

Review of *Foundations of Cognitive Science*

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Here we have a large book with a set of chapters written by different people on the foundations of cognitive science that is meant to answer the question, "What is cognitive science?" The book does answer the question, in so far as it can in such a young field, by providing a range of chapters tackling cognitive science from different points of view. Eric Wanner, Jerome Feldman, Michael Gazzaniga, S. Kosslyn, and Geoffrey Hinton all give the book strong positive vindication on its cover flaps.

Michael Posner's book was initiated when a board of editors met in St. Louis, Missouri, to outline the chapters needed to carry out the project, which was funded by a generous grant from the Sloan Foundation. Posner does not include a chapter himself, although he provides a short preface. He might have included a signature on the preface because it is the norm; otherwise, it leaves the reader wondering whether he wrote it. The book has an introductory chapter on foundations by Herbert Simon and Craig Kaplan and is then split into three parts: (1) foundations (7 chapters), (2) domains (11 chapters), and (3) assessment (2 chapters). It also includes an author and subject index. The foundations of cognitive science cover computing, symbolic architectures, connectionism, grammatical theory, logic and semantics, experimental methods, and mind-brain-body issues. These foundations are then applied in the next part to the central cognitive domains of language acquisition, reading, discourse, mental models, categories and induction, problem solving, vision, visual attention memory, action, and motor control. Finally, there are assessments focusing on cultural and philosophical issues. I think that this orga-

nization was a good idea because it helps to reduce repetition of the concepts provided in the earlier part on foundations. However, a number of issues are repeated across chapters, and it is not clear that the authors of each chapter had a chance to read the other chapters while they wrote theirs. The different parts of the book could have been better (more explicitly) named; for example, *domains* on its own means little to me!

The book has an advantage in that it provides a collection of chapters on the foundations of cognitive science written by different people; hence, we see differing points of view from experts in given areas, which could not be achieved by a single author. What the book gains in variety, it

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maybe loses in coherence across chapters, but this loss is inevitable. I personally like the editing approach better and to single author a foundations book would be an exhausting task to say the least. However, a criticism of the book is that nearly all the chapters are by authors with a U.S. affiliation, with a few from England, and I find it difficult to believe that leading cognitive scientists in other countries could not have written something. Thus, we get an American-Anglo view of cognitive science rather than an international one, such as that given in Ó'Nualláin (1995). Of course, I realize that there is not always space for everyone to include a chapter. In fact, it is worrying that we might get biased

viewpoints on foundations or other issues when we have books with mainly U.S., or mainly European, papers. What I like to see is more international volumes with a balanced set of multicultural views from the United States, Europe, and Asia. This goes back to Roy D'Andrade's chapter, which considers the importance of *cultural cognition*, where cross-cultural experiments on color and emotion show that people from different cultures see things from different points of view. He argues that the reasoning that people do depends on cultural models.

To my mind, some of the chapters indulge in lots of talk without any clear detail or data. I found that Daniel Schacter's chapter on memory was too full of references to other work and had little of his own discussion; it is more useful as a bibliographic listing. However, the chapter by Terrence Sejnowski and Patricia Churchland differs from many of the others in that it gives detailed pictures of brain biology and results from brain experiments that I found refreshing. Also, they emphasized cross-disciplinary work in their conclusions, which I believe is important. In fact, there is evidence that much of science in the next century will involve engineering and integration as subfields converge (see Horgan [1996]). E. Bizzi and F. A. Mussa-Ivaldi's chapter on motor control is also detailed with pictures of experimental results on kinematic data, torque stiffness, and trajectories for human and animal motor control.

Something that I found strange is that there are running footers, rather than headers, marking chapters. I think this is the first time I have seen this approach, and initially, I thought there were no headings at all. I wonder if there was a specific reason for this format; otherwise, I think it would have been better to have running headers. In addition, there are lots of cross-references across chapters, but I would like to have seen more detailed references listing specific pages. Each chapter has a full list of references, but there are lots of references repeated over chapters. Maybe more space could have been saved,

and cost reduced, by having one reference section at the back of the book.

