# HOW DOES A BRAIN GIVE RISE TO A MIND?
## From Vision to Cognition

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Major progress has been made during the past few decades in modeling how brains give rise to minds. Such models link brain mechanisms to behavioral functions, and predict brain representations of conscious and unconscious experiences, including links between behavior, neuroanatomy, neurophysiology, biophysics, and biochemistry. These models hereby contribute to solving the classical Mind/Body Problem. This progress has included discovery of new computational paradigms whereby advanced brains autonomously adapt in real time to a changing world filled with unexpected events: Complementary Computing clarifies the nature of brain specialization into parallel but highly interactive processing streams, and Laminar Computing clarifies why mammalian neocortex uses laminar circuits to represent multiple types of higher intelligence.

The talk will provide a self-contained introduction to these ideas with examples from vision, learning, recognition, and cognition described as variations of shared cortical design principles. It will propose how spatial and object attention are coordinated during view-invariant object category learning, recognition, and search; and how cognitive processing of event sequences may occur using shared circuit designs during serial recall, free recall, sequential motor actions, and speech categorization, notably how future auditory context can influence how past sounds are consciously heard during phonemic restoration. The talk will outline how processes of consciousness, learning, expectation, attention, resonance, and synchrony interact to enable fast learning without catastrophic forgetting, and why "all conscious states are resonant states". It will propose how multiple levels of brain organization cooperate during predictive cognitive processing, ranging from the spiking dynamics of single cells, through synchronous gamma and beta oscillations, to cognitive learning. The talk will also note applications to large-scale technological problems that are based on these concepts.

### Illustrative references (see http://cns.bu.edu/~steve)

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