Addressing the American problem by modeling cognitive development

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Piaget once suggested that questions about how to *speed up* development were an obsession of Americans. Cognitive developmentalists have since referred to "the American problem." This pejorative points to a set of issues surrounding the rate of developmental emergence and the hypertrophying of high-level functioning.

I aim to address these issues by offering two lessons learned from modeling cognitive development. First, I suggest that there are principled reasons for *not* trying to speed up cognitive development, even in systems with emergent hierarchical structures that don't have biologically determined limits on growth rates (e.g. AI, robotics, neural-networks). Basic processes need to be built and elaborated to fit the characteristics of level specific tasks and goals *before* higher-level processes can be built. Second, I argue that adaptive intelligence requires the ability to re-engage and reshape superseded skills, i.e. moving back down the hierarchy to restructure lower-level components to fit new tasks and goals. Lower-level skills need to remain malleable even after being subsumed by higher-level ones. To make these points I first review the history of theorizing about the hierarchical organization of cognitive architecture in order to clarify what it means to take a cognitive developmental approach. Then I appeal to recent work involving dynamic systems models of cognitive development and empirical analyzes of micro-development.

From Kant through Peirce to Sellars, philosophers have addressed epistemological problems by positing hierarchically structured cognitive architectures. To the question, "How is knowledge possible?" we get a variety of speculative answers, all of which suggest a set of *hierarchically nested cognitive processes*: from sensation, through concept formation, to rationality. Early last century J.M. Baldwin and Piaget initiated a shift of focus from the question, "How is knowledge possible?" to the question, "How does knowledge develop?" In addressing this question cognitive developmentalists have offered a variety of answers, all of which suggest a set of *hierarchically nested cognitive processes that emerge sequentially over time.* In the wake of this problem shift philosophical concerns about information exchange between levels in the cognitive hierarchy became psychological concerns about the processes that govern the emergence of cognitive structures during the course of development.

Understandably, those with practical concerns about the development of intellectual functioning, from educators to computer engineers, have often looked to cognitive developmental theorizing for usable knowledge. Here is where the so-called "American problem" typically arises, usually in terms of two natural lines of questioning:

(1): **Isn't faster development better?**

Not necessarily. Kurt Fischer and colleagues have argued for the advantages of delaying the emergence of higher-level structures and the concomitant supercession of control up the hierarchy. Highly convincing in this regard is a series of dynamic systems models that codify the theoretical underpinnings of Fischer's *dynamic skill theory*. In particular one set of models displays what has been called the *Piaget effect*, so named because it confirms some of Piaget's hypotheses about the detrimental effects of speeding up development. Models of the Piaget effect suggest that boosting early growth is disruptive of relations among skills and ultimately results in lower-level attainments for those skills receiving the early boost. These modeling exercises reveal that when behaviors are being constructed via processes of hierarchal integration *faster is not necessarily better*. Instead, it appears that optimal growth takes time, involving the robust elaboration of operations at a given level before these are subsumed by the emergence of higher-level processes. Moreover, empirical findings consistently show that a high density of lower-level skills is necessary before new higher-level skills can be built.

(2): **Isn't higher-level functioning to be preferred?**

Not necessarily. Being able to access and rebuild lower-level skills in novel situations is a key facet of human intelligence and adaptability. Empirical work in micro-development shows that humans consistently traverse the full range of available skills when solving problems, often dropping down to concrete and sensori-motor functioning, and actively understanding the problem in those terms before building up more abstract and complex understandings. This multi-level flexibility has important effects upon the dynamic development of hierarchical cognitive architecture, allowing ostensibly superseded levels to be re-worked and reshaped for the purposes of higher-level goals. If we remained stuck at our highest-level of functioning we would be unable to adjust to the demands of many types of novel tasks.