rotated so that the left eye is occluded, and neurons in the right eye, which projects to the left hemisphere, are more active early in development. This suggests that left-right asymmetries in sensory activity may entrain asymmetries in cerebral specialization.

The final three chapters of the book provide an account of the evolution of hominoids and hominids and examine the relationship between the physical evolution of brain structures and the evolution of such "behaviors" as culture, tool use, art, language, intellect, and self-awareness. This section is less densely packed with accounts of experimental design and results than previous sections and consequently is far more accessible to the general scientific reader. For each class of cognitive skills, the paleontological evidence of structural evolution is placed in the context of ethological and archeological evidence of the evolution of behavior. In the end, the authors have convincingly supported their primary argument: that although hemispheric specialization is most striking with regard to human speech and other advanced cognitive abilities, cerebral asymmetry is a quantitative rather than a qualitative distinction between humans and other animals.

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Vignettes: The Public Arena

The question becomes what today's comparative schools of "ideas" have to offer in domestic public policy. Models of capitalism, American style, are not persuasive in view of the faltering economy and the international competition that lies ahead. Models of revolution, neighborhood autonomy, republics in miniature, or little sovereign communities hold even less promise. . . . So, one turns again to the pragmatism and incrementalism of the painful progress of science.

—*Robert C. Wood*, in *Whatever Possessed the President? Academic Experts and Presidential Policy, 1960–1988* (University of Massachusetts Press)

Scientists are neither Gods nor charlatans; they are merely experts, like every other expert on the political stage. They have, of course, their special area of expertise, the physical world, but their knowledge is no more immaculate than that of economists, health policy makers, police officers, legal advocates, weather forecasters, travel agents, car mechanics, or plumbers. The expertise that *we* need to deal with them is the well-developed expertise of everyday life; it is what we use when we deal with plumbers and the rest. Plumbers are not perfect—far from it—but society is not beset with anti-plumbers because being anti-plumbing is not a choice available to us. It is not a choice because the counter-choice, plumbing as immaculately conceived, is likewise not on widespread offer.

—*Harry Collins* and *Trevor Pinch*, in *The Golem: What Everyone Should Know about Science* (Cambridge University Press)

The Developing Mind

Foundations of the Mind. Children's Understanding of Reality. EUGENE V. SUBBOTSKY. Harvard University Press, Cambridge, MA, 1993. xxii, 162 pp., illus. $22.50 or £35.

Ever since Jean Piaget's portrayal of the child as a "young scientist," cognitive development has been assumed to involve the supplanting of childhood "misconceptions" by a more rational, scientifically based understanding of the world. Much recent work has demonstrated that very young children exhibit rational thought and evince understanding of basic scientific principles such as gravity, causality, and the solidity of objects—concepts that are thought to replace earlier, more primitive ideas. It is widely held that once this more rational picture of reality is in place, it would represent an unusual, and perhaps even maladaptive, regression for a child (or an adult) to appear to espouse a more primitive belief.

In *Foundations of the Mind: Children's Understanding of Reality* Eugene Subbotsky turns this "replacement model" on its head, in the process calling into question one of the most basic assumptions in developmental psychology. Subbotsky's goal is to investigate the nature of consciousness—a topic that most Western developmental psychologists might consider beyond the scope of empirical investigation. His intriguing thesis is that rational, scientifically based beliefs and what we would consider more primitive or magical beliefs coexist in the human mind across the life-span, that "with the appearance of a new form of thinking, previous ones by no means disappear." On this view, development consists not of learning how to think in a different way but of learning what sorts of situations call for which kind of thinking.

What Subbotsky is challenging here is not simply Piaget's "young scientist" view but a long-standing commitment to rationality that has characterized philosophical and psychological thought since Aristotle. This commitment to rationality, or as Subbotsky prefers, "everyday reality," has been accompanied by a certain disdain for what Subbotsky refers to as "unusual realities"—the domain of myths, dreams, and imagination. Aristotle, Descartes, and Kant all extolled the superiority of everyday reality over unusual realities, with their logical flaws and contradictions. Subbotsky's mission is to draw the attention of psychologists to the significance of unusual realities and to give them an existential status comparable with that accorded to everyday reality.

Subbotsky grounds his thesis in an extensive set of experiments he conducted over the past 10 years to investigate how children's conceptions of objects, causality, space, and time—what he considers the basic structures of the mind—develop and change. In these experiments he would present subjects with an apparent violation of one or more of these basic structures and then observe their reactions. In one study children were shown a box and asked whether they believed that simply saying some magic words could cause a picture of an object placed in the box to turn into the object depicted. As expected, most of the subjects emphatically denied this possibility. They were then told a story about a girl who had a box very similar to the one in front of them and had achieved various magical results with it. Subsequently, each child was left alone in a room with this "magic box" and observed with the aid of a hidden camera. Subbotsky found that the children often proceeded to exhibit a variety of behaviors that seemed to reflect a conscious belief in magical phenomena: they chanted magic words, waved their hands, and looked surprised and disappointed when these actions did not produce results.

Subbotsky's claim is not simply that young children occasionally entertain beliefs in magic and other forms of fantasy but that these quasi-magical beliefs are a legitimate component of consciousness and are

present not just in infants and young children but throughout development. Many would agree with his statement that "under the constant pressure of culture, magical and other anomalous beliefs are . . . banished to the domains of fairy tales, dreams, and fantasies." Especially in Western culture, magical and superstitious beliefs are expected to be relegated to the world of fiction. Yet Subbotsky claims that as the child develops, these beliefs "keep their potency and importance. . . . The unusual structures give way, but they do not disappear." The boundary between the two spheres of consciousness becomes more and more stable, but it never becomes impermeable. Hence, given the proper conditions, magical or superstitious beliefs can always be reactivated, even in adults.

Subbotsky's experimental findings also inspire him to attack another deep-seated assumption in psychology—that what we say reflects what we think. The fact that in his studies children would often initially deny possessing any magical beliefs but then go on to exhibit such beliefs through their behavior leads him to propose a dissociation between the "verbal level of behavior" and actual behavior. He argues that scientifically based concepts of causality, object permanence, space, and time appear first in verbal judgments and only later begin to dominate practical action. Psychologists who study cognitive development often conduct their research by asking children questions; their answers are taken to reflect their understanding. But according to Subbotsky, the information we can gain from verbal responses represents only half the story; simply questioning children "does not permit an assessment of whether the fundamental oppositional structures (nonpermanent object, magical causality, permeable solid object, reversible time) are able to control children's behavior in a practical situation."

This book may be met with skepticism by many readers. Certainly the ideas proposed are unorthodox. But it may be time to reexamine long-standing assumptions in developmental psychology and begin to give more serious consideration to the "unusual realities" of fantasy, imagination, and myth. Interestingly, in arguing for granting these unusual realities a legitimate place in our consciousness, Subbotsky grants research on these topics a more legitimate status. Despite some weaknesses in his theory (in particular, in his discussion of infancy), on the whole the book is provocative and stimulating, and the evidence from preschool and school-age children is most compelling. As Subbotsky points out, "Independent of age and level of cognitive development, all individuals in everyday practice have to answer certain questions: What is true and what is false? What exists in reality and what appears only to us?" How children and adults formulate answers to these fundamental questions is what Subbotsky bravely seeks to address in this book. I imagine there are very few of us who study the human animal who, whether or not we agree with his answers, would not benefit from attending closely to his discussion of these issues.

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