BOOK REVIEWS

Boxes and Arrows *Versus* Brains

Working Memory and Human Cognition, by John T.E. Richardson, Randall W. Engle, Lynn Hasher, Robert H. Logie, Ellen R. Stoltzfus, and Rose T. Zacks. 1996. New York: Oxford University Press. 148 pp., $19.95 (PB).

Reviewed by CHRISTOPHER RANDOLPH, Ph.D., *Associate Professor; Director, Neuropsychology Service; Head, Cognitive Neuroscience Section, Department of Neurology, Loyola University Medical Center, Maywood, IL.*

I will confess to a lingering knee-jerk reaction when human cognitive processes are diagramed with boxes and arrows in a way never intended to correspond to identifiable neural pathways. In college and graduate school, such exercises seemed to me a waste of time, when I could be learning how the brain "really" works in mediating memory functions, language, and so forth.

Over the years I've become less concrete in my thinking, and paradigms developed by cognitive psychologists have played a major role in some of my research and that of my neuropsychologist colleagues. This type of cross-fertilization from other disciplines is useful in forcing us to reexamine our hypotheses regarding brain–behavior relations, and in broadening our perspective regarding cognitive processes.

The domain of working memory is perhaps the cognitive domain in which the influence from cognitive psychology has been most salient in the neuropsychology literature (see the recent dialogue regarding the central executive in *JINS Vol. 4, No. 5*). This volume in the *Counterpoint* series may therefore be of particular interest to neuropsychologists.

The purpose of the book is to compare and contrast the different conceptions of working memory that have evolved over the last 20 years in the field of cognitive psychology. It is a clearly written, concise compilation of five chapters by some of the leading investigators in the area. While this book is unlikely to significantly affect the way in which most neuropsychologists think about working memory from a clinical perspective, it will prove to be a useful resource to those of us involved in research on the topic.

It should be noted, however, that there is almost no reference to clinical data in this volume. Not only is working memory not discussed with reference to clinical populations, there is virtually no review of clinical approaches to assessing working memory functions, or of experimental neuropsychological or neurophysiological investigations in the area. Unfortunately, we are still not to the point where findings from the neuroscience and cognitive arenas are routinely synthesized. To be fair, this volume makes no claims to a comprehensive review of the topic, but one chapter dedicated to providing an overview of other scientific approaches to the study of working memory would have been nice.

A Current Perspective on Cerebellar Research

Motor Learning and Synaptic Plasticity in the Cerebellum, P.J. Cordo, C.C. Bell, and S. Harnad (Eds.). 1997. New York: Cambridge University Press. 197 pp., $34.95.

Reviewed by HARUO KASHIMA, M.D., Ph.D., *Department of Neuropsychiatry, School of Medicine, Keio University, 35 Shinanomachi, Shinjuku-ku, Tokyo 160-8582, Japan.*

This is a reprint of one issue in the Cambridge University Press journal *Behavioral and Brain Sciences*, originally based on the symposium *Controversies in neuroscience IV: Motor learning and synaptic plasticity in the cerebellum*, held in Portland Oregon on August 24 to 26, 1993. These symposia were organized by the Robert S. Dow Neurological Sci-

ences Institute and supported by NIH, NSF, and the Good Samaritan Foundation. The subjects of the symposium were the role of the cerebellum in motor learning and the connection between motor learning and synaptic plasticity.

In the preface to the book, the editors take a brief backward glance at the history of research on the cerebellum.

The phenomenon of long-term depression (LTD), first described by Ito and coworkers, and the temporal association between parallel fiber and climbing fiber inputs to a Purkinje neuron, possibly play an important role in motor learning and are already well established. However, the connection between the LTD and other types of synaptic plasticity in the cerebellum and motor learning remains unresolved and controversial.

