BOOK REVIEWS

Progress in cognitive neuropsychology

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Visual object processing:

A cognitive neuropsychological approach.

Edited by Glyn W. Humphreys & M. Jane Riddoch. 1987, Hillsdale, NJ: Lawrence Erlbaum Associates. 317 pp.

Neuropsychological approaches to cognition and behavior rely heavily on data concerning brain-damaged patients. Because such damage is frequently *selective*—that is, some cognitive and motor abilities are seriously impaired while others are relatively spared—many researchers have argued that useful inferences about the organization of brain and mind can be made on the basis of studies of patients with specific types of neurological damage. Early clinical studies of brain-damaged patients were initiated in the latter half of the 19th century by such eminent neurologists as Wernicke and Lissauer. By and large, psychologists did not become seriously involved in neuropsychological research until the development of psychometric tests that allowed for a relatively precise statistical analysis of patients' performance in relation to that of normal, non-brain-damaged subjects.

Traditionally, two types of psychologists have contributed to neuropsychology: clinical neuropsychologists, who analyze patients' performance in terms of their psychometric test profiles, and experimental neuropsychologists, who, as suggested by the name, rely on data generated by experimental paradigms rather than on psychometric test scores to assess patients' performance. In both cases, however, the major (if not the only) goal of neuropsychological study has been to illuminate the nature of brain-behavior relations by carefully correlating patterns of test performance with information concerning the locus of critical lesion sites.

During the past decade, a third type of approach to neuropsychology—cognitive neuropsychology—has emerged and begun to flourish. Cognitive neuropsychology differs from the preceding approaches in at least two crucial respects. First, analysis focuses on the implications of dissociations between spared and impaired

processes for understanding the *functional* architecture of cognition; there is less concern with specifying the loci of lesions or pursuing issues concerning neural organization. Second, whereas clinical neuropsychology and experimental neuropsychology have been largely (though not exclusively) atheoretical enterprises, cognitive neuropsychology emphasizes the development of well-articulated models of mental structure and the testing of such models by empirical studies of appropriate patients. Cognitive neuropsychology has developed rapidly during recent years, particularly in the areas of language, reading, and memory.

In *Visual Object Processing*, Glyn Humphreys and Jane Riddoch have assembled an impressive collection of chapters that serve to define and explore a cognitive neuropsychological approach to the fundamental problem of how normal and brain-damaged human beings process, represent, and recognize visual objects. The volume consists of chapters that draw on a variety of perspectives—including artificial intelligence, cognitive psychology, clinical neurology, and experimental neuropsychology—each of which contributes something unique to the overall cognitive neuropsychological approach.

The book begins with a useful introduction, in which the editors discuss the conceptual foundations of the cognitive neuropsychological approach, and flesh out issues concerning the nature and meaning of modularity, the relations among levels of description, and the logic of making inferences about normal cognition from data on brain-damaged patients, which are fundamental to neuropsychological analyses. It is followed by a lucid chapter by Stevens, who outlines a computational approach to visual object processing. The chapter highlights problems involved in developing an adequate account of such fundamental computational problems as stereopsis, the three-dimensional interpretation of motion and contours, and the forming of descriptions of surfaces and objects. Stevens also underscores the importance of the pioneering contributions of David Marr to current computational theories of vision; Marr's influence is evident in several of the subsequent chapters as well. The fact that the computational approach is given pride of place in this volume highlights the breadth of the interdisciplinary synthesis that the editors wish to promote.

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The following chapter, by Humphreys and Quinlan, can only be described as a masterly discussion of the problem of visual object constancy—that is, of how the visual system determines the identity of an object despite changes in viewpoint, orientation, and distance of the object across different perceptual encounters. The chapter begins with a discussion and comparison of various accounts of the problem, ranging from landmark or feature-based views that hold that object constancy is achieved by identification of critical distinguishing features of objects that can be detected from different viewpoints, to the Marr-inspired notion that objects are represented in terms of axis-based structural descriptions in which parts of an object are defined in relation to its principal axis. These and other theoretical views are evaluated in terms of a broad range of pertinent data from cognitive studies of normal subjects. Humphreys and Quinlan then turn their attention to relevant animal studies, and also discuss in detail recent research on patients with perceptual disorders that helps to clarify the role of feature-based and axis-based contributions to object constancy. One could hardly ask for a more scholarly or analytical treatment of both the cognitive and neuropsychological aspects of object constancy than the one provided by this chapter.

