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# The Cognitive Basis of Science: The View from Science

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The issue of the nature of the processes or “mechanisms” that underlie scientific cognition is a fundamental problem for cognitive science. A rich and nuanced understanding of scientific knowledge and practice must take into account how human cognitive abilities and limitations afford and constrain the practices and products of the scientific enterprise. Reflexively, investigating scientific cognition opens the possibility that aspects of cognition previously not observed or considered will emerge and require enriching or even altering significantly current understandings of cognitive processes.

## **The Baby in the Lab Coat: Why child development is an inadequate model for understanding the development of science**

Stephen P. Stich, Department of Philosophy, Rutgers University

In two recent books and a number of articles, Alison Gopnik and her collaborators have proposed a bold and intriguing hypothesis about the relationship between scientific cognition and cognitive development in childhood. According to this view, the processes underlying cognitive development in infants and children and the processes underlying scientific cognition are identical. One of the attractions of the hypothesis is that, if it is correct, it will unify two fields of investigation – the study of early cognitive development and the study of scientific cognition – that have hitherto been thought quite distinct, with the result that advances in either domain will further our understanding of the other. In this talk we argue that Gopnik’s bold hypothesis is untenable. More specifically, we will argue that if Gopnik and her collaborators are right about cognitive development in early childhood then they are wrong about science. The minds of normal adults and of older children, we will argue, are more complex than the minds of young children, as Gopnik portrays them. And some of the mechanisms that play no role in Gopnik’s account of cognitive development in childhood play an essential role in scientific cognition.

## **Scientific Cognition as Distributed Cognition**

Ronald N. Giere, Center for Philosophy of Science, University of Minnesota

I argue that most important cases of cognition in contemporary science are best understood as examples of distributed cognition. Here I focus exclusively on the acquisition of new knowledge as the paradigm of scientific cognition. Scientific cognition, then, does not reduce to mere distributed computation. The simplest case is that in which

two people cooperate in acquiring some knowledge that is not directly acquired by either one alone. It is even possible that neither person could physically perform the task alone. This is an example of what has been called “socially shared cognition” (Resnick) or “collective cognition” (Knorr). The most elaborate example is the case of experimental high-energy physics at CERN, as described by the sociologist, Karin Knorr in her recent book, *Epistemic Cultures*. I go beyond Knorr’s analysis to include the particle accelerator and related equipment as part of a distributed cognitive system. So here the cognition is distributed both among both people and artifacts. Such artifacts as diagrams and graphics and even abstract mathematical constructions are also included as components of distributed cognitive systems. This makes it possible to understand the increasing power of science since the seventeenth century as in large measure due to the creation of increasing powerful cognitive systems, both instrumental and representational.

## **The Cognitive Basis of Model-based Reasoning in Science**

Nancy J. Nersessian, Program in Cognitive Science, Georgia Institute of Technology

Although scientific practice is inherently “socially shared cognition,” the nature of individual cognitive abilities and how these constrain and facilitate practices still needs to be figured into the account of scientific cognition. This presentation will focus on the issue of the cognitive basis of the model-based reasoning practices employed in creative reasoning leading to conceptual change across the sciences. I will first locate the analysis of model-based reasoning within the mental modeling framework in cognitive science and then discuss the roles of analogy, visual representation, and thought experimenting in constructing new conceptual structures. A brief indication of the lines along which a fuller account of how the cognitive, social, and material are fused in the scientist’s representations of the world will be developed. That the account needs to be rooted in the interplay between the individual and the communal in the model-based reasoning that takes place in concept formation and change. Modeling is a principal means through which a scientist transports conceptual resources drawn from her wider cultural milieu into science and transmits novel representations through her community. Scientific modeling always takes place in a material environment that includes the natural world, socio-cultural artifacts (stemming from both outside of science and within it), and instruments devised by scientists and communities to probe and represent that world.

**Symposium Discussant:** Dedre Gentner, Department of Psychology, Northwestern