Editor's Corner

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A Voyeuristic View of Possibilities and Threats: Neurosciences and Education

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Let me first offer a humble forewarning that I approach this topic as a voyeur, enticed by the possibilities of the neurosciences for discovering insights into the complexities of human learning and development, and yet disturbed by both its uptake in the world of practice, and equally disturbed by what I think are serious conundrums in its use in related research circles. In this commentary, I discuss what I see as generative opportunities that studies in the neurosciences offer as well as the threats that extrapolations from the basic research pose.

As I argue elsewhere [Lee, 2010], from across various disciplines, some basic foundational principles are emerging regarding human learning and development [Organization for Economic Co-operation and Development, 2007]:

- complex inter-dependent processes involving interactions between persons and contexts make up the ecology of human development;
- physiological processes involving our brains and entire bodies are entailed in human thinking, communicating and problem solving;
- thinking, feeling, and perceptions are deeply intertwined.

In addition, several overarching themes are emerging that articulate a vision of human development as being essentially adaptive and of brain development as characterized by plasticity across the life course (despite periods in which we are more sensitive to particular kinds of development such as learning a second language). These underlying principles and themes are well supported across disciplines and represent a significant paradigm shift in the study of human development. These foundational principles and themes raise serious questions regarding what are becoming meta-narratives around learning for children in poverty, particularly in the US. These meta-narratives can be found both in what I will call applied studies in the neurosciences [Farah et al., 2006; Mani, Mullainathan, Shafir, & Zhao, 2013] and especially in a new fixation on implications of the neurosciences for educational practice [Jensen, 2009].

The opportunities for the astounding proliferation of studies in the neurosciences, including specializations in the cognitive, social [Cacioppo, 2002], and cul-

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tural [Chiao et al., 2010] neurosciences, are huge. The conditions of development for humans vary greatly across the Earth, illustrated beautifully in the film *Babies*, tracing the first year of development of babies born in Mongolia, Namibia, the US, and Japan. The film shows how each baby must accomplish the fundamental developmental tasks of the first year of life (learning to read the internal states of others, to manipulate his or her body to accomplish tasks, to communicate) but through very different pathways and toward very different social goals shaped by the cultural communities in which they were growing up. Among the challenges in many societies, especially the US, are hierarchical assumptions of singular pathways through which optimal development occurs [Mills, 1997], assumptions that become reified in institutional practices and in the distribution of societal resources. In the US, most traditionally promulgated in various fields in psychology and taken up in practices in education, there have been meta-narratives about deficits with regard to intellectual ability, language use, consequences of family functioning associated with conceptions of race, ethnicity, and class. And these meta-narratives get taken up in the practices of schooling. The impact of the field of eugenics in the early third of the 20th century and growth in the construct of IQ are examples in the historical record [Lee, 2009]. I am deeply concerned today that work in what I will refer to as applied neuroscience is making deficit claims with regard to language learning and executive control among populations of young people living in poverty. I have both conceptual as well as methodological concerns about much of this work, which I will address later.

What I think are the interesting emerging foundational principles suggest the need for cross-disciplinary collaborations across fields that have traditionally focused on one thread of development: cognition, motivation, health, life course development, and social and emotional learning. How the brain, over the life course, interacts with other systems in the body, at multiple levels of the physiological system, dynamically adapting to external contexts (physical, economic, social, cultural, intellective) that across the Earth are quite diverse, is the challenge this emerging paradigm invites. In addition, as these threads of development contribute to learning in schools, there is a need for collaborations that should now include studies of learning in the disciplines as well as organizational learning. Varma and Schwartz [2008] offer interesting examples of such disciplinary investigations in mathematics.

