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Mobilizing critical research for preventing and eradicating poverty

Child Poverty under the lens of Cognitive Neuroscience // Sebastián J. Lipina & Martha Farah

Child poverty and development are multidimensional phenomena which imply the need to analyze several biological and psychosocial components and processes within complex and changing contexts (Beddington et al., 2008; Bornstein & Lamb, 2011). Both have been studied by different scientific approaches that keep debates open on either the universality or context-dependence of biological and psychosocial underlying processes as determinants, and their implications at academic, social and policy levels. The complexity of the myriad environmental influences and their dependence on timing, suggests the need for conceptual and methodological advances in the study of child development.

This Policy brief argues:

- Poverty affects cognition, academic achievement and mental health. Research on brain development allows the identification of the differences in the cognitive and affective neural systems that underlie these effects.
- In addition to parenting quality and the in utero and home environments, there are other factors that may mediate the effects of poverty on neural development: toxin exposure, nutrition, prenatal drug exposure, and stress. Each mediator is a potential target for intervention and prevention programmes.
- Intervention programs could seek to influence aspects of brain development through strategies that include the training of specific neurocognitive functions, the provision of enriching environments during pre- and post-natal development, the reduction of parental stress, and enchancing parental emotional well-being and community resources, with focus on gender disparities (i.e., women's health).

A Cognitive Neuroscience approach to child poverty

One promising approach comes from research in Cognitive Neuroscience (for recent reviews see Hackman et al, 2009, 2010; Lipina & Colombo, 2009; Lipina et al, 2011). This approach benefits from five decades of several experimental projects and programs aimed at understanding of how material and social deprivation impacts brain organization and development at different levels of analysis, from the molecular up to the learning processes, in animals and humans (Hackman et al., 2009, 2010; Lipina & Colombo, 2009).

Specifically, the study of early cognitive development involves the consideration of several components and processes taking place at different stages. Hence, environmental deprivation factors could either modify or alter children cognitive development inasmuch as changes in some of those interrelated and interdependent subsystems components or processes are likely to affect the ongoing developmental process. Such an impact could vary according to the amount and timing of deprivation, as well as the individual susceptibility, quality and cultural nature of developmental contexts (NICHD, 2005).

As regards brain development and function, recent studies show that poverty affects people from birth to adulthood. These types of studies address the need to evaluate the role of different dimensions and mediators through which the environment may influence those and other basic, cognitive processes involved in school and social functioning (Hackman et al., 2009, 2010). In this context, recent behavioral studies carried out in different countries, have showed the impact of pertaining to a socially disadvantaged home on cognitive performance in tasks requiring basic operations related to the activation of different brain networks. For example, at a behavioral level much evidence suggest that

poverty modulates the performance in tasks demanding several language, and self-regulatory processses, and their associations with mathematics and literacy abilities, in infants, preschoolers, school-age children, and preadolescents (Hackman et al., 2009; Lipina & Colombo, 2009). In addition, there is evidence that cognitive self-regulatory processes are influenced by parenting styles, parent educational level, and the quality of language to which children are exposed at home environments. Beyond parental education level, income, structural aspects of households, and even general aspects of education and health, variables linked to parenting style such as raising children, coupled with availability and use of materials allowing children to either play and begin to learn in the early stages of development, are important to the modulating role of non-economic variables on poverty (Hackman et al., 2009, 2010).

At a neural level of analysis, there are some recent evidences after applying neuroimaging techniques that show how poverty modulates patterns of activations. For instance, Farah and colleagues (Noble et al., 2007) studied school-aged children who had been selected for having below-average phonological awareness scores, and found a complex modulator role for poverty, in which the higher the socioeconomic status, the less typical were the children's brain-behavior relationships. In another study of normal 5-year-old children performing an auditory rhyme-judgment task, Raizada and colleagues (2008) found a more direct relation: the higher the socioeconomic status, the greater the degree of hemispheric specialization (i.e., Broca's area). In addition, the findings from studies that apply event-related potentials (an electroencephalographic technic), are also consistent with those of behavioral studies analyzing attention, inhibitory control and working memory processes. These methods have opened a promissory way of analysis since activation represents a crucial dimension in terms of the characterization and development of basic cognitive processes, and the possibilities to modify them by exercising, training, or education.

