Representations: New approaches to old problems

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Overview of the Symposium

Modern cognitive science is built on a foundation of representation. All cognitive scientists assume that there are internal information carrying states that mediate thought and behavior. Despite this general agreement, there is significant disagreement about the nature of these internal states.

The classical view in cognitive science is that representations consist of abstract symbols that cut across modalities. This view takes the data structures of a computer as a model for cognitive representations. This view has come under attack from a number of directions because of observed limitations with this approach. For example, connectionists have pointed out that symbol systems are often too rigid and brittle to capture the context sensitivity of behavior. Advocates of perceptual representation have pointed out that there is no reason to believe that cognitive representations are divorced from perceptual modalities. It has also proven difficult to reconcile perceptual representations with these amodal symbols. Researchers using dynamic systems have focused on the self-organizing properties of behavior and have argued that representational theories lead to models of cognition that fail to capture the transitions between stable states of behavior. That is, they argue that models based on classical representations provide coarse descriptions of behavior, but fail to capture the fine details of individual performance.

The attacks on the standard view of representation typically begin with a core example that highlights an important problem with representation. From there, an argument is developed that cognitive science should dispense with the classical model of representation in favor of the approach that handles the example presented. Unfortunately, there is a tendency for researchers to sketch the way their new proposal for representation will handle cases beyond the example that initially posed a problem for the classical view of representation. Thus, debates over representation often degenerate into rhetorical battles.

In this symposium, we bring together researchers from different perspectives with the goal of having them talk explicitly about how to create a broader theory of representation. The symposium begins with an introduction presented by Arthur Markman, who will discuss the importance of having multiple approaches to representation, and will give an overview of the talks to be presented.

After the introduction, there are three speakers. The first speaker is William Bechtel. In his previous work, he has analyzed the steam engine governor that has been used by advocates of dynamic systems as an example of how cognition might take place without representation. He argues that the steam engine governor does indeed have representations, and describes the representational aspects of the governor. He gives a brief overview of his analysis of the steam engine governor and then focuses on whether cognitive science needs representations above and beyond those he suggests for the governor.

The second speaker is Lawrence W. Barsalou, whose recent work focuses on perceptual symbol systems. On his view, the classical construct of representation went astray by assuming that cognitive and sensory-motor representations are separate. After presenting initial arguments for why the brain evolved to be a representational device, he shows how perceptual symbol systems implement classical representational phenomena such as productivity and propositions. He argues that it is possible for a theory of structured representations to be dynamical, context-sensitive, and embodied, integrating insights of connectionism, dynamic systems, and classical representation.

The third speaker is John Hummel. He talks about the coordination of context sensitivity and structured symbol processing in connectionist modeling. A key strength of connectionist models is that they allow processing to vary with context. The problem with connectionist systems is that they often fail to represent relational (symbolic) structures. Dr. Hummel's work on connectionist models of object recognition and analogy has tried to bridge the gap by incorporating techniques for building relational representations within context-sensitive connectionist architectures.

Following the talks, Eric Dietrich will serve as a discussant. His presentation ties together the central themes raised by the speakers. In addition, he highlights the problems that remain. Finally, he explores the likelihood that researchers from different perspectives will be able to merge their perspectives. The session ends with a 20 minute discussion period moderated by Arthur Markman.

In sum, the goal of this symposium is to introduce a variety of approaches to representation. Furthermore, this session aims to go beyond the simple examples that motivate alternative approaches to representation, and to begin to attack the difficult problems that lie ahead.