Biologically Inspired beyond Neural: Benefits of Multiple Modeling Levels

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Abstract. Biologically inspired cognitive architectures can adopt distinct levels of abstraction, from symbolic theories to neural implementations. Despite or perhaps because of those widely different approaches, they can constrain and benefit from each other in multiple ways. The first type of synergy occurs when a higher-level theory is implemented in terms of lower-level mechanisms, bringing implementational constraints to bear on functional abstractions. For instance, the ACT-RN neural network implementation constrained future developments of the ACT-R production system cognitive architecture in biologically plausible directions. The second type of synergy is when cognitive architectures at distinct levels are combined, leading to capabilities that woudn't be readily available in either modeling paradigm in isolation. The SAL hybrid architecture, a Synthesis of the ACT-R cognitive architecture and the Leabra neural architecture, provides an illustration through its combination of high-level control and low-level perception. The third type of synergy results when the same task or phenomena are modeled at different levels, bringing insights and constraints across levels. Models of the sensemaking processes developed in both ACT-R and Leabra illustrate the deep correspondence between mechanisms at the symbolic, subsymbolic and neural levels.

A. Chella et al. (Eds.): Biologically Inspired Cognitive Architectures 2012, AISC 196, p. 33.
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