Distributed Cognitions is an interesting and exciting volume that is a good companion piece to recently released titles with a similar theme: the lack of a single central agent in cognitive action (e.g. Galegher, Kraut, & Egido, 1990; Rasmussen, Brehmer, & Leplat, 1991; Resnick, Levine, & Teasley, 1991; and Chaiklin & Lave, 1993). The volume is unique because the contributors thoroughly examine theories of "distributed cognition" within the traditions of psychology and educational research. Distributed cognition emphasizes a shift in conceptions of cognition, culture, and artifacts; they change from "food for thought" to "vehicle of thought." The change in emphasis highlights not only the distributed nature of cognition, but also its development over time, its power to support several individuals, and its mobility and continuity over several contexts, while maintaining that the human actor is the agent "at the steering wheel." In contrast to the theoretically close "socially shared cognition" (Resnick et al., 1991), which focuses on language and socially shared conceptions in general, this volume stresses the instrumental distribution of cognition.

The methodological and theoretical point of the book for psychology is that the field should not isolate individuals from their surroundings, rather it should redefine psychology research by using a broader unit of analysis. As for education, several contributors conclude that an understanding of the processes governing learning requires recognition of the importance of both a guiding partner (teacher or other) and the cognitive artifacts surrounding the persons engaged in learning. By recognizing the distributed nature of cognition and including this in the design of curricula, educators demonstrate that problem finding, not simply problem solutions, should be taught. In Salomon's words, educational outcomes should reflect "students' ability to handle new situations and meet new intellectual challenges" (p.128).

Five of the eight chapters are mainly theoretical. The three other chapters provide empirical support. I use theories in the plural because a mature and comprehensive debate continues throughout the book. Discussion of alternative theories relies on the merits of those theories, avoiding general attacks on traditional cognitive theory (see Still & Costall, 1991 for such attacks). Criticisms of cognitivism are still necessary, but are they the cause of renewed interest in distributed cognition? Salomon speculates that a renewed interest in Vygotsky and others who criticized cognitive theory have sparked interest in distributed cognition. But, I and many others
believe that computers and their complexity as cognitive tools have focused attention on this issue. We have more complex cognitive tools, and decentralized computer communication media make the distributed nature of work more apparent. Several lines of research are responsible for enhancing this perception of work, including: Connectionism (Hutchins, 1991), Distributed Artificial Intelligence (Brehmer, 1991), and Computer Supported Cooperative Work. Cognitive Science's second revolution centered on human-computer interaction, and cognitive psychologists now see the wider context of computer interaction. Teachers introduce computers into the classroom as both ordinary cognitive tools and simulated microworlds.

The term distributed cognition appeals to both socio-cultural approaches and more traditional approaches. This dual acceptance can be credited to Norman's and Hutchins' excellent integration of the approaches. Unfortunately, neither author appears in this volume. The cognitivist approach acknowledges that people have different knowledge bases, but holds on to the notion of universal in-the-head cognitive structures, implying that we coordinate our action with different instruments and persons to overcome flaws in the cognitive structures. According to the socio-cultural approach, knowledge develops in situ and is embedded within larger structures of history and culture, making knowledge and cognition inherently social, and therefore distributed.

Except for a short speculative passage in the final chapter by Nickerson, the formal approach of cognitivism is absent. Unlike Salomon, I do not see cognitivism and distributed cognition as two views, but rather as a continuum from general statements to instrumental action and activity. Some authors consider general theories and others consider specific empirical methods and operationalization. Their foundations may differ, but all the authors share an interest in Vygotsky's "Zone of Proximal Development," a fine starting point for a conceptual journey. Because of the fruitful confusion and unification around the terms distributed cognitions and zone of proximal development, the theoretical accounts are most enlightening.

Distributed cognition in communities

The first chapter, by Cole & Engeström, offers an interesting historical journey through the origins of distributed cognition beginning with Wundt and Munsterberg. They show that distributed cognition is not a new invention, but a new term raising long forgotten questions. We learn that psychology has taken only one of the gates its pioneers opened; social science is entering the second gate now. The historical background pays positive respect to former traditions.
Cole & Engeström demonstrate how activity theory accounts for distributed cognition as a universal fact throughout the human cognitive repertoire, from neuropsychology to culture and society. Two comments are in order. First, the existence of a phenomenon at one level does not guarantee the same phenomenon at the next level. Second, distributed cognition at a neuropsychological level is an old theme in cognitive theory. The chapter gives both a comprehensive account of activity theory and two short empirical examples, one of reading acquisition and one of work organization development (see Engestrom, 1993 for an extended account).

