Experience (and genes) shape human brain development and function.

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For several years we have employed psychophysics, electrophysiological (ERP) and magnetic resonance imaging (MRI) techniques to study the development and plasticity of the human brain. We have studied deaf and blind individuals, people who learned their first or second spoken or signed language at different ages, and children of different ages and of different cognitive capabilities. Over the course of this research we have observed that different brain systems and related functions display markedly different degrees or 'profiles' of neuroplasticity. Some systems appear quite strongly determined and are not altered even when experience has been very different. Other systems are highly modifiable by experience and are dependent on experience but only during particular time periods ("sensitive periods"). There are several different sensitive periods, even within a domain of processing. A third 'plasticity profile' is demonstrated by those neural systems that remain capable of change by experience throughout life. We have also observed the two sides of plasticity in several domains of processing: i.e. systems that are most modifiable (i.e. display more neuroplasticity) display both more enhancements in the deaf and blind and greater vulnerability in those with or at risk for developmental disorders.

Guided by these findings, we have recently begun a program of research on the effects of different types of training on brain development and cognition in typically developing children of different ages. In one series of studies we are targeting the most changeable and vulnerable systems in 3-5 year old Head Start preschoolers whom we study before and after 8 weeks of either (a) daily attention training, or (b) 8 weeks during which their parents receive training in parenting skills or (c) a combination of the two types of training. Standardized measures of cognition and ERP measures of attention and language document large and significant effects of these different types of inputs. Genetic and Gene X Environment (training) interactions are also evident in these data. These studies will contribute to a basic understanding of the nature and mechanisms of human brain plasticity. In addition, they can contribute information of practical significance in the design and implementation of educational programs.