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Book review

A fruitful blend, or a trinket-box? A book review of The MIT Encyclopedia of the Cognitive Sciences. R.A. Wilson, F.C. Keil (Eds.); MIT Press, Cambridge, MA, 1999, 964 pp., ISBN 0-262-73124-X, US$ 149.95

> Knowledge is of two kinds: we know a subject ourselves, or we know where we can find information upon it — Samuel Johnson

Cognitive Science prides itself on its interdisciplinarity (Schunn, Crowley & Okada, 1998). Since the object of interest, namely the mind, is immensely rich and multi-faceted, then so too must be the means of investigation. Thus, the story goes, with the glorious vanquishing of Behaviourism still fresh in their hearts and minds, researchers from neuroscience, linguistics, AI, psychology, philosophy, and more have banded together to form the flourishing subject we have today.

Some awkward facts stand in the way of this edifying story. To feed one's interest in a different discipline, simply reading a few review articles may suffice. However, to enrich one's research by building-in findings from another discipline, one must first know and understand that area well enough to be able to judge the validity of the work. But by this measure can, say, any single neuroscientist understand the contents even of one issue of *The Journal of Neuroscience*, or a cognitive psychologist an issue of *Cognitive Psychology*? Research has grown explosively, but researchers have stayed mortal. Can neighbouring disciplines truly cross-fertilise, or must we all be dilettantes?

The new *MIT Encyclopedia of the Cognitive Sciences*, or *MITECS* for short, makes a brave attempt to solve this problem. It consists of a huge number of short, readable and cross-referenced articles, spanning almost every imaginable topic in Cognitive Science, and also has six longer introductory chapters by the Section Editors, covering Philosophy, Psychology, Neuroscience, Computational Intelligence, Language, and Culture & Evolution. The cast of contributors is stellar; for any given entry, the author is almost always reassuringly well known. As stated in the Preface, the book aims to capture "the ways in which ideas are linked together across topics and disciplines, as well as the ways in which authors from very different disciplines converge and diverge in their approaches to very similar topics".

With such breadth and quality of content, then, *MITECS* sounds like a sure win. However, the Encyclopedia's aims, and its success or failure at meeting them, must be judged against the background of the crowded Cognitive Science overview market which it seeks to join. Freshly updated and with equally authoritative contributors, the four volume *Invitation to Cognitive Science* series, edited by Osherson (1998), covers the same ground, but contains a moderate number of chapter-length essays instead of a throng of two-page summaries. Cognitive Neuroscience, currently the fastest-growing and arguably the most fruitful branch of the Cognitive Sciences, is served by Gazzaniga (1999), again in long-essay format, freshly updated, and written only by the biggest names. Readers of *Neural Networks* were admirably served by the still relatively recent *Handbook of Brain Theory and Neural Networks* (Arbib, 1995), which has exactly the same encyclopedic format as *MITECS*, but is now available in a paperback edition at half the price of the newer hardback books. Not all of the competition comes from these MIT Press sibling rivals. For almost exactly the cost of the new Encyclopedia, one can buy a year's subscription to the new journal *Trends in Cognitive Sciences* (or *TICS*) which is rapidly gaining prestige and readers, and which offers high-quality medium-length review articles covering recent developments across the whole field.

Against this background, then, *MITECS* has two unique selling points. Firstly, it provides bite-sized chunks of knowledge, as opposed to the more time-consuming but deeper essays of Osherson (1998), Gazzaniga (1999) and *TICS*. This has the immediate consequence that a *MITECS* article has the greatest potential use for researchers from *outside* the particular discipline being described, since it can provide only an outline summary, which those from within the given discipline would already mostly know. Secondly, by covering a very broad range of topics within one volume, it potentially allows a greater scope for inter-disciplinary enrichment than the similarly designed but more specific encyclopedia of Arbib (1995). Taken together, these considerations imply that *MITECS* would fill its market niche most successfully if it were to allow researchers to peek across into other disciplines and quickly see what links there might be with their own. Taking inspiration from the Johnson quotation above: we may not know how to make our research interdisciplinary, but at least with *MITECS*, we would know where to go to find out.