The book contains eight papers, open peer commentaries by scientists in related subspecialties, and also replies to these commentaries by the authors of the target papers. Four of the papers address the phenomenology and mechanisms of synaptic plasticity at excitatory and inhibitory synapses in the cerebellar cortex, and another four articles address the evidence for cerebellar involvement in motor learning in animals and man through experimental and theoretical approaches. Of the papers on plasticity, the first, by David J. Linden ("Cerebellar Long-Term Depression as Investigated in a Cell Culture Preparation"), is concerned with the phenomenology of LTD using cultured embryonic Purkinje neurons, and the second paper by F. Crépel et al. ("Cellular Mechanisms of Long-Term Depression in the Cerebellum") discusses the contributions of various cellular processes to the generation of LTD in the *in vitro* slice preparation. These two papers report opposite results on the role of nitric oxide. The third paper by Masanobu Kano ("Long-Lasting Potentiation of GABA-ergic Inhibitory Synaptic Transmission in Cerebellar Purkinje Cells: Its Properties and Possible Mechanisms") shows that plasticity at inhibitory synapses appears to be present in the cerebellum and must have an important role in motor learning. The fourth paper by Steven R. Vincent ("Nitric Oxide and Synaptic Plasticity: NO News From the Cerebellum") discusses the biochemical pathways responsible for the synthesis and action of nitric acid.

The last four papers are concerned with the systems or behavioral levels of analysis. The fifth paper, by James C. Houk et al. ("Models of the Cerebellum and Motor Learning") reviews models of the cerebellum and motor learning, from the landmark papers by D. Marr (1969) and J.S. Albus (1971) through those of the present time. The sixth paper, by J.I. Simpson et al. ("On Climbing Fiber Signals and Their Consequence(s)"), reviews what is known about the messages conveyed by climbing fibers and about the effects of climbing fibers on Purkinje cell activity. In "Does the Cerebellum Learn Strategies for the Optimal Time-Varying Control of Joint Stiffness?", Alan M. Smith shows that the cerebellum plays an important role in motor learning by forming and storing associated muscle activation patterns for the time-varying control of limb mechanics. The last paper, by W.T. Thach ("On the Specific Role of the Cerebellum in Motor Learning and Cognition: Clues From PET Activation and Lesion Studies in Man"), using the data from human studies, extends the role of the cerebellum into cognition function.

The book provides an excellent review of contemporary research on the cerebellum in motor learning. It succeeds in making a significant contribution toward clarifying unresolved and controversial issues through informed commentaries and the replies to them from the original authors. Finally, this is an informative book that communicates the current state of cerebellum research. Readers can surely feel that they are on the site of the symposium in which almost all of the leading researchers in this field participated. Reconsidering the cerebellum may also suggest a model for those who study the neural mechanisms of other brain structures and systems.

The Broad Scope of Clinical Neuropsychology in Old Age

Handbook of Neuropsychology and Aging, P.D. Nussbaum (Ed.). 1997. New York: Plenum Press. 559 pp., $85.

Reviewed by FRIEDEL M. REISCHIES M.D., Ph.D., *Department of Psychiatry, Research Group Neuropsychology and Brain Imaging, Freie Universität Berlin, Germany.*

Neuropsychological aspects of neuropsychiatric diseases that are common in old age or that present problems for diagnosis and treatment especially in the old patient represent the objective of this book. There are several good reasons for addressing this topic. Disorders of brain function become more frequent in old age and neuropsychology thus gains importance in geriatric medical evaluation and in distinguishing the many dimensions of neuropsychological deviations from "normal senescence." Research in this area has recently intensified and valuable insights have accumulated; however, few books on this topic are currently available. The *Handbook of Neuropsychology and Aging* focuses on neuropsychological aspects; specifically, on geriatric psychiatry and neurology. Here, the editor has attempted to bring together outstanding researchers to cover the entire field of geriatric neuropsychiatry.

The book has five main sections. The first is a general part about normal aging. It is helpful that a discussion of psychosocial aspects of aging is added to chapters on cognitive aspects and the pathophysiology of aging. The second part, "Psychiatric Disorders of Late Life," deals with psychiatric disorders such as depression and syndromes with productive psychotic symptoms. The authors seek to combine a general introduction to the diseases with presentations of their particular features in old age, emphasizing their neuropsychological dimensions. This approach is mostly

