A new field of developmental neuroscience changes our understanding of the early years of human life

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By the time our children reach kindergarten their learning and developmental patterns are already taking shape, as is a trajectory for their future health. Now, for the first time, scientists have amassed a large collection of research that looks "under the skin", to examine how and why experiences interact with biology starting before birth to affect a life course.

Biological Embedding of Early Social Adversity: From Fruit Flies to Kindergartners, a special volume published in the Proceedings of the National Academy of Sciences and authored largely by researchers of the Canadian Institute for Advanced Research (CIFAR), sets out an emerging new field of the developmental science of childhood adversity.

The implications of the research are far reaching, from new approaches to learning and language acquisition, to new considerations for the health effects of social environments affecting large populations, and policies for early childhood care and education.

"CIFAR's multidisciplinary and international program in early childhood development is transforming our understanding of how early life experiences affect the development of the brain and in so doing set a lifelong trajectory," says Dr. Alan Bernstein, CIFAR President & CEO. "This research is providing the scientific basis for public policy concerning the critical window to provide the optimal conditions that

will enable our children to grow up to be well-adjusted, well-educated and productive individuals."

The volume is a multidisciplinary collection of 25 thought-provoking papers that have implications for a broad range of scientific inquiry: from molecular genetics, evolutionary biology and neuroscience to social and behavioural science, epidemiology and social policy.

"This is the first volume of collected research to provide such a substantial and comprehensive picture of the interaction between experience and biology in the early years," says Dr. Marla Sokolowski, Co-director of CIFAR's program in Experience-based Brain & Biological Development, and Co-editor of the *PNAS* volume. "Brain and genetic development are extraordinarily intricate and complex, and so by approaching this question from multiple angles, we're able to reveal a convergence on a number of themes, giving us new insights and an understanding of a greater whole, which now sets more clearly a direction for research to come."

Select highlights:

From the lab of CIFAR Fellow Michael Meaney (McGill University): Scientists have provided evidence that socioeconomic status affects family function and the development and function of brain regions that are critical for attention, learning and memory. Meaney's lab looks into how parenting produces lasting effects on cognitive and emotional development. His lab examined development in rats and found parental influences on the chemical, or 'epigenetic', signals that control the activity in the brain of genes that influence the connections between brain cells as well as learning and memory. In adult animals that were licked more frequently by their mothers the epigenetic signals enhanced the activity of genes associated with learning and memory. These findings reveal that social influences during early life affect the activity

of genes that affect the structure and function of brain regions critical for cognitive capacity.

From the lab of CIFAR Fellow Takao Hensch (Harvard University): Given that music is a powerful tool for probing and promoting brain development, Hensch and his collaborators exposed young mice to music and discovered a critical period between 15 and 24 days of life when they could change the mice's innate preference for a silent shelter to a preference for shelter with music. Typically, this preference cannot be altered in adulthood. However, the team then treated adult mice and were able to show that a key brain region could be re-wired to have a preference for music in later adult years. His results point to molecular factors that emerge after early critical periods of plasticity and can be manipulated in adulthood – the first evidence that a juvenile form of higher cognitive behavior can be restored. This clearer picture of molecular mechanisms in early development is critical to eventually treating complex, life-long disorders of the brain, such as autism or acute anxiety.

From the lab of CIFAR Fellow W. Thomas Boyce (University of British Columbia): Guided by animal models of hierarchy and an understanding of the health effects of socioeconomic status (SES), Tom Boyce and his team examined the behavioral development of children in a kindergarten classroom hierarchy. The study found that children in subordinate roles had more depressive behaviors and inattention, fewer good friends and diminished academic ability. The study found that subordination was compounded by low SES – the children with low SES had the lowest levels of prosocial behaviors. Importantly, the study found that teachers who utilized child-centred teaching practices to create better classroom climates were able to diminish some of the adverse effects of stratification. The study suggests that socioeconomic gradients in health and development are the products of more than simply differences in access to money, material goods, medical care, or nutrition. When taken

with our growing understanding of the importance of the first five years of life, this research renders even more crucial the need to provide egalitarian and supportive early childhood settings.

From the lab of CIFAR Fellow Janet Werker (University of British Columbia): Janet Werker and her researcher collaborators at University of British Columbia, the Child & Family Research Institute (CFRI) at BC Children's Hospital and Harvard University studied babies belonging to three groups of mothers – one being treated for depression with serotonin reuptake inhibitors (SRIs), one with depression not taking antidepressants and one with no symptoms of depression. By measuring changes in heart rate and eye movement to sounds and video images of native and non-native languages, the researchers calculated the language development of babies at three intervals, including six and 10 months of age. The heart rate response of unborn babies at age 36 weeks to languages was also measured. Their study is the first to show that maternal depression and its treatment can accelerate babies' ability to attune to the sounds and sights of their native language, thereby affecting the timing of language development in babies.

More information: *Biological Embedding of Early Social Adversity: From Fruit Flies to Kindergartners*, *PNAS* Volume, 109, Issue 42, October 16, 2012

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