Many of the leading lights in cognitive science are authors here: Bower, Churchland, Grosz, Johnson-Laird, Jordan, Newell, Pinker, Pylyshyn, Rumelhart, Sejnowski, and Simon. However, I missed a chapter by Roger Schank, or any of his school (for example, De Jong, Dyer, Lehnert, Wilensky), who is undoubtedly one of the leaders in this field. Schank's views on language understanding, pragmatics, and natural language processing had people think again about Chomsky's focus on the primacy of syntax. Posner's book is fair to both the symbolic-connectionist and the logic ("neat")-nonlogic ("scruffy") traditions in cognitive science because it includes chapters from all these camps. All the classic issues are discussed, such as the fact that people do not reason logically well (Wason card test), requiring more (for example, mental models) than neat logic to model cognition.

I am happy to see that nearly all the classical issues of cognitive science are covered (and sometimes by more than one chapter), including (1) the Turing test; (2) Searle's Chinese room problem; (3) Marr's three-level hypothesis (in many chapters); (4) Newell and Simon's physical symbol system hypothesis; (5) computer architecture as a metaphor for cognitive architecture; (6) Wittgenstein and Rosch's category theory; (7) schemas, frames, and scripts (Bartlett, Minsky, Schank) (in many chapters); (8) representation as language propositions or images (Kosslyn, Pylyshyn); (9) people not reasoning logically (Wason, Johnson-Laird); (10) procedural-declarative representations; (11) Minsky and Papert's 1969 death knell to connectionism; and (12) Miller's 7 ± 2 value for short-term memory.

Simon and Kaplan's introductory chapter on the foundations of cognitive science is good, going over the central classic issues and listing the main contributing disciplines as psychology; AI; linguistics; philosophy; neuroscience; and, to a lesser extent, anthropology and social psychology. They take the expected swipe at behaviorism, although they do not

mention or reference Skinner at all who was one of its main proponents. Methodology (protocol analysis, content analysis, AI-computer simulation metaanalysis) and philosophy, systems that adapt to their environments, and learning and social cognition are also covered.

Simon and Kaplan discuss some of the tricky issues in cognitive science, such as whether people's knowledge representations are language-propositions or something else such as images and how the semantic components of language and vision are related. They say, "What is the relation between the meaning that is extracted from the sentence *there is a cat in this room* and the meaning that is extracted from seeing a cat in the room?" (p. 16); they favor the hypothesis that there is one unified meaning representation. For more recent discussions on integration of language and vision processing with an AI slant, see Srihari (1995).

I found interesting Jon Barwise and John Etchemendy's design of a simple language called OLD ZELANADISH, which is a hybrid of first-order logic and English, in their chapter on formal logic. It is similar enough to familiar languages to be able to guess the intended meanings but different enough to remind us that it is not English. Such constructions are invaluable for building up explanations.

For me, the final two chapters on analysis are the most useful, with Roy D'Andrade stressing modeling culture, where cultural models are to some extent "little machines" (p. 824). We get a full discussion on the moves toward cognitive linguistics, as advocated by Talmy, Langacker, and Lakoff. Also, two topics come up here that are important for cognitive science to address more in the future: (1) color and (2) emotion. I would like to see cognitive science conduct more work on emotional intelligence (see Goleman [1996]), where emotion is given a higher priority. In accordance with D'Andrade, Ó'Nualláin (1995) stresses the need for more focus on embodiment and social interaction in cognitive science. Gilbert Harman's chapter focuses on the philosophical issues of qualia, intentionality, and the mind-

body problem. Dennett's work on intentionality and Searle's Chinese room problem are discussed thoroughly here.

Posner's book provides a solid foundation for a field that is now well established and part of the ongoing effort to understand the self, mind, and consciousness. In fact, the understanding of consciousness takes front seat in cognitive science now (see Ó'Nualláin, Mc Kevitt, and Mac Aogáin [1997]). Posner's book is a valuable one for students and others who want to know about the foundations of cognitive science.

References

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