Reviews

Advances in cognitive science, volume 2. Theory and applications edited by G Tiberghien; Ellis Horwood, Chichester, Sussex (published in the USA by Halstead Press, New York), 1989, 206 pages, £39.95 (US: $59.95)

This book consists of ten articles divided into a theoretical section, covering symbolic and subsymbolic processing in learning and problem solving, and an applications section, concerned with computer vision, object and face recognition, arithmetical and semantic concepts, and industrial control. Many of the articles also contain useful reviews of relevant publications in both French and English.

In his editorial introduction, Guy Tiberghien, of Grenoble University, claims that cognitive science is a research program with its own methodology, experimental paradigms, theories, and models. His definition of 'cognitive' is information processing in the CNS, including subsymbolic and automatic levels as low as synaptic parameters of connectionist paradigms. He argues that mental phenomena of a symbolic nature are produced by other units situated at an inferior subsymbolic level. However, he admits to some difficulties in understanding the role of higher-level processes in cognition (such as affect), and finds the process of belief generation "totally opaque".

Although these demarcation issues may be forced upon us by the academic system, they are unlikely to benefit cognitive science in the long run. Where they reduce communication between cognitive scientists and higher and lower levels of analysis they weaken the constraints which knowledge of strategic goals and implementational details can impose on irrelevance and error at the level of algorithmic production. There is also the question of scientific coherence and economy; clearly there are complex processes of recognition, communication, and adaptive control taking place both at microbiological and social levels, and powerful developmental constraints operate between levels. Ideally, cognitive science should provide a unified developmental account for data processing at all levels.

Particular difficulties can be caused by considering information processing in the CNS out of its cultural and social context, as if each brain develops monadically in isolation, without benefit of educational processes or cultural evolution. Sociobiology has highlighted the individual's need to develop the cognitive capacity to model the strategies of rivals and allies in competitions for scarce resources essential to fitness, and social psychology has revealed group pressure on individuals to conform to the beliefs values and programs of successful cultures.

In this context, it was interesting to find that none of the more theoretical papers take explicit account of the social dimension. Murphy and Winieski (chapter 1) elegantly demonstrated that learning $N$-feature concepts does not involve laboriously recording the $N(N-1)$ correlations between individual features and that only the $N$ links from features to the concept node are required to account for the way that concepts operate to constrain attention. Their conclusion is that concept learning is constrained by our 'world-view', but they do not discuss the nature or origins of this world view, or Vygotsky's theory that our concepts and beliefs are culturally determined and serve to guide our attention to goal-relevant features in complex environments. Richard's interesting description of task-specific interpretation biases in problem-solving tasks, such as the Tower of Hanoi (chapter 2), also fits in with the idea that problem-solving skills are a function of education. Ans's article (chapter 3) is particularly 'asocial'. He shows how a Kohonen topologizing network can be used to transform nonlinearly separable classes of patterns adaptively into forms which can be readily distinguished by a simple associative network. This network may well have valuable applications to machine learning. However, for most human cognition, the equivalent pattern separation process is performed either by biological evolution, producing new key distinguishing features, or by cultural evolution, coining new concepts which direct attention to linearly separable feature sets. Anderson's Brain-State-in-a-Box network for qualitative multiplication models a number of interesting psychological behaviours (chapter 7), but these do not include the social contexts in
which arithmetic skills are acquired, or the symbolic skills which could perform the same task. Amy (chapter 4) provides a sophisticated discussion of the ubiquitous problem of context in artificial intelligence (AI) and describes a connectionist contextual cognitive machine, but he also does not mention the social context of political loyalties and ‘world views’ within which human cognitive systems must operate. The point here is that, however good the individual experiments and simulations described in these articles, their findings are much more interesting or satisfying if the competing higher-level explanations provided by social contexts are ignored.

This problem does not arise in the AI papers. Lux’s paper (chapter 5) on model-based object recognition includes a sophisticated comparative review of alternative approaches, attending to criteria of computational and phenomenological adequacy. Similarly Abdi and O’Toole’s connectionist model of facial feature extraction (chapter 6) provides a novel and potentially valuable approach to macrofeature detection. The final two articles are more heavily applications oriented. Le Ny (chapter 8) is concerned with automatic diagnosis of student concept acquisition, and Hoc (chapter 9) provides an impressive review of the design of computer support for process control.

