

Inquiries Into the Origins of the Mind: Blooming and Still Buzzing

Jacques Mehler and Robin Fox (Eds.)
Neonate Cognition: Beyond the
Blooming, Buzzing Confusion
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Review by
Philip J. Kellman

Jacques Mehler is director of research at the Centre National de la Recherches Scientifique and directeur d'Etudes, Ecole des Hautes Etudes en Sciences Sociales (Paris, France). He is coeditor, with M. Garrett and E. Walker, of Perspectives on Mental Representation. ■ Robin Fox is university professor of social theory at Rutgers University (New Brunswick, New Jersey). ■ Philip J. Kellman, associate professor of psychology at Swarthmore College (Pennsylvania), is recipient of the American Psychological Association's Division 7 Boyd R. McCandless Young Scientist Award. He contributed the chapter "Theories of Perception and Research in Perceptual Development" to A. Yonas (Ed.) The Development of Perception. 20th Minnesota Symposium on Child Psychology.

This volume emerged from the 1982 Conference on Neonate Cognition sponsored by the Harry Frank Guggenheim Foundation. The conference brought researchers in sensory, perceptual, cognitive, and language development together with researchers in developmental neurophysiology.

The result is a book that can be approached in two very different ways. On one hand, it contains reasonably current summaries of knowledge about the sen-

sory, perceptual, and cognitive capacities of infants, and about developmental neurophysiology. The chapters, written by an impressive group of scholars, are thoughtful and generalist in style. The book accordingly makes a fine reference. It is an especially strong resource in speech perception and, more generally, the cognitive and biological foundations of language development, owing to the number and authority of contributions on these topics (Mehler, Eimas, Jusczyk,

Kuhl, Rosen and Galaburda, Neville, Osherson and Weinstein, Carey). Thoughtful treatments of both sensory and perceptual aspects of vision can be found here, including space perception (Yonas and Granrud), binocular depth perception (Held, Aslin), perceptual and conceptual contributions to object knowledge (Spelke), color vision (Bornstein), and neonatal imitation (Meltzoff and Moore). A notable gap is the absence of any specific treatment of motion and event perception, although these topics surface indirectly in several contexts.

Virtually every chapter constitutes, in a particular cognitive domain, a refutation of James's characterization of the neonate's world. Instead of a blooming, buzzing confusion, the infant's perception of space, objects, and color; preparation for language; and ability to represent action appear to develop from innate foundations of considerable coherence and sophistication. In general, these foundations are limited in comparison with adult abilities; infant research, as described here, is also beginning to indicate the ways in which experience builds upon initial capacities.

The neurophysiological mechanisms that support early competence, particularly in the case of the basic sensory aspects of vision, likewise reveal considerable innate organization, but depend on experience for their maintenance, elaboration, and differentiation. The effects of various regimens of early visual experience on the orientational selectivity, binocularity, and disparity sensitivity of cat and monkey cortical neurons are thoroughly reviewed by several of the contributors (Imbert, Aslin, Held), along with the probable import of findings in these areas for human visual development. Moreover, insights are emerging on the question of how experience maintains and selects certain neural connections while allowing others to deteriorate, a topic lucidly and provocatively addressed by Changeux.

Cognition, biology, and levels of description

In contrast to its reference value, this book can also be read as an attempt to *connect* the experimental psychology of sensation, perception, and cognition with neurobiological studies. The underlying premise of the book, and the conference from which it emerged, is that workers in developmental neurophysiology and cognition have something to say to each other and that saying it will advance both endeavors.