In summary, findings from neuroscientific studies indicate that based on the current criteria use to define child poverty socioeconomic disparities affect cognitive processing at behavioral and neural level. Specifically, childhood poverty would affect some neurocognitive systems more than others, with the largest effects on language and self-regulatory processing.

Studies in humans suggest that prenatal factors, parent–children interactions and cognitive stimulation at least partly underlie the effects of poverty on brain development. These effects are somewhat specific, with the level of cognitive stimulation in the home environment best predicting a child's cognitive development and the quality of parental care more closely related to its emotional development. However, future research is required to confirm how these factors indeed account for poverty impacts on neural development and to apply this work to the development of more effective interventions.

Integration of Cognitive Neuroscience approach to Social Sciences

In general, the economic and sociological disciplines refer to deprivation as lack of income and material resources, basic needs or rights unattended, all of which are limiting factors for the full development of human populations. Recently there has been renewed interest in differentiating the effects of child poverty from poverty in general. This work has focused on the role of environmental deprivation in damaging mental, physical, and emotional development, with significant implications to children needs and rights (Sen, 2009; UNICEF, 2005). Specifically, the impact of low income is generally experienced in combination with other indicators of deprivation or developmental factors, such as psychosocial stress and environmental toxins, and these factors often synergize with one another to increase the damage to the developing child (see Hackman et al., 2010, for a review). Furthermore, associations between income and the broader measure of SES are likely to vary according to ethnicity and location along the urban/rural continuum; and the analysis of impacts of child poverty on cognitive development varies according to the poverty measurements taken into consideration (Hill & Michael, 2001). In addition, the diversity of poverty effects are also mediated by the co-occurrence and accumulation of different risk factors present in nearly all developmental contexts (Walker et al., 2007). Risk factors refers to those biological and psychosocial hazards likely to compromise child development at any level of analysis –intrauterine growth restrictions, undernutrition, specific nutritional deficits, infectious diseases, environmental toxic exposures, parental home stimulation, and parental sensitivity and responsivity. Nevertheless, not any combination of risk factors is likely to generate necessarily a similar type and level of impact, even in the same geographical area or within the same sociocultural group (Guo & Mullan- Harris, 2000; Obradovic et al., 2010).

Conceptual and operational definitions of poverty are unlikely to notice either specific information on the deprivation to which children are subjected, or to associate deprivation with different developmental stages and dimensions. That is, it has been assumed that children do suffer from deficiencies and deprivation. However, the level and type of deprivation, as well as the neurocognitive and social developmental stage at the time of deprivation (timing), may modulate the impact of the events (Vandell et al., 2010). This means that analyzing different effects of poverty on several developmental dimensions

at any stage is of great importance in considering how poverty affects development; and in designing actions aimed at giving developmental opportunities to children living in poverty, as well. In this context, Neuroscience research has a unique role in synthesizing approaches from multiple disciplines that include sociology, medicine, public health, psychology and psychiatry to characterize poverty-related differences in neural development, and to chart the mechanisms through which childhood experience affects neural function.

Looking to the future

In the short period of time during which cognitive neuroscientists have attempted to understand the effects of child poverty, encouraging progress has been made. Besides these promissory findings, it is important to consider the challenges that this multidisciplinary effort will have to meet in the future, which include methodological, epistemological, and practical concerns and opportunities.

It will be important to support efforts aimed at promoting collaborations focused on the integration of different levels of analysis. In this sense, an agenda for the next studies on impacts of poverty should include the reconsideration of definition and measurement of child poverty in order to account for developmental processes in different contexts, and specific biological and social determinants and their mediation role as well.

The importance of the early years is increasingly appreciated among policy-makers, and there is growing recognition that families, communities, and governments have a shared interest in assuring the healthy development of children (Shonkoff, 2010). In this context, the targeting of brain development through interventions has involved familiar approaches, such as improving children's access to medical care or nutritional supplementation. More recently, it has included programmes aimed at training particular neurocognitive systems directly, for example by using computerized, game-based strategies for training self-regulatory processes or school curricula that employ specific exercises as well as overarching strategies to promote self regulation throughout the school day.

Cognitive neuroscientists studying child poverty must grapple with the inevitable conflict between two good motives that arise in this context: the motive to translate laboratory work into the real world as quickly as possible by designing programs to screen for, reverse or prevent the neurocognitive impairments caused by child poverty, and the motive to defer drawing conclusions from research until carefully designed studies have been carried out, subjected to peer review, and even replicated across laboratories.

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