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# Reviews

**Memory from A to Z: Keywords, concepts, and beyond** by Y Dudai; Oxford University Press, Oxford, 2002, 331 pages, £37.50 (US $65.00) ISBN 0 19 850267 2

In the preface to his landmark 1974 book *Human Memory: Theory and Data*, Murdock pondered "[w]hat is there about the area of human memory that warrants a complete book devoted to this particular topic?" (page x). Although, as Murdock notes, the field of memory research was growing rapidly at the time his book was written, it was still possible to cover the field, in great detail, in a single 370 page book (see also Crowder 1976). If Murdock's question still holds relevance today, it is in the face of the immense amount of memory research generated and published in the last thirty years.

One danger of development common to any scientific field is that a literature becomes inaccessible by virtue of its size. Although it might be argued that only a subset of any scientific literature is worth looking at (Price 1965), there is still the problem of quickly accessing this information. This is also of critical concern for the increasing number of cross-collaborative projects, particularly given that examination of memory from different perspectives will require different sets of terminology. Hence the impetus for Yadin Dudai's *Memory from A to Z: Keywords, Concepts, and Beyond*. In the preface to this recent book on memory, Dudai states his desire to have a common terminological base through which to communicate with peers and students having a range of scientific backgrounds (including biology and computer science). The result is an impressively detailed, interesting, thoughtful, and ultimately entertaining compendium of concepts from the area of memory research.

Rather than take the form of a standard review volume, Dudai's book constitutes a cross between a dictionary and a reference manual, as suggested by the title. *Memory from A to Z* contains 131 entries, each of which consists of a heading, a short definitional abstract, and a body giving an involved definition of the term, discussing relevant research and theory, and relating the term to other areas. Dudai intended the entries to be read in a single sitting (page iii), and has managed this admirably. Each page takes a two-column format of quite fine print, with each entry taking up two pages and figures interspersed, such that entries are of a length to allow a detailed mini-essay on the topic within the limits of human attention span. The book also includes a bounty of references (66 pages worth) for the budding researcher. While classic papers are covered, the material, as reflected in the reference section, is not only up-to-date, but also cutting edge.

Despite its format, *Memory from A to Z* should not be understood to be cognitive psychology's equivalent of a computer manual. Dudai brings humour and insight to the topics he covers, whilst still managing to communicate the core ideas of the term covered in each entry—an impressive task given the restricting format of a reference book. At times, *Memory from A to Z* bears a striking resemblance to the namesake of the late Douglas Adams's (1988) *Hitchhiker's Guide to the Galaxy*. As well as the humour implicit in Douglas's writing, many of the entries follow the format of the imaginary *Guide*, focusing on the core, defining aspects of the topic, but move on to discussion of recent interesting research or philosophical musings (can animals recall, and do they have prospective memory?; evolutionary aspects of infantile amnesia; how we will arrive at meaningful estimates of memory capacity; and research on sensitisation in the *Aplysia* as a classic example of the reductive programme in psychology). For example, an entry on "bias" begins, unsurprisingly, with a discussion of bias in memory (eg the link between memory bias and depression), but ends with a discussion of bias in the editorial decisions of journals. Although these musings can sometimes be distracting, and possibly take valuable page space away from more immediately relevant information, these discussions are conducted in a warm yet thoughtful manner, and make reading the book more enjoyable and rewarding. Indeed, it is probably the case that most researchers in the field could sit down and read the book from cover to cover, and be both informed and entertained.

Dudai's choice of topics is also novel. Dudai's background (in neurobiology; his PhD was in biophysics) gives the book a definite neuropsychological bent. Many of the entries thus relate to neurological aspects of memory and learning. While some of these entries are unsurprising in a book on memory (eg "amygdala", "hippocampus", "long-term potentiation", "plasticity"), others show a definite leaning to examination of memory at lower levels. For example, entries dealing with "CREB", "immediate early genes", "late response genes", and "protein synthesis" deal with memory at the level of molecular-genetic analysis. This leaning is evident across most entries—Dudai discusses the neurological substrates of, amongst other things, bird song and observational learning, and diagrams of brains and synapses abound. Dudai also introduces some entries that are somewhat eccentric. Entries for "classic", "enigma", "anthropomorphism", "red herring", "scoopophobia", "zeitgeist", and "palimpsest" appear baffling until one realises that Dudai has used these entries as devices to introduce issues in the investigation of memory and the philosophy of science, albeit in an idiosyncratic manner. These issues may not be the meat of psychological research, but they are worth being aware of, and may be useful references for those conducting graduate or postgraduate studies. However, a note of caution: some entries will themselves constitute red herrings for many readers—an entry on "criterion" makes no reference to the role of criteria and thresholds in recognition and recall, and those flipping to the entry for "development" will find no reference to age differences in memory.