In this respect, the book is less than unified. Individual contributors postulate or assume, without much elaboration, diverse views about the relation of the two types of inquiry. A number of authors insist that understanding cognitive functioning *requires* a neurophysiological approach. Changeux postulates, for example, that "every operation performed by the nervous system . . . is completely described by: . . . the anatomical organization . . . the activity [electrical and chemical] and behavior" (p. 264). In a similar vein, we encounter the sentiment that one might study language without regard to the brain only up to the point when one develops aphasia, at which time one dashes off to the nearest neurologist. Despite such characterizations, convincing evidence of constraints on psychological theory emerging from neurophysiological data appears only in some of the sensory areas, such as the emergence of sensitivity to binocular disparity. Generally, studies of most cognitive and perceptual processes, including knowledge of objects, space, and speech, currently seem neither constrained by nor constraining of neurophysiological research.

The deeper issues involved in connecting these research domains are seriously considered only near the end of the book, especially in a chapter by Pylyshyn (who served as a general commentator for the meeting). Pylyshyn suggests that the study of cognition and of brain mechanisms might be complementary but largely independent endeavors. He argues for "a principled notion of level of description of a biological system," such that the cognitive level might involve "autonomous principles" and constitute a "separate empirically adequate science" (p. 404). For example, although one might expect that certain aspects of color perception might have a neural and chemical explanation, an adequate explanation of how one determines the referent of a pronoun in an utterance is not likely to refer to neurons or brain chemicals. The central insight, which Pylyshyn calls a "fundamental discovery of the last half century" (p. 406), is that some aspects of a system can only be explained by describing the information available to a system and represented by states of the system. Although every instance of information transmission is also a case of energy transfer, the description of the content and relations of information are not translatable into physical terms (because, for example, equivalent information can be represented in physical systems in an unlimited variety of ways).

These arguments are by now well known and widely accepted. If they are invalid, then the emerging discipline of cognitive science, most of cognitive psychology, and many aspects of computer science are incoherent. It is possible that more reductionistic opinions expressed by some contributors to this volume derive from principled disagreement with these arguments, or with the applicability of these general arguments in specific domains. It is hard to tell. Although Pylyshyn's commentary is clearly addressed to those issues, there is no inclusion of rejoinders by the various authors. Some record in the book of interchanges among the conference participants would have been valuable. In its absence, the general reader might do well to read first the chapter by Pylyshyn, and also the chapter by Chisholm on the evolutionary context of neurophysiology and cognition. Doing so may help to clarify in the various chapters what issues are being addressed and are addressable in principle with what methods.

Given the need for separable levels of description, interaction between psychologists and neurophysiologists still seems to be crucial to determine what aspects of human functioning require "knowledge-based" or "mechanism-based" explanations. As Goldman-Rakic points out, where anatomical and physiological approaches have proven informative, for example, in the case of spinal reflexes, there is little argument for hardware-independent competence descriptions. One suspects that the dialogue will continue in many domains treated in this book. For example, degeneration of binocular function of cortical neurons due to visual deprivation seems amenable to a biochemical explanation rather than a knowledge-based explanation, but delayed imitation of a range of facial gestures by newborn infants (Meltzoff and Moore) seems to demand explanation in terms of innate knowledge and motivation. In the latter case, detailing the neural networks subserving imitation may complement but would not replace the cognitive account. If, however, early imitation should turn out to be some sort of reflex, that is, not knowledge-based, then neural networks *would* provide sufficient explanation. Available data suggest that, in normal development, facts at the level of neurological mechanism underlie a host of changes in sensory resolution, possibly some aspects of perceiving properties of the external environment and relatively few and incidental aspects of thinking per se. Such a sketch is con-

jectural; classifying aspects of cognitive development, and mature cognition for that matter, with regard to the appropriateness of the two kinds of explanation remains a major challenge for the cognitive and neural sciences.

Summary

Overall, this is a valuable book. It summarizes great progress on long-standing problems and is truly sufficient to van-

quish James's "blooming, buzzing confusion" from our notions about the mind of the infant. Issues raised by the increasing sophistication of both neurophysiological and cognitive approaches to development, however, including the nature of their relationship, are still evoking enough blooms, buzzes, and occasional confusions to keep researchers of all orientations enthralled with the mind of the neonate. ■