The crucial breakthrough was made about three years ago, when Martha Farah and colleagues of the University of Pennsylvania (2005, 2006, 2007) showed that the working memories[2] of children who have been raised in poverty had smaller capacities than those of middle-class children. Socioeconomic status (SES) was a significant predictor of working memory.

[2] Working memory is the ability to hold bits of information in the brain for current use —the digits of a phone number, for example. It is crucial for comprehending languages, for reading and for solving problems. Entry into the working memory is also a prerequisite for something to be learnt permanently as part of declarative memory —the stuff a person knows explicitly, like the dates of famous battles, rather than what he knows implicitly, like how to ride a bicycle.

Since Farah's discovery, Gary Evans and Michelle Schamberg of Cornell University have studied the phenomenon in more detail, looking for the underlying biological mechanisms to account for a SES–neurocognitive link. Just a couple of weeks ago (March 30th, 2009), they have reported that childhood poverty is inversely related to working memory in young adults, probably mediated by elevated chronic stress during childhood, affecting the way that childish brains develop (i.e., poverty -> chronic stress -> working memory).

Evans's and Schamberg's volunteers were 195 17 years old participants in a long-term sociological and medical study that Evans is carrying out in New York state. All were white, and the numbers of men and women were about equal. To measure the amount of stress an individual had suffered over the course of his life, the two researchers used an index of chronic stress known as allostatic[3] load (Lupien et al. 2006). This is a cumulative biological marker caused by the mobilization of multiple physiological systems in response to chronic environmental demands. It is the combination of the values of six variables: diastolic and systolic blood pressure; overnight concentrations of three stress-related hormones (cortisol, epinephrine, and nor epinephrine); and the body-mass index (BMI) a measure of obesity (BMI was calculated as kg/m^2). A higher value indicates a more stressful life; and for all six, the values were higher, on average, in poor children than in those who were middle class. Moreover, because Evans's wider study had followed the participants from birth, they were able to estimate what proportion of each child's life had been spent in poverty. That more precise figure, too, was correlated with the allostatic load. And chronically elevated allostatic load could lead to disturbances in working memory in human beings, even if to date this has not been tested yet.

The capacity of a 17-year-old's working memory was also correlated with allostatic load. Those who had spent higher proportion of early childhood (from birth to age 13 years) in poverty could hold an average of 8.5 items in their memory at any time. Those brought up in a middle-class family could manage 9.4, and those whose economic and social experiences had been mixed were in the middle.

These correlations do not by themselves prove that a smaller working memory causes poverty or perpetuates it, nor that chronic stress damages the memory, but Evans and Schamberg then applied a statistical technique called hierarchical regression to the results in order to remove the effect of allostatic load

[3] Allostasis is a dynamic and interactive set of multiple physiological systems of bodily equilibrium maintenance. According to allostasis theory, the body continuously adjusts its normal operating range in response to external requirements. Overexposure to a combination of multiple, activated bodily response systems (e.g., neuronal, endocrine, cardiovascular) alters the ability of the body to respond efficiently to environmental demands. Chronic and more intensive environmental stressors cause the body to mobilize multiple physiological systems to meet those demands, but at higher levels of activity. Conversely, when environmental demands are low, individuals who have had a higher allostatic load burden will be less efficient in turning off the multiple physiological resources marshaled to deal with chronic demands.

on the relationship between poverty and memory discovered originally by Farah. When they did so, that relationship disappeared. In other words, the diminution of memory in the poorer members of their study was entirely explained by stress, rather than by any more general aspect of poverty. To confirm this result, the researchers also looked at characteristics such as each participant's birthweight, his mother's age when she gave birth, the mother's level of education and her marital status, all of which differ, on average, between the poor and the middle classes. None of these characteristics had any effect. Nor did a mother's own stress levels.

A strange thing however is the variable of allostatic load and the relationship of its constituent elements to each other. At age 9 and 13, only two allostatic load variables are consistently higher in the poor group over time - BMI and systolic blood pressure. What happens when BMI is placed in the hierarchical regression analysis instead of allostatic load? Does the relationship between poverty and working memory disappear? Both the mechanisms and the public policy implications would obviously be different if obesity/nutrition were implicated as the relevant variable. As blood pressure is highly related to weight, thus, an alternate explanation of the data might be that obesity, not stress, is driving the differences in cognition.