A final aspect of the book worth commenting on is its extensive cross-referencing. If a term has an entry in the book, it will usually be marked with an asterisk when it appears in other entries. These are rather like manually enacted hyperlinks, and would no doubt facilitate the book's conversion to an online format for distribution on computers. These cross-references can occasionally be distracting *when *several *occur in a *row, and some of the terms thus referred to do not refer to the same meaning as implied in the referring entry's context (context itself is an example), but the book does generally benefit from them.

Overall, *Memory from A to Z* constitutes a useful and engaging companion to those from any area of cognitive science. Although it is probably too advanced for undergraduate teaching, for postgraduate students coming to grips with the entirety and multi-tiered field of memory research all the book needs are the words 'Don't panic!' printed on its cover in large, friendly letters.

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**Filling-in: From perceptual completion to cortical reorganization** edited by L Pessoa, P De Weerd; Oxford University Press, Oxford, 2003, 340 pages, £49.50 (US $69.95) ISBN 0 19 514013 3

How does the brain deal with discontinuities in the visual field? We are frequently unaware of these discontinuities because the visual system fills in these discontinuities with the surrounding background. The filling-in of patterns within the physiological blind spot and the completion of contours across it has mystified scientists and non-scientists alike, and has been intensely debated in the last hundred years. Similarly, the filling-in of pathological scotomas has interested neurologists for a long time. The last few decades have seen efforts to explain the disappearance of stabilised images and our perception of artificial scotomas. The last decade has seen intense debate among psychologists, physiologists, mathematicians, and philosophers over filling-in and completion at blind spots. This convergence of interests from several disciplines has enriched our understanding of these phenomena. *Filling-in*, edited by Pessoa and de Weerd, with contributions from psychologists, physiologists, mathematicians, and clinicians, highlights the multidisciplinary

efforts to understand this phenomenon. The editors, with computational and physiological backgrounds, have produced a book that looks at filling-in from a variety of viewpoints and captures the excitement and the controversy in this area of research. The list of authors is impressive, covering a range of expertise, with most of the authors being widely known in their fields.

The strength of this book is in Part I, which deals with perceptual filling-in, with a thorough coverage of the associated psychophysics and neurophysiology. I particularly enjoyed Chapters 4 – 6, which describe the filling-in of brightness, texture and colour, respectively. Having the filling-in of the three features described side by side facilitates an appreciation of the similarities and differences between the mechanisms for filling-in of these stimulus attributes. Filling-in of each of the three features involves processes that start at boundaries and fill inwards. The speed at which brightness fills in is comparable to that for texture. The responses of some V1 neurons are correlated with brightness. The time-courses of responses of some neurons in V2 suggest that they are involved in the filling-in of texture. However, neither the responses of neurons in V1 nor in V2 are correlated with the filling-in of colour. In spite of similarities in the filling-in of different features, filling-in of each of the three features involves different processes and occurs at different levels of the visual pathway. The computational chapters in Part I of the book were a bit disappointing. The efforts to make these chapters accessible to readers who are not mathematically inclined have resulted in some loss of clarity. However, these chapters provide a theoretical context that ties together the diverse psychophysical and neurophysiological studies of filling-in.

The last decade has seen significant advances in our understanding of plasticity in the adult cortex. The cortical sensory maps of adult primates were traditionally thought to be non-plastic beyond the developmental period. More recent work, involving deafferentation of cortical neurons, has shown conclusively that the adult cortex retains much of its plasticity. Reorganisation of adult mammalian sensory maps occurs in primary somatosensory cortex following the severing of the appropriate nerves, in primary visual cortex following the induction of retinal lesions, and in primary auditory cortex following the induced cochlear lesions. In addition, the learning of new motor skills could involve rapid reorganisation within the primary motor cortex. Parts II and III of the current book provide informative and up-to-date reviews of plasticity within the visual, auditory, and motor cortex in adult animals. Having the studies of plasticity within the three cortical areas presented side by side permits one to appreciate the similarities in the questions asked, the techniques used to answer the questions, and particularly the results obtained while studying the different sensory modalities. The similarities in experimental results across modalities give one confidence that these findings reveal general principles of brain organisation that are based on neuronal competition and cooperation. Parts II and III also provide a flavour of the range of techniques used to study plasticity in the mammalian cortex, which include psychophysics, single-cell physiology, functional magnetic resonance imaging, and transcranial magnetic stimulation.

