with the initial outgrowth of retinal ganglion cell axons and with the neurogenesis and migration of cells that make up the visual system and other events that occur largely during prenatal development but are now amenable to study because of significant technological advances. These omissions weaken the book and make it less suitable for the reader seeking a comprehensive introduction to this field. However, those working in the field will find the book useful not only as a source of information, but also as a reminder that much more must be learned before it is possible to understand fully how connections in the visual system can be altered by the effects of experience.

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A Science of Cognition

Method and Tactics in Cognitive Science. WALTER KINTSCH, JAMES R. MILLER, and PETER G. POLSON, Eds. Erlbaum, Hillsdale, N.J., 1984. xii, 324 pp. $29.95. From a conference, Boulder, Colo., 1981.

Methods are justly notorious for the barriers they can impose between adjacent sciences. It is therefore not surprising that the recent movement to integrate the several sciences of cognition has encountered its most stubborn obstacle in the diverse methodologies employed in psychology, linguistics, computer science, neuroscience, and the rest of the cognitive sciences. This book is a valiant effort to confront the problem.

Authored by about a dozen cognitive scientists of various stripe who met together in a conference, the book keeps its bearings by working from concrete examples of research in artificial intelligence (AI), linguistics, and cognitive psychology. In each chapter, the authors attempt to illustrate the methods employed in their particular corner of cognitive science and to assess the relations between their own methods and those of their near neighbors. Kintsch, Miller, and Polson provide introductory and concluding chapters that summarize the entire exercise.

Collectively, the authors are of three minds about the current relations among the methodologies and their future prospects. One camp argues that certain methods are inherently more powerful and will come to dominate the field. Philosopher John Haugeland, for instance, maintains that AI is "first among equals" because computers make it "feasible to build, maintain, and intellectually manage systems of unprecedented complexity." Therefore, Haugeland argues, AI can attempt to synthesize the full scope of human intelligence, whereas each of the other cognitive disciplines is stuck with "some little tag-end of the phenomena that it can get a relatively firm grip on" (p. 92). A second camp, principally represented by computer scientist Eugene Charniak but also including the editors of the volume, argues that methodological diversity is cognitive science's greatest current asset. Since all efforts to understand the workings of intelligence remain fairly primitive, cognitive scientists should not attempt to prejudge which will evolve most successfully. Meanwhile, tolerance and an effort to understand each other's methods should be the order of the day. The third camp takes a somewhat stronger line: namely, that the disparate battery of cognitive methods can be employed in complementary fashion to achieve a science of cognition that is more successful than any of the current cognitive sciences alone can be.

Of the three views, the last is undoubtedly the most interesting, since only in it is there any promise that cognitive science might become more than the sum of its parts. Anyone interested in assessing this promise should look particularly at the chapter by Bresnan and Kaplan, which sets forth the methodological program underlying lexical functional grammar, and also at the chapter by Van Lehn, Brown, and Greeno, which reviews the so-called "buggy" studies of children's problems learning multiplace subtraction problems. Bresnan and Kaplan argue that linguistic criteria alone are not sufficient to determine a psychologically valid representation of linguistic competence. In their view, a grammar must be usable, learnable, and psychologically testable in order to stake a psychological claim, and they try to show how lexical functional grammar might meet these tests. Van Lehn, Brown, and Greeno similarly argue that isolated cognitive methods are insufficient, but their target is AI, not linguistics. In their view, AI's efforts to simulate intelligent behavior are in danger of simply substituting "one black box, a complex computer program, for another, namely the human mind" (p. 237). Computer science may have given psychology the means of expressing detailed cognitive models, but this increased representational capacity has not been matched by efforts to analyze the principles underlying intelligent behavior, either natural or artificial. As a result, "the new, richly detailed models of cognitive science often fail to meet the traditional criteria of scientific theories" (p. 237). Van Lehn and colleagues recommend that the theoretical techniques of linguistics and the experimental techniques of psychology be added to AI in order to develop testable claims about the underlying nature of intelligence. Certainly, one comes away from this book with an enhanced sense of the methodological options available in the cognitive sciences. But one also emerges with a sense that it matters, perhaps more than previously supposed, whether we think of the cognitive sciences as one or many.

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(Continued on page 100)