Typically these applied neuroscience studies involve analyses examining correlations between outcomes on academic assessments presumed to have ecological validity and basic research on specializations in brain functioning. Such studies using, for example, measures such as the Peabody Vocabulary Test or simple counts of the number of words middle class versus poor children learn before entering school do not take into account debates in the field of reading comprehension around multiple pathways through which children can learn to comprehend texts. Assumptions that correlations between outcomes on the Peabody and the economic status of a restricted population sample warrant extrapolations about deficits in the functioning of particular regions of the brain are highly speculative and reinforce dominant negative stereotypes. For example, on the one hand, the 2012 update of *From Neurons to Neighborhoods* [Institute of Medicine and National Research Council, 2012], says "… the public and some quarters of the scientific community have gained the mistaken impression that neuroimaging can reveal a direct link between brain activation and sophisticated behaviors, even though such a link is extremely complex" (p. 4). But then the report summary goes on to say, "Low socioeconomic status is associated

with poor language skills, poor executive function, and other effects on learning ability'' (pp. 16–17). And studies that make predictions from early academic achievement correlated with poverty to later outcomes typically do not take into account the quality of schooling available to poor children in the US as they progress across the grades. This confound complicates what is typically already a questionable line of logic from local assessments to neural activity to predicted academic outcomes. For those of us concerned with the educational implications of what emerging work in the neurosciences can tell us, Varma, McCandliss, and Schwartz [2008] warn ''knowing the location of an elementary cognitive function tells us nothing about how to design instruction for teaching that function, just as knowing where the alternator resides in an engine tells us nothing about how to teach driving'' (p. 142).

Many of these studies also typically do not have diverse participant samples. Here I define diversity along multiple dimensions – diversity along racial, ethnic and class lines – but equally cross-cultural samples across nations and historical ethnic diversity within nation states. I raise this as a concern because poverty is not experienced the same way across the globe and because even the experience of poverty within the US is not monolithic. Socioeconomic status indicators such as single parent households do not account for single parent families that have extended family networks that contribute to the development of children and the well-being of the families. Second, the typical emphasis on assessments of vocabulary, working memory, or executive control as predictors of the functioning of particular brain regions has limited explanatory power, in part, because regions of brain activity do not function in isolation; and there are data that similar cognitive tasks can be accomplished through different neural pathways depending on the cultural features embedded in the task. For example, Tang et al. [2006] found that Chinese- and English-speaking participants activated different areas of the brain while computing and comparing Arabic numbers. They speculate that the distinctions may be attributable to differences in cultural ways of learning (e.g., visual and motor representations socialized through routine use of the abacus among Chinese participants). Third, these studies often operate under an implicit assumption that vocabulary knowledge supportive of early reading is monolithic or that psychological tools such as executive functioning are generic rather than having both some generic features as well as being deployed in context-specific ways. For example, I think a reasonable argument could be made to question the executive functioning, the ability to inhibit choices, used by those who designed and carried out the derivatives fiasco resulting in the recent economic collapse in the US, who were wealthy, well educated, and largely white. Varma et al. [2008] raise significant questions about the technology to capture both speed and location of neural processing, especially across regions, as people are engaged in real world learning. As a consequence, extrapolations from the necessary replication of primed experimental tasks to examine neural processing has its limitations.

Despite these cautions, there are a number of exciting horizons of possibility that work within and across the neurosciences can offer, especially when work can include collaborations with researchers in other disciplines. To name a few, they include the following: what Varma and Schwartz [2008] call an area focus on how networking across regions of the brain operate as we engage in complex tasks of learning; cross-cultural work that examines the range of pathways through which cognitive tasks can be accomplished and how these pathways are connected to the routine cultural practices of different communities; understanding the intricate interconnections among

the social, the emotional, the phenomenological and the cognitive in human learning and development; biological substrates contributing to our understanding of human learning as entailing complex systems, expanding our understandings of cultural-ecological systems of human development [Bronfenbrenner & Morris, 1998]; and studies of neural plasticity and its connections to resilience, especially in populations living in poverty in diverse parts of the world [Spencer et al., 2006].

So I am a cautious but hopeful voyeur.

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