Cognitive Tutelage

Apprenticeship in Thinking. Cognitive Development in Social Context. BARBARA ROGOFF. Oxford University Press, New York, 1990. xiv, 242 pp., illus. $27.95.

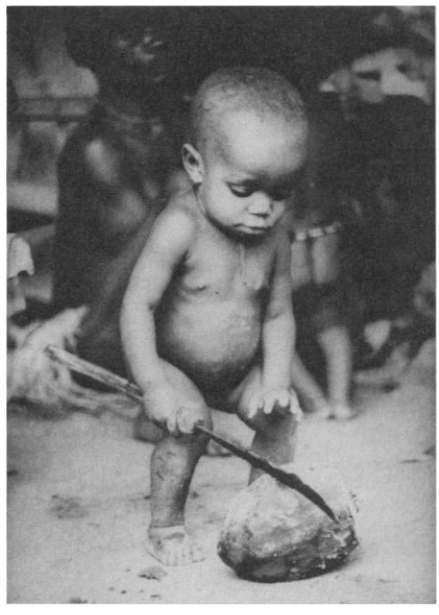
Most contemporary analyses of children's cognitive development are grounded in the assumption that the role of social and cultural factors can be understood only after we have created a "basic" and universalistic analysis of mental functioning in the individual. This analytic priority given to the individual and to the universal has resulted in an inability to address sociocultural forces in a principled, nontrivial way.

Barbara Rogoff's *Apprenticeship in Thinking* is a major contribution to the study of cognitive development because it builds sociocultural factors into theory and method from the outset. Rogoff achieves this by starting with an analysis of the socially shared activities in which children participate and then proceeding to an account of how this participation leads to the development of certain aspects of individual human cognition.

Two levels of sociocultural phenomena provide the core of Rogoff's analyses. The first involves social interaction, especially as it is carried out by adult-child and child-child dyads in problem-solving settings. It is by examining such social interaction that the concrete practices of "apprenticeship" can be described. Second, Rogoff studies the cultural contexts in which various forms of social interactional and individual psychological processes occur. Drawing on her own and others' investigations of cross-cultural differences in socialization practices, Rogoff outlines some of the fundamental dimensions along which the organization and cognitive consequences of apprenticeship may vary. For example, she shows how the forms of representation used by adults to guide children, and later by children to guide themselves, through a task may vary widely among cultures depending on the degree to which language is used and the type of language employed.

The theoretical underpinnings for Rogoff's approach come from a variety of sources, such as Piaget's writings, but many of her major insights are grounded in the writings of the Soviet psychologist and semiotician L. S. Vygotsky (1896–1934). Vygotsky's ideas about the social formation of mind have come to play an increasingly important role in Western developmental and educational psychology over the past decade, but Rogoff has extended them in several important ways. A key to this extension is her account of "guided participation," a construct which assumes that "both guidance and participation in culturally valued activities are essential to children's apprenticeship in thinking" (p. 8). Rogoff's clear text and effective use of drawings and photographs are useful throughout, but they are particularly important in helping her explicate this rich construct.

In her account of guided participation, Rogoff outlines some of the processes involved in engaging children, beginning at a very young age, in task settings and gradually transferring cognitive responsibility to them as they participate at higher and higher levels. In order to analyze these processes she introduces and develops the notion of intersubjectivity, or "shared understanding based on a common focus of attention and some shared presuppositions that form the ground for communication" (p. 71). During very early stages of socialization, this intersubjectivity may be primarily emotional in nature, but Rogoff documents how, with the emergence of representational systems such as language, the shared understanding may shift to other objects and events, including those not in the immediate social interaction setting.



"A baby of 11 months from the Ituri Forest of Zaire cuts a fruit with a machete, under the eye of a relative. This is not an unusual situation in this culture, where infants are generally able to observe and participate in skilled cultural activities, according to [David] Wilkie." [From *Apprenticeship in Thinking*; photograph courtesy of David Wilkie]

Rogoff organizes her analyses of guided participation and intersubjectivity in such a way that she manages to avoid the pitfalls of two major camps of theorists in cognitive development. On the one hand, she avoids the tendency to view children as independent discoverers or inventors. Instead of assuming that children act as isolated agents operating on reality in order to discover its underlying structure—an assumption that characterizes much of the American interpretation of Piaget—Rogoff argues that guidance by more experienced members of a culture is an essential ingredient in cognitive growth. On the other hand, she avoids the tendency to view children as passive recipients in a process of cultural transmission. This latter tendency is sometimes reflected in simple learning-theory interpretations of Vygotsky, but is specifically ruled out in Rogoff's account through her focus on participation.

In the final third of the volume, Rogoff draws on her theoretical framework to sort out several theoretical and empirical issues. For example, she has produced one of the most insightful comparative discussions of Vygotsky and Piaget to date. It is a discussion marked by an absence of the stark contrasts and bogus debates that characterize much of the contemporary literature on the topic.

One of the most important contributions Rogoff makes in this final section concerns the role of adult-child and child-child interaction in children's cognitive development. Her argument follows directly from her claims mapped out earlier in the volume about the social origins of cognitive processes in the individual. Studies carried out by Rogoff and her colleagues, as well as by others, suggest major differences in how adult-child and child-child interactions are organized and how these differences influence cognitive development. Specifically, these studies indicate that adult tutors are often superior to child tutors in their ability to foster the development of certain skills such as planning among children tutees. In contrast, fundamental shifts in perspective—resembling paradigm shifts in scientific inquiry—seem to be better fostered through the conflicts that occur in peer interaction. Thus two qualitatively different forms of social interaction are viewed as being tied to

two quite different forms of cognitive growth in the individual.