The subsequent chapter by Riddoch and Humphreys on picture naming is equally superb. The authors begin by distinguishing among three types of information that are involved in picture naming: the *structural* representation of an object's form, the *semantic* representation concerning its functions, and the *phonological* representation of its name. The first part of the chapter reviews data from priming experiments with normal subjects, which lend empirical support to the distinction between a stored structural description of an object and a semantic/functional knowledge of that object. The importance of the semantic/structural distinction has been to a large extent overlooked in information-processing models of object recognition. The authors then turn to their own and others' neuropsychological studies of patients with object-recognition deficits, and marshal impressive converging evidence for the reality of the structural/semantic distinction. These studies focus on patients with the relatively rare syndrome of *visual agnosia*: patients who have relatively intact "elementary" perceptual functions (e.g., brightness discrimination) yet nevertheless cannot recognize visually presented objects. The authors discuss data indicating that some such patients have intact access to structural knowledge of objects together with serious impairments of semantic/associative knowledge, whereas others have structural deficits as well. The cognitive and neuropsychological observations are integrated nicely by the authors in their cascade model of picture naming, which is strongly influenced by recent ideas about parallel distributed processing. This chapter represents a cognitive neuropsychological approach at its best: the authors do full analytic justice to the cognitive literature on cognitive grounds and to the neuropsychological literature on neuropsychological grounds. They go well beyond the

rather less satisfying approach of simply "borrowing" paradigms from cognitive psychology and applying them to a particular patient population.

The nature of visual agnosia occupies center stage in chapters by Kertesz, Marin, and Campion. The chapters by Kertesz and Marin provide useful clinical neurological overviews of the major phenomena observed in agnosias attributable to focal lesions and global dementias, respectively. The classical distinction between *apperceptive* agnosia, which involves difficulties in attaining a "coherent percept," and *associative* agnosia, which involves difficulties in attaching meaning to an allegedly "intact" percept, is discussed at some length by both authors. Campion's chapter questions the validity of the classical view that the elementary or low-level perceptual functioning of *apperceptive* agnosics is entirely intact. The author presents evidence from his own carefully controlled experiments, which indicates that with sensitive perceptual tests, low-level perceptual deficits can be documented in *apperceptive* agnosics. It remains to be determined, however, whether the presence of such deficits is sufficient to account for the syndrome. These chapters on agnosia are complemented by a chapter by Funnell that is very much in the cognitive spirit of the Riddoch and Humphreys chapter; it focuses in particular on the representation of conceptual knowledge about objects, and it also provides a useful link to cognate literature on acquired reading disorders. Sergent provides an informative overview of issues concerning hemispheric contributions to visual object processing that draws heavily on deficits observed in patients with unilateral brain lesions.

The volume concludes with a chapter by Humphreys and Riddoch, in which they attempt to replace the traditional categories of *apperceptive* and *associative* agnosia with a more refined seven-part taxonomy, itself suggested by a number of the empirical facts and theoretical perspectives presented elsewhere in the book. Although this taxonomy is broadly consistent with the available evidence, and does represent a welcome departure from the 100-year-old *apperceptive/associative* distinction, it must be noted that the empirical support for it is based on observations gathered from a very small number of agnostic patients. One cannot help but feel slightly uncomfortable when the validity of fundamental distinctions and theoretical ideas rests on just a few patients. On the other hand, many of the distinctions suggested by Humphreys and Riddoch are supported by cognitive studies of normal subjects, thereby providing converging evidence for them. The ability to marshal such converging evidence represents a major strength of the cognitive neuropsychological approach advocated by the editors, which is one reason why this volume clearly constitutes an invaluable contribution to the study of visual object processing.