Mattingley and Walker (Chapter 11) point out difficulties in determining whether patients with hemianopic field defects actually experience pathological completion. They suggest that pathological completion is less widespread than is generally believed, and the incidence of completion in patients reported in the medical literature may have been exaggerated by shortcomings in methodology. Further, they suggest that pathological completion is a consequence of a lack of awareness of the missing information and is associated with damage to parietal areas of the brain. The methodological difficulties involved in determining whether a patient experiences pathological completion are not unlike the difficulties involved in making precise observations in the vicinity of the blind spot. The difficulties in making precise measurements around physiological and hemianopic blind spots necessitate the careful selection of control conditions for making meaningful comparisons with perception around the blind spot. For example, Ramachandran, in his Foreword (page xviii) points out that filling-in of yellow at the blind spot is perceptually different from amodal completion of a cat under the table with only its tail visible. However, for a cat that is completed amodally under the table, the fairer blind-spot comparison is a cat presented entirely within the blind spot (monocularly) with only its tail sticking out of the blind spot. Both cases permit one to entertain the idea that the unseen animal is a mutant pig with a cat's tail.

Davis and Driver (Chapter 7) present novel experiments to distinguish between amodal and modal completion of objects. These experiments could readily be adapted to blind spots in order to address the similarities and dissimilarities between blind-spot completion and amodal completion (Durgin et al 1995).

Kaas et al (Chapter 10) discuss the changes that occur to the retinotopic maps in primary visual cortex when inputs from parts of the visual field are eliminated by inducing retinal lesions. If the lesions are binocular, or if the non-lesioned eye is enucleated, rapid reorganisation occurs in the primary visual cortex, so that the 'silenced' cortical neurons start to respond to stimuli presented to the immediate surround of the lesioned region. This has the advantage of a cortical over-representation of the region surrounding the lesion, which facilitates filling-in phenomena. But it has the disadvantage that some neurons in the retinotopic map would signal inappropriate visual direction; the larger the lesion, the larger the expected spread of the errors in visual direction. A stimulus presented just outside a scotoma would activate neurons that signal appropriate as well as inappropriate visual direction. How is the information from the deviant neurons reconciled with that from neurons signalling correct visual direction, and do the subsequent levels of the visual system learn to correct for the misinformation from the deviant neurons? Behavioural experiments with animals having focal retinal lesions, with stimuli presented at the lesion edges, could provide insights into questions such as these.

Vision scientists studying reorganisation in the cortex frequently refer to similar research in the somatosensory literature for historical reasons, but tend to overlook similar work in the auditory domain. Pantev et al (Chapter 12) highlights the similarities between recent studies in the three domains. When cochlear lesions are introduced in cats and guinea pigs, the silenced neurons in the primary auditory cortex (where the mapping is tonotopic) start to respond to lesion-edge frequencies, resulting in an over-representation of lesion-edge frequencies. Similar over-representation of lesion-edge frequencies has been demonstrated in humans with deafferentation caused by cochlear damage in a frequency sub-range. Short-term plasticity in the auditory cortex induced by having subjects listen to 'notched music' is similar to the artificial scotomas induced in vision. An explanation proposed for tinnitus based on distortions of the tonotopic map in auditory cortex is similar to the explanation proposed for phantom-limb pain involving distortions to the somatosensory map in the cortex. This chapter beautifully illustrates the converging nature of research in the different sensory modalities.

One way of inducing cortical reorganisation in humans is to train them to learn new motor skills. Doyon and Ungerleider (Chapter 13) suggest that, though the results obtained from the various studies are controversial, the primary motor cortex may be a major node in the acquisition, consolidation, and long-term retention of motor skills. A better understanding of the cortical network involved in learning new motor skills could help in the rehabilitation of patients with motor disorders (Chapter 14).