V Dobson
Department of Experimental Psychology, University of Oxford, Oxford OX1 3UD, England

**Perspectives on dyslexia** 2 volumes edited by G Th Pavlidis; John Wiley, Chichester, Sussex, 1990, 279 pages and 331 pages, £39.95 each (US: $84.95)

The first of these two volumes is entitled *Neurology, Neuropsychology and Genetics*, the second *Cognition, Language and Treatment*. There are seventeen chapters in all, many of them joint-authored, and sixty-eight contributors.

In the foreword, Cruickshank wisely points out that the issue of dyslexia “is not one for a single discipline”. What the book provides is a series of contributions from a variety of different points of view. In the first volume there are sections on the neurological basis for subtypes, on the role of genetics, on neuroanatomical research, and on eye movements, and in the second there are chapters on diagnosis, on cognitive deficits, and linguistic and phonological problems, on literacy difficulties in languages other than English, on dyslexia in adulthood, on the personality of the dyslexic, and on methods of treatment. Most of the contributors assume some degree of specialist knowledge on the part of the reader, and the book is likely to be heavy going for the layman.

It has long been known that dyslexia has a genetic basis; but the Colorado-twin study, reported on by LaBuda and DeFries, is unique in its thoroughness and in the sophistication of the techniques used. The outcome, according to the authors, is “definitive evidence of a genetic etiology for reading disability” (volume 1, page 73). It is also possible that a gene influencing reading ability is located on chromosome 15, though Smith and her colleagues do not claim that this is decisively established.

The chapter by Rosenberger on cerebral asymmetries is a model of lucidity. In his last paragraph he puts forward a view similar to that published elsewhere by Galaburda, namely that asymmetry of the two cerebral hemispheres is the norm and that in the case of dyslexics it is lack of asymmetry which may turn out to be the important finding. Particularly striking are his comments on the nature of dyslexia in general:

“We view definitions of dyslexia based upon reading underachievement ... as essentially mistaken .... It is entirely possible for a dyslectic youngster, by virtue of proper tutorial assistance, to read at grade level; and selection criteria that require an achievement deficit of one or two grade equivalents, even those that take IQ into account, will miss this important subgroup” (volume 1, page 103).

It is time this warning was more widely heeded.

In their chapter on PET-scan studies Gross-Glenn and colleagues conclude that “a number of different brain regions seem to be involved in the normal reading process”. A particularly striking finding—albeit based on only a small number of subjects—was that “the peri-insular cortex, a region that lies between the frontal and temporal lobe language regions, was significantly lower in relative metabolic activity for dyslexics than for normals”. This is important
because "lesions in this region, at least in the left hemisphere, are known to produce profound language disturbances" (volume 1, page 116). The studies reported in chapter 8 by Naylor et al, involving event-related potential (ERP) data and data on cerebral blood flow, are broadly supportive of the same view. They say in conclusion:

"The results of our physiological studies to date provide strong evidence of an underlying physiological deficit in left hemisphere functioning in core language areas, primarily the left temporal region. However, there is also strong evidence to suggest that the underlying physiological deficit, at least for the individuals who fail to improve their reading skills by adulthood, has a bilateral component as well" (volume 1, page 159).

There is also a fascinating chapter in which John et al raise in physiological terms the distinction between 'maturational lag' and 'functional deviation'. They show how it is possible, by combining a variety of measurements, to determine a person's "physiological age". From this it follows that "a developmental deviation exists when an observed set of neurometric features, deviant from the normal region, would not fall within the normal range no matter what the age of the patient" (volume 1, page 126). It is of particular interest that an issue which has long been discussed in behavioral or functional terms should now find its analogue in neurometric research of this kind.

The final chapters of volume 1 are concerned with eye movements (Dodgen and Pavlidis) and with vergence control (Fowler, Riddell, and Stein).

An outstanding chapter in volume 2 is that by Mann and Ditunno. In it they provide confirmatory evidence that the typical manifestations of dyslexia result from deficiencies at the phonological level. These are then classified as "(1) awareness of phonological structure; (2) retrieval and perception of phonological structure; and (3) use of phonetic representation in working memory" (volume 2, page 127). In a later chapter Torneus raises the important question of the extent to which 'metalinguistic' knowledge—for instance ability to segment words into their component sounds, appreciation of rhyme, and judgments of grammatical correctness—is required for the development of fluent reading. She concludes that "whatever the causal direction is, the relationship between early reading and metaphonological skills is reliable and quite close" (volume 2, page 155).

Research into dyslexia is by no means restricted to English-speaking countries; and there is a very interesting chapter by Matajcek, Pazlarova, and Sturma in which they describe letter confusions and other errors made by Czech and Norwegian children. This is followed by a chapter by Porpodas describing his research into the reading and spelling of Greek words. An interesting characteristic of Greek orthography, so he tells us, is that, although the spoken form of the language has undergone many changes, the written form of the words in fact represents the way in which they were pronounced some 2000 years ago.

