Cognitive Neuroscience: What does it tell us about high-order cognition?

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Motivation

Cognitive neuroscience has generated considerable excitement among cognitive scientists. It offers a new route to understanding the mind. But some have argued that the current techniques of cognitive neuroscience apply mainly to perceptual-motor and attention tasks. This symposium considers the contribution cognitive neuroscience can make to the study of high-order cognition.

Jay McClelland

Formulating cognitive theories in terms of neural computations

Cognitive Neuroscience is a relatively new field defined differently by different people. One activity that might fall under the rubric of cognitive neuroscience is the effort to formulate cognitive theories in terms of the underlying neural computations. This effort, I will suggest, may ultimately lead to theories that are not only grounded in neuroscience but also more satisfactory as accounts of cognitive phenomena. I will exemplify the approach with my own work on the development of the complementary learning systems theory of learning and memory. The work draws on insights from neurophysiology, neuroanatomy, neuropsychology, and connectionist modeling to develop an overall theory of learning and memory

Ken Paller

A cognitive neuroscience perspective on memory with and without awareness

Patterns of memory impairment in patients with amnesia suggest that memory for facts and events depends on a process of "cross-cortical storage" that is not required for other forms of memory. This neuropsychological evidence provides a theoretical foundation for understanding memory phenomena like recollection (the conscious experience of remembering facts and events) and priming (a type of item-specific implicit memory). Building on this foundation, measures of brain activity have revealed distinct brain potentials and brain activations that are associated with recollection of episodic memories versus certain types of priming. This cognitive neuroscientific approach thus constitutes an appropriate way to investigate the neurocognitive events that make "memory-with-awareness" so different from "memory-without-awareness."

Paul J. Reber

Cognitive (neuro)science: Models of recognition and categorization

Categorization and recognition have been investigated with a variety of approaches that have led to very different conclusions. Dissociations reported in the patient literature suggest separate representational systems. A resolution is proposed based on integrating key computational features of Nosofsky & Zaki's (1998) exemplar-based model with the Complementary Learning Systems (CLS) theory, a neural network model of memory system organization (McClelland, McNaughton & O'Reilly, 1995). Functional neuroimaging studies of categorization and recognition with healthy participants (Reber et al., 1998a,b, 2003) provide evidence supporting the two-system CLS theory. Integrating computational approaches with both behavioral and neuroscience data thus leads to a better account of recognition and categorization than any single approach.

Mark Jung-Beeman

Imaging higher-order language comprehension and insight problem solving: What and how from where?

Neuroimaging of higher-order cognition offers two advantages: First, it can provide a relatively covert measure of processing; and second, cortical location information can constrain or expand cognitive theories regarding component processes. In one set of studies, we used fMRI signal in specific cortical regions as markers for two component processes in drawing inferences: semantic integration, and semantic selection. We thus observed the engagement of these processes while people comprehended stories, without requiring a concomitant "probe task." In another line, we studied insight processes in verbal problem solving and found involvement of an area of the right temporal lobe, similar to that observed in the inference experiments.

Andrew Ortony (Discussant)

Andrew Ortony's work has ranged from computational modeling to philosophy. His current research is on emotion and cognition.