Symposium: Development and Cognitive Architecture

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Introduction

This symposium examines interrelationships between fundamental aspects of neural/cerebral development and later cognitive architecture. Topics will include: the role of DNA in plasticity and organization; the benefits of innate, domain-specific constraints; as well as a defense of distributed functional modularity. Theoretical positions on these issues are advanced and defended. Recent arguments concerning the implications of brain-imaging studies for functional modularity are also examined.

1. A Defense of Functional Modularity (Hadley)

Although belief in the existence of mental modules *of some form* is widespread among cognitive researchers, neurally sophisticated researchers commonly resist the view that cognitive processing involves modules which are *functionally independent* of one another. Moreover, within the past few years, at least three noted researchers (Fodor, Kosslyn, and Uttal) have called into serious question the existence of distinct modules in broad areas of human cognition.

This talk offers a defense of the existence of functionally independent modules, which, though spatially distributed, communicate via traditionally conceived input/output channels. This defense proceeds (i) by showing that the anti-modularity arguments of Fodor, Kosslyn, and Uttal are not compelling; (ii) by presenting theoretically-grounded reasons why any connectionist is committed, via the most basic tenets of connectionism, to accepting the existence of functionally independent modules.

2. Developmental Biology and the Origins of Cognitive Architecture (Marcus)

To the extent that cognitive architecture appears to be modular, a question arises as to whether that architecture is innate (in the sense of being organized prior to experience) or learned as a product of experience. Traditionally, most discussions about the relative merits of these two alternatives has centered on learnability studies (characterizations of what formal systems could or could not do) or empirical studies of the capacities of human infants. In this talk, I bring recent results from developmental neuroscience to bear on these questions, exploring what genes really do, why they are not blueprints, and what they can or cannot contribute to modular architecture, using computer simulations of neurogenetic development as an illustration.

3. Does Visual Development Aid Visual Learning? (Jacobs)

It is well-known that biasing a learning system through the use of domain-specific constraints can dramatically improve the performance of the system. We study the idea that developmental events constrain the internal representations acquired by a learning system in useful ways. We advocate the "less is more" hypothesis of Newport (1990) which states that perceptual or cognitive limitations during early stages of learning are actually helpful because they bias learners to initially acquire simple representations which are suitable building-blocks for the subsequent acquisition of more complex representations. Newport has studied the role of attentional and memory constraints in language learning. We consider the "less is more" hypothesis by studying the role a developmental change in visual resolution (from coarse-scale to multi-scale) may play in the acquisition of sensitivities to binocular disparities in pairs of visual images or of motion velocities in sequences of images. The results indicate that developmental progressions in resolution are helpful to systems attempting to acquire aspects of visual perception. Overall, studies of the "less is more" hypothesis suggest the usefulness of perceptual and cognitive systems with modular organizations by highlighting the fact that different developmental events constrain the acquisition of different domains of knowledge.