An Integrated Neurodynamical Framework for Thought and Action

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The biological bases of thought and action have both been studied extensively by neuroscientists, cognitive scientists and psychologists, but usually as separate issues. We describe a framework to unify these from a complex-systems perspective, where both are seen as emergent patterns in multi-scale, modular self-organizing networks. The framework is based on two fundamental concepts – modularity and synergy – and explores how all cognitive responses, including memory, thought and action, arise from a modular brain-body network with embedded synergies. The model proposes that context-specific functional networks arise from the substrate of this system under patterned selection and modulation, and the entire system is shaped by adaptation at multiple time-scales, ranging from evolution through development to behavioral learning and real-time adaptation. We demonstrate the framework using simple models of associative memory, ideation (thought) and reaching (action).