quite successful; for example, the section on substance abuse, which is exemplary. The third section, on the neuropsychology of neuropsychiatric diseases and clinical syndromes, follows with discussions of Alzheimer's dementia, strokes, and aphasia, as well as depression. This part, labeled "Neuropsychological Disorders of Late Life," seems to contrast with the chapter on psychiatric disorders. However, this distinction does not hold true in the case of depression in late life. Furthermore, one can question whether there are in fact neuropsychological disorders in the strict sense or if, instead, neuropsychology deals with an important part of the signs and symptoms of diseases such as Parkinson's disease. The fourth section deals with assessment. It includes a review of neuropsychological assessment of different diseases and syndromes as well as memory assessment. In addition, the relationship between neuropsychological test data and everyday functioning is described in detail, which has hitherto been a much neglected feature of geriatric neuropsychology. In the final section, therapeutic approaches are described, ranging from memory rehabilitation to ECT and psychopharmacology for the aged. The goals of the handbook are to broaden the perspective for neuropsychological applications in old age and to aid in establishing training programs in geriatric neuropsychology. The *Handbook* therefore covers generally the field of common interests between neuropsychology and geriatric science.

It is inevitable that the quality of contributions to such a comprehensive work will vary. Individual chapters are almost all well written; some contributions are at an introductory level, whereas others contain specialized discussions of data and neuropsychological models, as in the Parkinson chapter, and discussions of the relative value of certain new antidepressive medications. The chapters represent selective reviews of the field. Furthermore, there is some overlap between chapters, as for example in discussions of depression, Parkinson's disease, and vascular pathology. Yet relevant topics such as organic personality disorder or affective lability are not described, and more importantly, the neuropsychology of delirium and confusional states is omitted, despite its considerable importance for geriatric neuropsychiatry. Some major topics are described in only a few pages: The neuropsychology of aging covers seven pages, the neuropsychology of the many dementias only 59, and neuropsychological assessment is accorded 48 pages of the 559 comprising the book. Perhaps in the next edition of this work the relative weights of the topics can be adjusted somewhat, with even more differentiation from a textbook of geriatric neuropsychiatry. Additionally, some chapters could invest even more attention and space on such specific aspects of old age as aphasia and stroke. The full citation of all authors in the text sometimes hampers fluid reading.

The intention and merit of this book is to look at the role of neuropsychology for geriatric neuropsychiatry. This will certainly give impetus for future research and development in this field. Neuropsychology must find its place between special diagnostic test batteries, clinical complexities, and neuroscience interests. At the present time, neuropsychological or neurolinguistic investigation is essential for the diagnosis of the aphasias, beginning dementia syndromes, and for many posttraumatic cases. In the future, the clinical contributions of neuropsychological investigation will probably be extended into more fields of geriatric psychiatry as more research data become available, much as the role of neuropsychology has expanded into the study of schizophrenia in adult psychiatry. There is, of course, a question of whether a one-volume handbook should attempt to cover all the domains of geriatric neuropsychology, or whether these would be better presented in individual, more specialized texts.

The *Handbook of Neuropsychology of Aging* can, in any case, be fully recommended to both students and clinicians with interest in geriatric psychiatry and the neurology of old age. This book gives an opportunity to learn the essential research data and clinical facts from experts in a field of growing importance for neuropsychology. The neuropsychology of aging is a clinical discipline in which not only information about diagnosis can be provided, but also about how deficits interact with everyday functioning. Knowledge of the whole of a patient, the subjective experience and mood, somatic aging, and aspects of multimorbidity as well as the dynamics of brain diseases have import for the evaluation of the individual patient.

Photons to Philosophy

Fundamentals of Functional Brain Imaging, by Andrew C. Papanicolaou. 1998.
Lisse, The Netherlands: Swets & Zeitlinger. 143 pp., $72.00 (HB).

Reviewed by TERRY L. JERNIGAN, Ph.D., *Department of Veterans Affairs Medical Center, Departments of Psychiatry and Radiology, Brain Image Analysis Laboratory, 9500 Gilman Drive, University of California, San Diego, La Jolla, CA 92093-0949.*

In less than 150 pages, the author has written a lucid and broad-ranging primer on functional imaging with much to offer the neuropsychologist. The book consists of three sections: "Basic Concepts," "Three Methods of Imaging Brain Activation," and "Establishing the Correspondence of Activation Patterns to Behavioral Functions," with brief Preface and Postscript ("Imaging Consciousness"). The level of description is more conceptual than technical, relying more

heavily on beautifully illustrated visual models of the techniques than on more mathematical accounts, and thus the material is likely to be easily accessible to clinical and basic neuroscientists alike. The text should serve well as required reading for upper division and graduate courses introducing the topic, and will be a painless and thought-provoking introduction for scientists in other areas of specialization as well.

