Eye, brain and vision

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Vision and Visual Dysfunction. General editor: John Cronly-Dillon. *Macmillan: 1991. 17 volumes. Approximately 5,000 pages. £1,250, $2,295.*

VISION and Visual Dysfunction is no lightweight: indeed its seventeen volumes weigh in at nearly 42 pounds. Fifty years ago, everything worth knowing about vision could have been comfortably packed into a single volume: one wonders what has happened since to justify the size of this work. We have, it is true, come close to understanding certain phenomena, such as colour vision and stereopsis, though in both cases there are annoying facts at the fringes for which there is still no agreed theoretical explanation. Motion perception is also less of a mystery than it once was, but here the areas of doubt are wider. There has been an explosion of work on the neurophysiological basis for the performance of such visual tasks and in all three cases its results tally reasonably well with the psychological findings. Many other areas are less well understood: despite David Marr's valiant effort, we are still only groping our way towards an understanding of object recognition. Except in the case of early visual processing (where Marr's ideas followed neurophysiological findings), neurophysiology has rarely led the way towards an explanation of how such tasks are achieved: the basic mechanisms of colour vision were discovered some time before colour opponent cells were identified.

Despite the march of progress, there are some topics on which little or no advance has occurred over the past 50 years. The constancy of shape and size is one example. Moreover, we have no understanding of how certain very simple visual tasks are performed. If an observer is presented with a square and a circle horizontally aligned, regardless of the parts of the retina to which they project, he can detect rapidly and accurately which is to the left (or right). This phenomenon is an example of 'transposition', a term that does not appear in this book's index. Another easy task is seeing that one thing is inside another, whether in two dimensions or three; again we have no idea how this is done.

Such tasks can be readily performed by computer, but unfortunately not by methods that have much plausibility, given what we know about the nervous system. Nevertheless, artificial intelligence has helped our understanding of some problems, for example the estimation of depth from shading or the use of vertical disparities in stereopsis. It can help to define the nature of a task and can suggest possible mechanisms by which it is performed by the visual system.

The awesome array of facts gathered over the past 50 years and presented in this work owes something to the development of new techniques. The neurophysiologists invented the microelectrode and have greatly refined its use. Not to be outdone, psychologists have developed increasingly ingenious techniques for elucidating the properties of the visual system. They include random dot stereograms, random dot kinematograms and the cancellation method of investigating opponent colour processes. Moreover, psychophysical data can now be analysed by much more sophisticated methods, including the use of signal detection theory.

It is, however, to be feared that the tendency to jump on bandwagons has sometimes led to the publication of more and more papers at the expense of discovering less and less. The craze for the specification of stimuli in Fourier terms may be useful as a descriptive device, but has failed to produce any revolutionary theoretical insights. Does it really matter how many spatial frequency channels there are or whether they are continuously distributed?

Another recent fashion, particularly in Europe, is neuropsychology — the investigation of the effects of brain damage on vision. The results are bedevilled by the fact that no two patients have the same lesion: indeed perhaps no two have their cortices organized in the same way outside the primary areas. It is as though one were trying to solve a jigsaw puzzle in which both the shape of the pieces and the patterns on them are constantly changing. The observations made in such studies have a certain bizarre interest, but have thrown little light on the organization of the visual system. We need to know not where but how a visual task is performed. It is difficult to think of any visual disturbance that cannot result from a brain lesion. There is a story that the late Oliver Zangwill, on being presented with an agnosic patient, began the first interview by displaying his fountain pen, while asking the patient to examine it closely. He produced it again at the end of the session, but the patient was still unable to recognize it. This procedure was repeated with the same result for nine sessions. At the end of the next and final session, Zangwill again produced the pen and the patient again merely stared at it blankly. In desperation, Zangwill asked "Do you know who I am?", whereupon the patient replied, "Oh, yes. You're the man with all those fountain pens."

All these topics (except Zangwill's patient) are covered in massive detail in *Vision and Visual Dysfunction*. Most of the volumes are highly technical and assume a specialized knowledge of the area covered, whether it be "Spatial Vision", "Binocular Vision" or "Limits of Vision". Only a few of the volumes contain an introductory chapter setting the scene and outlining the main problems. There is, moreover, an enormous amount of repetition, partly because each volume is complete in itself; even within volumes, however, the same topics are repeatedly covered by different authors. For example, the distinction between the dysphonetic and the eidectic type of dyslexia is defined several times in the volume on "Vision and Visual Dyslexia". The general editor, J. R. Cronly-Dillon, seems to have left the format of the individual volumes very much up to their editors. Some contain glossaries, some do not: they are badly needed as there are a vast number of neologisms ranging from "heautoscopy" to "GOMS models". One of the most annoying tricks is the constant use of initials. Try digesting this sentence: "A subset of the tuned excitatory neurones TN and TS . . . give similar excitatory responses to GFS and RDS." To make matters worse, initials rarely appear either in the indices or glossaries. Unfortunately, none of the sections on reading describes experiments comparing reading speed for initials with that for terms set out in full — an exercise

Readings on cognition

■ *Brain Development and Cognition: A Reader* edited by Mark H. Johnson claims to be "the first comprehensive review of the emerging interface between cognitive neuroscience and the study of cognitive development". It contains both classic articles (some specially updated by their authors) and commissioned chapters. Blackwell, £60 (hbk), £19.99 (pbk).

■ *Frontiers in Cognitive Neuroscience* edited by Stephen M. Kosslyn and Richard A. Andersen contains 55 articles that provide a foundation for examining how brain function gives rise to mental activities such as perception, memory and language. The readings are grouped in parts that cover vision, auditory and somatosensory systems, attention, memory and higher cortical functions. The editors provide an introduction to each section. MIT Press, $70.