Impact of Early Life Deprivation on Cognition: Implications for the Evolutionary Origins of the Human Mind

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ABSTRACTS

Feral Children: Two Living Examples and a Little Neurology

Douglas K. Candland, Bucknell University

The question of what is learned, which is innate, and how the two relate is at the heart of 2,000 years and more of the 4,000 reports of feral children. I set aside, only briefly, any operational definition of 'feral'.

The issue of innate or cultural is also at the metaphorical heart of this symposium. I offer my knowledge of two such living persons known to me, only one of whom has been documented in the TV literature. The first is John Ssabyuna of Uganda and the second, known as CauCau, of southern Argentina. I compare these to the publications regarding studies of the wild boy of Avignon whose scientific patron in France around 1800 was Itard, and the so-called Wolf-Girls of India, raised at the Singhs' orphanage in the early 20th century.

The Effects of Early Psychosocial Deprivation on Brain-Behavioral Development: Findings from the Bucharest Early Intervention Project

Charles A. Nelson III, Harvard Medical School and Boston Children's Hospital

Experience is the engine that drives much of postnatal brain development. When children are deprived of key (i.e., experience-expected) experiences, particularly during critical periods of development, brain and behavioral development can be derailed. There is perhaps no more egregious form of deprivation than being raised in large, state-run institutions. In My talk, I will introduce a project launched nearly 20 year ago, based in Bucharest, Romania. In the Bucharest Early Intervention Project, three groups of Romanian children are being studied: infants abandoned to institutions and who remain in institutional care; infants abandoned to institutions but then placed in high quality foster care; and infants who have never been institutionalized. These three groups have been studied through age 16; a 20 year follow up will be launched Fall 2019. In my talk I will introduce the overall project, including its conceptual framework, its experimental design, the ethics involved in conducting this work and the nature of the intervention we deployed. I will then briefly summarize findings from several key domains, including cognitive development, social-emotional development, psychopathology, brain development and stress physiology.

Maturational Constraints on Learning

Elissa Newport, Georgetown University

It is well known that our ability to learn languages fully and fluently changes over age. While adults are skilled in many other learning tasks, only young children are remarkable in learning languages so well – often much better than adults. Of great interest, then, is how we have evolved to have such outstanding language learning abilities during childhood but which do not continue throughout life.

I will discuss our findings on what the young brain computes that underlies our ability to learn human languages. In a long program of research (on what we have called 'statistical learning') we have shown

that infants and young children are capable of rapidly extracting a variety of complex statistics about the frequency and co-occurrence of sounds, words, and word categories from the speech they are exposed to – and that these rapid and complex computations form the foundation of learning the rules of their native languages. I will also suggest that maturational changes and expansions in these computational abilities make adult learners excel at learning many other things but no longer be as good at learning languages.

Individual Differences in Language Development and Disorders

Paula Tallal, Salk Institute for Biological Studies

Language co-evolved with the human brain throughout the evolution of Homo sapiens. Most of what we know about language in the brain comes from studies of adults who already have a fully developed language system or who have lost language functions due to brain injury. However, if we want to understand the evolution of language, our best insight may come from understanding the factors that affect the individual differences in language development and, more specifically, the various types of deprivations that may lead to language disorders.

While it is true that most children do not need to be explicitly taught to speak, all children do need sufficient exposure to language for language to develop normally. The modern infant brain comes equipped with intrinsic sensory/perceptual/motor and statistical learning capacities that are fundamental for developing language. This talk will focus on longitudinal studies that show that the efficiency with which these foundational capacities operate, particularly critical auditory processes, determines individual differences in the proficiency of spoken language learning. This intrinsic system is affected by many different genetic/biological as well as environmental/cultural factors, including most of the types of deprivation being discussed in this symposium.

Developmental Amnesia

Faraneh Vargha-Khadem, UCL Great Ormond Street Institute of Child Health

In modern humans, an exquisite cognitive ability has evolved that enables 'mental time travel', *viz*: the ability to mentally travel back in time and re-experience a personal event from the past that is no longer physically present. This unique human ability, referred to as 'episodic memory', has a protracted trajectory, first emerging around the age of 3 or 4 when children begin to recall their past memories. The late emergence of episodic memory, in contrast to the very early appearance of language and semantic memory, is attributed to the slow maturation of its neural substrate, the hippocampus, a subcortical structure that is widely regarded as the hub of the memory circuit.