The distinction Rogoff makes between skill development and shifts in perspective is only beginning to be explicated in studies of children's cognitive development, and it remains problematic in certain respects. However, along with several of the other constructs and distinctions Rogoff has outlined in this volume, it goes a long way toward clarifying central debates in the field, and it is one of the points that makes this the best account of a sociocultural approach to cognitive development we have to date.

JAMES V. WERTSH
Frances L. Hiatt School of Psychology, Clark University, Worcester, MA 01610-1477
PETER TULVISTE
Department of Psychology, Tartu University, Tartu, Estonia.

The Mind's Eye

Principles of Mental Imagery. RONALD A. FINKE. MIT Press, Cambridge, MA, 1990. x, 179 pp., illus. $19.95.

Mental Imagery. On the Limits of Cognitive Science. MARK ROLLINS. Yale University Press, New Haven, CT, 1989. xx, 170 pp. $21.50.

Mental imagery is a topic that has long engaged psychologists and philosophers. Reasons for this range from the practical (ancient Greeks developed imagery-based strategies for facilitating memory) to the creative (Kekulé is reputed to have discovered the molecular structure of benzene by imagining a ring of snakes). Thus, it is not surprising that the reemergence of representation-based psychology under the guise of cognitive science was sparked in part by new discoveries on imagery (most notably by Roger Shepard and his coworkers). These findings brought with them new concerns about the status of visual imagery as a distinct representational medium and, consequently, during the late '70s, imagery became the focal point of an extended debate on the nature of the internal representations of the mind. Just as cognitive science is an interdisciplinary endeavor, so the imagery debate began as an interdisciplinary rift with lines drawn by discipline. On one side were the descriptionalists, mostly philosophers, who argued that cognition is the product of propositionally based, non-visual representations—a so-called "language of thought". On the other side were the pictorialists, mostly experimental psychologists who argued that a complete theory of cognition must also include pictorial representations as distinct entities to account for new findings concerning visual imagery.

In this context, it is remarkable that two books about imagery, one by an experimental psychologist and one by a philosopher, could lead the reader to similar conclusions. The agreement is even more striking in view of their radically different approaches. Finke, one of the more ingenious experimentalists studying imagery today, ignores most philosophical arguments, overwhelming the reader with an onslaught of data supporting the pictorial conception of imagery. In contrast, Rollins, the philosopher, ignores most empirical findings concerning imagery, leading the reader through a series of carefully reasoned logical arguments likewise supporting the pictorial viewpoint.

This agreement is more than superficial. Both authors attempt to demonstrate the viability of their particular visions of mental imagery as a pictorial medium. Unfortunately, neither is willing to commit himself to a precise mechanistic theory of mental imagery. In Rollins's case this is less surprising; as a philosopher he is more concerned with what is hypothetically plausible than with what must be explained by theory. To this end, Rollins makes it clear that his goal is to establish "that mental depiction plays a role in cognition that is different than that of mental description" (p. xvi). Yet I was disturbed by the small number of references to the empirical. This is fine if one is concerned only about representation in the abstract, but if one is concerned with the human capacity for imagery then existing behavioral data must be addressed (given the unexpected solutions the human brain has adopted via natural selection). Furthermore, Rollins's claim that "pictorialists have not probed the representational properties of displays or depictions sufficiently to produce a fully developed theory" (p. xiv) is unwarranted given his disregard for the significant theoretical progress made over the past decade (for instance, the work of David Marr or Irving Biederman). This same omission is less forgivable in Finke's book, where only a few pages are devoted to recent advances in visual representation. Instead Finke concentrates on five "general principles of mental imagery" that elucidate broad rules for how pictorial representations should function. Finke defends this position by arguing that principles avoid many of the "disadvantages" of using computational models, yet still "identify the general characteristics of a cognitive process that are common to many tasks" (p. 144). Though this may be true, I disagree with his dismissal of formal models. As in any science, adequate theories of the mind must ultimately specify the precise mechanisms and representations underlying cognition.

Both authors concentrate on areas they know best. Together the two monographs make an excellent introduction to the central elements of the imagery debate—Finke providing an exhaustive review of the collected knowledge about the human capacity for imagery and Rollins providing a thoughtful discussion of the philosophical questions. My guess is that each will also find its own niche in the literature: Finke's volume serving as a concise yet comprehensive reference work and Rollins's volume providing a model case study of the broader issues surrounding the nature of mental representation. However, since much of what they omit will in all likelihood form the core of a theory of visual representation, their works are already somewhat out of date.

MICHAEL J. TARR
Department of Psychology, Yale University, New Haven, CT 06520

Atomic Clocks

The Quantum Physics of Atomic Frequency Standards. JACQUES VANIER and CLAUDE AUDOIN. Hilger, Philadelphia, 1989 (distributor, American Institute of Physics, New York). Two volumes, boxed. xviii, 1567 pp., illus. $550.

Atomic frequency standards are electronic devices by means of which the frequency of oscillation of an electromagnetic wave associated with the transition of an atom from one energy state to another is made available as the basis for an extremely uniform or accurate time scale. Such devices are the "atomic clocks" properly so called, as they function, quite analogously to pendulum clocks and quartz crystal timekeepers, by repetitively marking off and adding up very nearly equal time intervals. By contrast, radiocarbon dating and other such methods put only approximate dates on particular artifacts by estimating the degree of relaxation of a population of nuclei or atoms from some higher energy state.

Atomic frequency standards are available as commercial instruments, neatly packaged and pictured in electronic manufacturers' catalogs, or they may be found as specially built-up apparatus in a few dozen time-standard development laboratories around the world. Between these two extremes lies a wide range and large number of made-to-order devices—usually excelling through diminishment of their size, weight, or sensitivity to their physical environment—for various military, national security, and space applications.