The first two chapters, comprising section I, describe the basic signal recording and reconstruction problems that attend all functional imaging methods. Some terminology is then introduced to describe the relationship between observed patterns of activation and brain functions or mechanisms. The author distinguishes between "tokens" or "phenomenon-tokens" (which are sometimes observable) and the functions and mechanisms that are the constructs of interest in functional imaging experiments. The former terms are used throughout the book to describe the means by which investigators select particular signals from the ongoing stream, and then attempt to link them to brain mechanisms or functions. Although this device is mildly strained at times, it serves well to protect the reader from the common vice of equating paradigm and brain function.

Part II consists of three chapters describing magnetoencephalography (MEG), functional magnetic resonance imaging (fMRI), and positron emission tomography (PET), respectively. Not surprisingly, given the author's impressive contributions with this technique, the exposition of MEG is both eloquent, and at times, editorial in tone. This copiously illustrated chapter is likely to leave even the novice with a very good basic understanding of a highly complex technique. A minor weakness lies in the explanation of the disproportionate contribution to the signal made by dendritic currents, which, in spite of a beautiful illustration of different neuronal currents, doesn't quite reveal the basis for this claim.

The author succeeds in conveying the clear advantage of MEG over the other methods discussed with respect to temporal resolution, and makes it clear that the MEG signal emerging from a single dipole oriented parallel to the head's surface is less distorted than the comparable EEG signal. However, the section describing the limitations of MEG, particularly its insensitivity to dipolar sources oriented perpendicular to the head's surface, is not fleshed out in practical terms. An example or two, describing the MEG results for hypothetical circuits with cortical and deep gray matter stations, might have been helpful to readers by expressing in common sense terms the strengths and weaknesses of the method. Without clear guidance, one is left wondering whether when studying functional circuits which include structures with cortical columns oriented the wrong way, one would or would not prefer EEG over MEG data.

The chapter on fMRI is another gem; the explanation of the physical basis of the technique is one of the best tutorials on this topic anywhere. Though the chapter explicitly focuses on the use of MRI to measure contrast resulting from blood oxygenation level, the reader's understanding of all MRI techniques is likely to be deepened by the explanations given for such terms as spins, magnetization vectors, relaxation, and recovery.

The chapter on PET, while perfectly serviceable, is perhaps not quite as successful as the preceding chapters on MEG and fMRI. The exposition of the nature of the signal in PET, as well as that of the method of recording the electromagnetic signal, are strengths of the chapter. However, treatment of the basis for spatial mapping of the detected events, while accurate, did not reach the heights of lucidity encountered in the earlier chapters. The description of back-projection, for example, is likely to leave some readers puzzled about why it works.

The chapters of section III treat a whole host of issues relating to data reduction, pattern extraction, and interpretation of functional imaging data, primarily within the context of studies of sensorimotor functions in chapter 6, of "higher functions" in chapter 7, and in a variety of other contexts in chapter 8. Here the author returns frequently to his distinction between "phenomenon-tokens" and functions. Usually the desired result is achieved; the reader is alerted to the questionable validity of inferences regarding the brain mechanisms underlying cognitive and affective functions. The important roles of integration and subtraction as methods for extracting patterns are explained in chapter 6, the logic (and illogic) of experiments attempting to isolate specific processes is dealt with in chapter 7, and throughout section III the author highlights some of the relative strengths and weaknesses of the different methods. Some may wish to take issue with the sharp distinctions drawn by the author between sensorimotor, cognitive, and affective functions with respect to the consistency of their manifestations in functional images and their general accessibility to functional imaging techniques, but most will acknowledge some degree of distinction. An important point made in this set of chapters relates to multimodality imaging. Combining different functional imaging techniques to provide some information with high temporal resolution, for example, alongside other information with high spatial resolution, is likely to produce results that significantly constrain the range of viable neuropsychological models of the brain mechanisms under scrutiny.

The postscript about imaging consciousness reveals the author at play, and invites the reader to join the game. In general, this short disquisition is a fitting reward for those who have tamed the technical material and wrestled with the inferential challenges posed in the earlier chapters. A note to the reader though: by "consciousness" the author seems to be referring to something akin to "mind"; there is little here about the related issue of "conscious" as opposed to "unconscious" or "nonconscious" mental computations, which is perhaps better described as "awareness."