In this presentation, I will describe how certain neonatal or early childhood pathological events, most commonly hypoxic/ischaemic episodes, target the immature hippocampus, leading to the later emergence of the syndrome of Developmental Amnesia, often without evidence of any neurological or other cognitive impairment. Yet, this selective episodic amnesia interferes profoundly with the acquisition of a chronological autobiography, recall of personal events of daily living, planning for the future, and development of self-esteem and quality of life, ultimately precluding independence in adulthood.

Where is My Mother? Uncovering Mechanisms of Neglect in the Maternal Brain

Danielle Stolzenberg, UC Davis

In 2017 alone, an estimated 674,000 children were victims of abuse and neglect in the United States and over 1,000 of these children died from maltreatment. Mothers were the perpetrators in 69% of these cases and children under the age of one experienced the highest rates of victimization. However, in the same year less than 300 journal articles on the topic of infant abuse or neglect were published in the United States and less than 10 of these papers addressed potential causes of caregiver maltreatment. How does dysfunction in the maternal brain arise? This question has critical implications for our understanding the adverse early life experiences that are ultimately byproducts of pathological

parenting. This talk will describe new research using rodent models that has shed some light on how the brain regulates maternal and neglectful responses to infants with a particular emphasis on how the brain might change as mothers transition between these two behavioral states.

Deprivation of nutrition as a factor in human cognitive evolution

Marcus Pembrey, University of Bristol

Adequate vitamins and minerals are essential for normal cognitive development and iodine will be taken as the example. Severe iodine deficiency is a known cause of learning difficulties, but even suboptimal maternal iodine in early pregnancy can reduce the child's verbal IQ. Early humans thrived on the coast, perhaps the rich iodine diet contributing to cognitive development. Interestingly, bonobos restricted to the central part of the Congo basin, regarded as iodine deficient, dive for aquatic plants that turn out to be rich in iodine. A different theme concerns the pay-off between body size, pelvic size for safe offspring delivery and food supply. Current humans contain Neanderthal DNA sequences indicating past interbreeding. Neanderthals were larger with wider pelvises than present day humans and maintaining adequate food supply could become critical with shifts in climate and available habitat. How modern humans might have resolved this challenge will be considered.

The Resilient Brain: Epigenetics, Stress, and the Life course

Bruce S. McEwen, Rockefeller University

The brain is the central organ of stress and adaptation to stress because it perceives and determines what is threatening, as well as the behavioral and physiological responses to the stressor. The healthy brain is resilient and responds to experiences over the lifecourse that produce epigenetic changes which result in structural and functional adaptive plasticity from the level of gene expression out to the cell surface. These changes are mediated in part by circulating hormones as well as by neurally-derived neurotransmitters and neuromodulators, reflecting the two-way communication between brain and body whereby neural activity also regulates the neuroendocrine, metabolic and immune systems. The genetic constitution of an individual sets the limits on what experiences are able to do. The lifecourse is a "one way street" in which there is no true reversal but redirection that occurs in response to positive or negative experiences that may be unique to each stage of life. It is important to remember that experiences even before conception as well as early life experiences can have a lasting impact. This work has led translationally down a conceptual path, namely, that mediators of adaptation act biphasically – protective in the short run and potentially damaging in the long run – embodied in the now widely used concepts of allostasis and allostatic load/overload. Supported by Hope for Depression Research Foundation.

Resilience Processes in Development

Ann S. Masten, University of Minnesota

Dr. Masten will discuss the meaning of resilience from a developmental perspective, highlighting the significance of findings from studies of extreme adversity in childhood for our understanding of processes that nurture or disrupt human capacity for adapting to challenges over the life course. She will discuss resilience as the capacity of a system (a child, family, community, economy, or other dynamic system) to adapt to challenges that threaten system function, survival, or development. While child resilience at any given time is distributed across many interacting systems, inside and outside the organism, caregivers play a critical role both in protecting early wellbeing and nurturing the future resilience of children and their societies. She will speculate on the significance of research implicating a short list of adaptive systems strongly associated with resilience across diverse adversities and cultures.