In several respects, the book lives up to this promise. Selected key research areas are described from multiple disciplinary angles, in complementary articles lying side by side. Examples are the neighbouring entries on Speech Perception, Speech Recognition in Machines, and Speech

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Synthesis, and also three articles on Object Recognition, from the vantage points of animal studies, human neuropsychology, and AI. The article on animal object recognition, by Edmund Rolls, is itself a good example of interdisciplinarity, describing the invariant tuning of macaque inferotemporal neurons in the context of possible computational means by which this invariance might be achieved. The introductory summary chapters are also very valuable, covering a broad range of research areas and the relations between them. Even the most erudite will find much that is enlightening; the chapter on Culture, Cognition and Evolution, for example, will provide new and interesting material for many readers.

However, not even a volume as large as *MITECS* can devote multiple complementary articles to every worthy theme. Hence, the majority of topics are allocated one short outline article each. As mentioned above, outline summaries should be aimed at researchers from other disciplines, since they will be old news to those within the field. This goes beyond just avoiding insider jargon; the contributors should show how their topics might enrich other Cognitive Scientists' research, rather than merely being interesting but inert trinkets of information.

Unfortunately, a large proportion of the articles stay firmly within the self-imposed walls of their own discipline. Although interdisciplinarity within Cognitive Science is still far from having reached the point that every topic has an obvious link to work in some other field, there are few research areas so isolated that one could not even smuggle a couple of cross-disciplinary references into the bibliography. However, *MITECS* contains far too many cases of, for example, linguistics articles that refer only to linguistics, and philosophy articles that speak of nothing but philosophy.

The greatest sense of lost opportunity comes in articles where highly successful research programs are entirely ignored. The entry on Face Recognition, for example, gives a readable and informative summary of work on neural responses to faces in humans and monkeys. However, not a single reference is made to the fact that computer face recognition, once thought to be an intractable problem, has now been solved to the extent that several successful commercial systems are available. Although the possible relations between the machine vision algorithms and the actual neural computations are far from clear, it cannot but have enriched the article for such links at least to have been mentioned. In fact, excellent articles discussing the possible connections between the two areas do exist (Chellappa, Wilson & Sirohey, 1995).

The Encyclopedia contains many such examples of ignored interdisciplinary links. The entry on Modal Logic, which deals with the formal treatment of necessity and possibility, completely fails to mention that this philosopher's construct is now used by AI programmers for reasoning about knowledge (e.g. Boutilier, 1994). Without this kind of cross-disciplinary information, one is left wondering why such a seemingly abstract topic gets mentioned in *MITECS* at all. Readers of this journal might be saddened to note that the entry on Self-Organising Systems says much about thermodynamics and autocatalytic sets, but nothing about self-organising neural networks. Conversely, Michael Jordan's entry on Neural Networks says much about their statistical applications but neglects to mention that they can be used for modeling the brain. Although other parts of the Encyclopedia do discuss each of these connections, the excessively narrow focus of many of the articles often makes the interdisciplinary links hard to find, violating the book's own stated aims.

Despite these caveats, *The MIT Encyclopedia of the Cognitive Sciences* is an extremely informative, wide-ranging and up-to-date book that would grace any university library, provided it can cover the expense. Its articles are almost without exception clear and well written, and span a healthy diversity of opinion as well as of subject matter. Online and CD-ROM versions of the book are also available; the greater ease of cross-referencing which these would allow might help to offset the often overly narrow focus of the articles themselves. Perhaps a little like Cognitive Science itself, the included disciplines nestle side by side but fail to intermix and enrich each other as much as they might. *MITECS* is not so much a fruitful blend as a trinket-box. But the trinkets are so pretty, it is hard to resist.

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