But their hypothesis that stress, and stress alone, is the responsible for damaging the working memories of poor children, is also backed up by work done elsewhere on both people and laboratory animals, which shows that stress changes the activity of neurotransmitters, the chemicals that carry signals from one nerve cell to another in the brain. Stress also suppresses the generation of new nerve cells in the brain, and causes the "remodelling" of existing ones. Most significantly of all, it shrinks the volume of those parts of the brain most closely associated with working memory: the prefrontal cortex and the hippocampus (LeDoux, 2003; Sapolsky, 2004).

According to Evans's and Schamberg's study, children with stressed lives, then, find it harder to learn; they do less well at school, end up poor as adults and often visit the same circumstances on their own children. Many personal histories who have broken the cycle of poverty, however, do not support or even contradict these hypothesis and findings: not all people who grow up in poverty will be poor! It would be quite interesting to find out why some "poor" are driven to escape it and some who also are "poor" are hell bent on staying with what they know. What is going on in the brains of these two distinct groups if the poor are equally stressed? Human beings are able to rise out of poverty when given the opportunity; the stress of poverty only appears to drive them even more! We should never forget thus that in humans neither a "pure" biological approach nor a "pure" sociological one would be able to "explain it all". Obviously both, nature and nurture, come from the same place. We need a more holistic and global psychobiological approach to poverty too: probably an interwoven variety of genetic, epigenetic, and environmental mechanisms accounts for its intergenerational transmission.

This study does not examine the nature of the stress that the children of the poor are exposed to, but it is now well established that poor adults live stressful lives, and not just for the obvious reason that poverty brings uncertainty about the future. The main reason poor people are stressed is that they are at the bottom of the social heap as well as the financial one. And people at the bottom of social hierarchies experience much more stress in their daily lives than those at the top —and suffer the consequences in their health. Even quite young children are socially sensitive beings and aware of such things. So, it may not be necessary to look any further than their place in the pecking order, as it is concluded in the above mentioned *The Economist* article, to explain what Evans and Schamberg have discovered in their research into the children of the poor.

But one has to be aware against too simplistic explanations. The effect of stress on fetal and juvenile development, far from being overall negative, is varied throughout the animal kingdom. Obviously when exceeding a certain level stress is unhealthy, doing more harm than good to people: an intense or continuous and chronic stress is remarkably well correlated with low social status and lack of situational control, which in our species is shorthand for poverty. Yes, 'social' stress seems to diminish mental capability (statistically speaking there will always be exceptions, but most poor people had poor parents), but frequently stress may also have an adaptative effect, allowing the offspring to cope with a potentially more competitive and hostile environment. Poverty and stress thus may create adaptations in the human body and atrophy of certain skills. These adaptations are not damages, just adaptations. Move the person to a different environment and with time he/she will adapt to that new environment. Never underestimate the ability of life to adapt! Great thinkers, entrepreneurs and leaders have emerged from highly troubled and difficult backgrounds. Life is complicated and tough. Stress physiologically prepares the mind and body to respond to life, and motivates people to thrive.

Furthermore, something similar could be said about the reduced short-term memory found in poorly raised children. Might there be some adaptive benefit to reducing working memory when faced with stress? For instance, it could allow children who experience more day to day violence or social discrimination to mentally set aside these incidents and focus on the task at hand, much in the way autism with its heightened sensitivity cripples children in dynamic or complicated environments; it would keep them focused on things that are directly relevant to survival, instead of shutting down and placing themselves in greater danger.

I am aware that all what Evans and Schamberg show is that these two outcomes of childhood poverty are interrelated. But this underlies a quite interesting general message: that the stresses in the lives of the poor may reduce their ability to act in a constructive way to get them out of poverty; and that a positive early life will be a better preparation for later life and prosperity than the negative. This research thus adds further wrinkles to the field of neuropsychobiology: even if much more work in developmental neuroscience remains to be done to tease out what aspects of stress affect individuals in what ways, it may offer a valuable insight into why

poverty begets poverty. And it is not lacking of practical suggestions: government policies and human rights programs that aim to reduce the income-performance gap should consider the stress children experience at home, such as housing problems; more conflict in the family, more pressure in paying the bills, which perhaps may end up moving more often…

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