The book is reasonably priced. It is too specialised for an undergraduate audience. However, anyone with an interest in filling-in should consider reading this book. The individual chapters can be read in isolation, but a proper appreciation of the book requires the comparing of information across the different chapters. It is only then that the similarities and differences between the different types of filling-in and between the different sensory modalities becomes evident. I thoroughly enjoyed reading the book and strongly recommend it. It is a rich source of information covering a broad range of topics relevant to the psychophysics and physiology of filling-in and to neural plasticity.

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**Visual perception: Physiology, psychology and ecology** by V Bruce, P R Green, M A Georgeson; Psychology Press, Hove, Sussex, 2003, fourth edition, 483 pages, £45.95 cloth, £19.95 paper (US $75.00, $31.95) ISBN 1 84169 237 9, 1 84168 238 7

The title of this book, which is now in its fourth edition, reveals its ambitious goal: to give an overview of the whole process of visual perception, beginning with the transduction of light energy in the retina to the perception of social world phenomena like animate motion or facial expressions. The book is divided into three main parts dealing with the physiological basis of visual perception, vision for awareness, and vision for action. A concluding fourth part is dedicated to a comparison of different theories of visual perception. As the authors point out in the preface to the first edition, their choice of topics differs from that of most textbooks on visual perception. They try to present their story within the framework of an ecological approach in its wider sense, which both James Gibson and David Marr were committed to.

The first part deals with the filtering properties of the retina and the visual pathways in the brain. It has been substantially updated and includes new evidence from neuropsychology and neuroimaging. The authors are especially successful in explaining the notion of spatial frequency and filtering, a concept that some undergraduate students have problems understanding and which is the building block for things to come. The treatment of the visual pathways is detailed and up to date and avoids the kind of oversimplification that can arise when block diagrams of visual areas seem to leave no room for further questions. The theory of the dorsal and ventral pathways as the main routes of the visual cortex is critically reviewed and the need to understand their respective interplay is emphasised.

The second part, more than 200 pages long, is the most important. After contrasting Marr's theory with some connectionist models of visual perception, the demanding chapter 5 deals further with the filters and features that lead to the formation of the primal sketch. It also gives a substantial overview of the mathematical concepts used in this area of research. Chapter 6 is committed to perceptual organisation, texture segmentation, and the question why the Gestalt laws work. This is followed by a comprehensive chapter on seeing a 3-D world which also contains an analysis of binocular, monocular, and motion cues to depth, including some rarely examined pictorial cues such as cast shadows. In chapter 8, the authors thoroughly discuss some principles of motion computation, along with the visual mechanism that may carry out these computations. It also contains recent evidence for the role of areas MT and MST in the dorsal pathway in encoding global patterns of motion and the influence of attention on these processes. A chapter on object recognition with the different approaches of Marr's and Nishihara's theory and that of Irving Biederman concludes part II.

Part III is dedicated to the study of the interplay of vision and action. It starts with an introduction to the ecological approach to visual perception, which is followed by chapters on optic flow and locomotion, and the timing of action. The final chapter accounts for the perception of the social world, including biological motion and facial expressions. A highlight of the book is part IV. It discusses in great detail the differences of the cognitive and ecological theories to perception. It is this multiple-viewpoint approach that makes the book especially worth reading.

Obviously, when there are so many topics dealt with in only around 480 pages, there must be some shortcomings. For instance, the treatment of colour perception is restricted to the most basic facts such as the existence of different types of cones or colour constancy. Interestingly, the comparative neglect of colour is also noticeable in the appearance of the book. Apart from the cover, there is no colour in the book. This may be due to the fact that the first edition dates back to 1985. Also, the moderate price of £19.95 for the paperback edition may explain the absence of colour. However, in a contemporary textbook on visual perception one expects to find at least some coloured illustrations. The chapter on binocular stereopsis, in particular, would have benefited from it. Furthermore, as the authors point out, "The study of perception is brought to life, and made more exciting, by observing and playing with unusual or compelling visual phenomena for oneself". It thus would have been welcome, if there had been a CD with the book containing demonstrations that cannot be shown on paper. There is an appendix with a list of references to some sites on the worldwide web. But we all know how short-lived those links can be. Nevertheless, owing to its interdisciplinary approach, the book is a good

choice for a wide variety of students. It gives a good introduction to the field and also contains a great deal of information for the advanced reader.

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**Book received**

**Johnson-Frey S H** (Ed.) *Taking Action: Cognitive Neuroscience Perspectives on Intentional Acts* MIT Press, Cambridge, MA, 2003, 413 pages, $58.00 (£37.95) ISBN 0 262 10097 5

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