Ruthless Reductionism in Recent Neuroscience

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A "ruthless reductionism," of mind to molecular pathways, is alive and thriving in recent neuroscience. Numerous research programs are now intervening directly with cellular and sub-cellular processes within neurons to generate measurable effects in behavioral paradigms commonly used by psychologists to study specific cognitive processes (learning, memory, perception, attention). I'll begin this talk by briefly surveying some of these programs, including Pat Goldman-Rakic's work on "working memory neurons" in primate dorsolateral prefrontal cortex; William Newsome's and Ranulfo Romo's work using cortical microstimulation of tiny (250 micron) clusters of neurons in visual and somatosensory cortex; and Eric Kandel's and Alcino Silva's work using genetically engineered mice on the molecular (and molecular genetic) mechanisms of contextual and social recognition memory consolidation.

I'll then turn to a lesson that this "ruthless reductionism" teaches for "higher-level" disciplines of cognition and intelligence: AI, cognitive neuroscience and psychology, neuropsychology, and philosophy of mind. The lesson is that these disciplines play an *essential*, but ultimately only a *methodological* role in the scientific search for the mechanisms of cognition and intelligence. Once they have exhausted their role toward discovering lower-level mechanisms, these theories have provided everything they are capable of providing. I'll illustrate the nature of this methodological role and its explanatory limits by presenting some results from a recent "transdisciplinary" study by my research group on saccade (eye movement) sequencing that uses resources from cellular physiology, neurocomputational modeling and computer simulation, and functional magnetic resonance imaging (fMRI).

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