Perhaps inevitably when brevity is one's goal, some things must be left out. It should be said that there are some significant omissions in this book to which the reader should be alert. First, the relatively new practice of collecting "event-related" fMRI signals, and thus applying "averaging" rather than "integration" in the data analysis path, is completely

ignored in the book. One wonders where this new method would fit into the discussions enumerating strengths and weaknesses of the different techniques were it to be included. Several other ways of extracting functional signals with MRI, such as MR spectroscopy, are also omitted from the fMRI chapter, but this is understandable given the stated aim of the book to focus on methods attempting to link brain mechanisms to psychological functions.

Experts in the field are likely to be most troubled by the author's neglect of the particularly agonizing data-analytic issues that attend the process of statistical inference in brain imaging research. In order to make the case that one has observed "activation" of the brain under particular experimental circumstances, one has to define such, often with no comfortable level of compromise between the risk of Type I and Type II errors. This process, which has received a great deal of attention in the brain imaging literature, is referred to in this book only briefly, as a kind of "thresholding." Many would consider this short shrift for an issue with such important implications for the interpretation of functional imaging results. Also neglected, though in the author's defense, neglected virtually everywhere else as well, is the higher order problem of establishing localization *per se*. By this I refer to the fact that, even when one has settled on a reasonable criterion for concluding that "activation" has been produced, and even when that criterion has been exceeded in one or more voxels of the imaged space, this fact in no way establishes that the activation has a specific neuroanatomical substrate. In other words, common statistical tests for the presence of activation do not support the inference that there is a specific relationship between the activation and the particular anatomical structures in which it appears.

The tests are not statistical tests of *localization*, which is interesting, given that the expressed aim of most functional imaging studies is localization of functions, and indeed most authors infer localization in their Discussion sections despite the fact that it is not significance tested. But perhaps this criticism digresses . . .

This review would itself be negligent without extra words of praise for many marvelous illustrations provided by the author and particularly, by the talented Dr. George Zouridakis. I have no doubt that many of these illustrations have already been collected by those of us who teach about these techniques, and that they will soon be dog-eared with use as course material. Although there are a few minor errors of reference to the figures, and an occasional distortion consistent with artistic license, these shortcomings are greatly outweighed by the remarkable success with which they convey the basic nature of the phenomena. The figures make it possible for the authors to accomplish his pedagogical goals without recourse to many more formulae. My only criticism is that on occasion the author does not seem to take full advantage of the detail of the figures, in that particularly informative features are not labeled or referenced in either the legend or the text. An example of this is the overly brief explanation of the rightmost "proton" graphic in the wonderfully informative Figure 35 illustrating changes in magnetization associated with the application of the RF pulse in MRI.

In summary, the book is recommended to all who wish to learn more about, or who are obliged to teach others about, functional imaging. Its many virtues far exceed its shortcomings, it succeeds in provoking thought about many important unresolved issues, and it is written from a perspective that is particularly accessible to neuropsychologists.

Other Books of Interest

Aylward, G.P. (1997). *Infant and early childhood neuropsychology.* New York: Plenum. 125 pp., $21.50 (PB).

Brandimonte, M., Einstein, G.O., & McDaniel, M.A. (Eds.). (1996). *Prospective memory.* Mahwah, NJ: Lawrence Erlbaum Associates. 418 pp., $79.95.

Goldstein, S. (1997). *Managing attention and learning disorders in late adolescence and adulthood.* New York: Wiley. 512 pp., $75.

Parks, R.W., Levine, D.S., & Long, D.L. (Eds.). (1999). *Fundamentals of neural network modeling: Neuropsychology and cognitive neuroscience.* Cambridge, MA: The MIT Press. 458 pp., $60.

Slater, A. (Ed.). (1998). *Perceptual development: Visual, auditory, and speech perception in infancy.* Philadelphia: Psychology Press. 464 pp., $54.95.

Stein, D.J. & Ludik, J. (Eds.). (1998). *Neural networks and psychopathology: Connectionist models in practice and research.* New York: Cambridge University Press. 371 pp., $85.

Teeter, P.A. & Semrud-Clikeman, M. (1997). *Child neuropsychology: Assessment and interventions for neurodevelopmental disorders.* Boston: Allyn & Bacon. 330 pp., $53.95.