Activity theory is easy to comprehend when it is approached as these experts in the field approach it. In other hands, activity theory sometimes appears too broad. Moll et al., who present empirical work from the activity theory perspective, are an example of this broad treatment.

Brown et al. investigate the design of classrooms that can facilitate the practice of "learning to learn." Instead of asking where cognition resides, they design the classroom environment in certain ways and let the students develop expertise in the subjects of their choice. Their point of departure is reciprocal learning, in which the teacher's role is to be a "guide" and the student's to be a "scientist." In this way they build the distribution of knowledge into the educational system. Using artifacts and people, Brown et al. create overlapping zones of proximal development.

Having seen many visionary, but naive, individual centered hi-tech "tools" for children's education, it is a pleasure to see a mature framework in which hi-technology is only one part of a guided mutual appropriation. I hope that teachers fascinated with hi-tech and researchers read this detailed, holistic chapter and take notice of its insights, before being carried away by graphics and sound.

Cognition distributed over artifacts

Pea also begins with activity theory, but he goes on to focus on the situated instrumental action of human interaction with intelligent artifacts. In Pea's view, any artifact crafted for certain activities embodies some of the cognitive reasoning of the originators. Taking a constructionist view, he concludes that intelligence must be accomplished in interaction rather than being a property of the actor or the artifact. This might seem awkward, even contradictory, to speak of intelligent artifacts, but the main theoretical claim is that intelligence is something that is accomplished. Pea relies on Norman's (1988) approximate action/activity model, which accounts for the interaction between the affordance of artifacts and the actors'
desires/goals. In Pea's argument, reasoning and understanding become part of the artifact. He gives several examples of how cognition is distributed across artifacts. His main contribution for educational work is to encourage us to empower students through reflection and invention of old and new tools.

Both Pea and Perkins use the term accessibility of knowledge. What matters is not where certain cognitive functioning resides but how easy it is to access. Perkins proposes an "access framework," which includes four categories for analysis: knowledge availability, knowledge representation, retrieval of knowledge and construction (or transformation) of knowledge into other structures. The strengths of the access framework lie in its ability to show optimal or suboptimal practices that must be recognized in complex and dangerous distributed cognition systems, such as power-plants and other distributed decision systems (see Rasmussen et al, 1991). Perkins' analysis shows that the environment or artifacts may have executive functions, but higher order knowledge can only be distributed among people, as the environment does not meet the criteria of the access framework for higher knowledge. Perkins echoes Pea's conclusion that desire and affordance must coincide for artifacts to be included in the distributed cognitive system. Perkins, however, makes a sharp contrast between artifacts and people, which ignores the fact that people's coordination is achieved through mediating tools, such as language, which imposes its own constraints.

The individual in distributed cognition

Pea, Perkins, Salomon and Hatch & Gardner place the cognitive actor in a fundamental, although not central, position. Salomon and Hatch & Gardner make the cognitive actor the core object of analysis. Salomon is perhaps most reluctant to expand the unit of analysis. He critically examines the individual's role in distributed cognition and concludes, "Distributed cognitions, throwness, and contextual actions interact with those elements one traditionally attributes to the mind of the individual: mentally represented knowledge and skill" (p.120). Salomon does not do justice to activity theory in his critique. He seems to ignore what Leont'ev wrote, "In activity the object is transformed into its subjective form or image. At the same time, activity is converted into objective results and products" (quoted in Cole, 1985:159). Because internalization is a major concept in Vygotskian theory (Wertsch & Stone, 1985), the problem is how to investigate mental representation accurately without inferences from situated action or interacting with the subject and thus also change the representation.

Hatch and Gardner present a concentric circle model in which
individuals are the core surrounded by the local environment and culture. The model may have heuristic value, but it is arbitrary, even if the circles are interdependent. Still, the authors provide an elegant and interesting comparative study of children in a kindergarten, showing how different forces interdependently structure action. Through studies of two children playing together at the sand table and the art table, they conclude that both forces from within and from the culture structure the setting. However, it could also be concluded that the two children have developed a social organization of how to interact with one another.

Summary

This excellent book should be read not only by people interested in psychology and education, but by cognitive psychologists, anthropologists, sociologists and interdisciplinarians. It will evoke reflection upon reasoning, practice, and the use of artifacts. The book misses some theoretical considerations, for example how connectionism may be integrated into a framework of distributed cognition. In the introduction Salomon writes, "This book is an attempt to explicate, illustrate, and critically examine the idea of distributed cognitions in its general and educational manifestations" and "(T)his book is an attempt to raise questions and start a debate rather than present a unified view with worked-out implications." I think that the contributors have done a good job of fulfilling these goals.

References


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