It is not always appreciated that the cognitive difficulties of dyslexics can often generate difficulties on the personal and social side; and there is an admirable chapter by Bryan and Bryan in which the evidence in this area is systematically reviewed.

With regard to the book as a whole I have two main worries. The first is that most of the authors (with the exception of Rispers and van Yperen in volume 2, chapter 2, and Mann and Ditunno in volume 2, chapter 6) seem quite prepared to accept uncritically the concept of 'IQ'. Figures for 'verbal IQ' and 'performance IQ', based on WISC results, are cited as though they needed no further discussion or justification. There is no reference to the 'ACID' profile (that is, distinctive weakness of dyslexics at the arithmetic, coding, information, and digit span items), though this is a well-attested phenomenon; and it is surprising that so many of those who carry out their own research with such care are content to cite other people's results (which WISC scores usually are) without any consideration of the cognitive complexity of the tasks involved. It may be enough for certain purposes to say that one wishes to exclude general dullness, but particularly in the case of some of the contributors to volume 2 one feels that more might have been said on the question of how particular scores should be interpreted. 'General dullness', after all, is a decidedly coarse-grained concept.

My second worry is the familiar one of definition. Readers of this book are likely to receive the impression that the area is full of basic disagreements (volume 2, page 17: "Even defining the condition is still a controversial issue"). The trouble, I suspect, is that researchers
are so intent on 'doing their own thing' that they do not read carefully enough what others have said. The condition (or group of conditions) discussed by Hinshelwood, Orton, Critchley, and others should strictly be called 'specific developmental dyslexia'; and in many contexts 'dyslexia' is obviously—and unobjectionably—being used as an abbreviation for this. Some of the alleged controversies in the area, however, seem to me to be spurious: some writers, when they use the word 'dyslexia', clearly mean 'specific developmental dyslexia', whereas others appear to be thinking largely in terms of 'poor reading'; and because the two sides are talking about different—even if sometimes overlapping—groups it is not surprising if their generalisations differ. For example, it is obvious that poor reading can arise from many different causes, and in that context it is not unreasonable to search for 'subtypes'; whether there are subtypes within 'specific developmental dyslexia', however, is a different issue, and it may well be that there are not. Insofar as questions of definition are addressed in the present two volumes the contributors are by no means speaking with one voice. In his foreword, Cruickshank rightly says that "the two groups, dyslexics and non-dyslexic retarded readers, are of entirely different genres" (volume 1, page xiv), and some of the other contributors commendably show themselves aware of this distinction (for example, Pavlidis in volume 2, chapter 1, and Matajcek and his colleagues in volume 2, chapter 9). Yet we also find references to "specific reading disability (ie developmental dyslexia)" (italics mine, volume 1, page 4), "reading disability" (volume 1, chapter 3), "unexpected reading failure" (volume 2, page 17), and so on. It is a pity some of the contributors did not heed the important warning given by Rosenberger quoted above (volume 1, page 103). It is my belief that if this point were properly recognized many of the seemingly 'fundamental' controversies in the area of dyslexia would disappear.

Overall, I have for the most part been delighted by the papers in these two volumes, and occasionally irritated. In general the delight has been far greater than the irritation.

T R Miles
Department of Psychology, University College of North Wales, Bangor, Gwynedd LL57 2DG, Wales

Books received

Ayache N Artificial Vision for Mobile Robots: Stereo Vision and Multisensory Perception MIT Press, Cambridge, MA, 1991, 342 pages, £40.50 (US: $60.75)

Cracknell A P, Hayes L W B Introduction to Remote Sensing Taylor and Francis, London, 1991, 293 pages, £39.00 cloth, £16.00 paper

Farah M J Visual Agnosia: Disorders of Object Recognition and What They Tell Us about Normal Vision MIT Press, Cambridge, MA, 1990, 184 pages, £22.50 (US: $33.75)

Friedman W J About Time: Inventing the Fourth Dimension MIT Press, Cambridge, MA, 1990, 147 pages, £17.95 (US: $26.95)

Sakharov D A, Winlow W Simpler Nervous Systems. Studies in Neuroscience No. 13 Manchester University Press, Manchester, 1991, 391 pages, £55.00

Ullman S, Richards W (Eds) Image Understanding 1989 Ablex, Norwood, NJ, 1990, 233 pages, $55.00 cloth, $32.50 paper

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