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Book Review of Gazzaniga (1997)
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It is an under-appreciated fact that we have no significant understanding of the neurobiological mechanisms supporting any aspect of cognition, broadly construed. The limited understanding we do have is a combination of a multitude of enticing empirical fragments, scattered sparsely on a background of noise, and a number of vastly underdetermined theoretical frameworks. But however incomplete the *answers*, the *questions* posed by cognitive neuroscience are compelling. Indeed, it is nothing less than ourselves -- our decision making abilities, our command of language, our own consciousness -- that we are seeking to understand.

This understanding, or at least an early attempt at it, is the goal of *The Cognitive Neurosciences* (Gazzaniga 1995), a mammoth volume of well over 1,400 pages consisting of 92 chapters organized into 11 sections. Its stated aim is 'to define the emerging field of cognitive neuroscience', and presumably this means something like serving as a canonical text and reference for the field, in the way the Rumelhart and McClelland (1986) volumes do for connectionism, and Kandel, Schwartz and Jessell (1991) for neurophysiology. These two latter texts have stood the test of time primarily because they have succeeded at being useful for those trying to learn the field, as well as being a useful reference for those already knowledgeable in the field -- difficult constraints to jointly satisfy.

The Cognitive Neurosciences fares with at best mixed results against these criteria. Its greatest advantage for those attempting to introduce themselves to cognitive neuroscience (or one of its subfields) is the volume's broad coverage. Not only does it contain sections on neural plasticity, perception, motor control, memory, attention, imagery and consciousness, but it also must be applauded for including sections on emotion and 'evolutionary perspectives'. On the other hand, the sections are not uniformly organized to facilitate an outsider's introduction to the (sub)field. Unlike other similar works (such as Kandel, Schwartz and Jessell, and Rumelhart and McClelland), the sections of this collection make no consistent attempt to provide introductory/overview chapters to help interested outsiders follow the discussion and locate the issues. For example, the *second page of the very first chapter* contains the following passage:

Using cultured hippocampus as neuronal dissociates in a fully defined medium or as explants, direct evidence that depolarization regulates NGF gene expression was obtained... The depolarizing stimuli -- either elevated K⁺ (35mM) or the Na⁺ channel blocker veratridine -- evoked a threefold increase in NGF mRNA... The effect of veratridine was specifically blocked by tetrodotoxin, which antagonizes the channel-blocking actions of the alkaloid, suggesting that depolarization itself increased NGF gene expression.

A diligent reader might follow the bare logic of this passage without a molecular biology background, but should not expect to get any of such background *here*, and thus should be prepared to at best roughly follow the logic of many core contributions, and to do so with a minimum of appreciation for the import of the reported results with respect to the discipline at issue and its literature.

The section on attention, edited by Micheal Posner, is a refreshing exception to this trend. The first contribution in this section is a well crafted introductory article, authored by Posner himself, which nicely introduces the issues and provides a framework within which the other contributions make sense as interrelated parts of a unified inquiry.

Another more serious potential problem is that little editorial effort was put into guaranteeing unbiased, or at least balanced, contributions within the sections (each section was edited by a knowledgeable researcher in the field in question). For example, all seven contributions in the section on language, edited by Steven Pinker, seem devoted to defending Pinker's own not uncontroversial view of language implementation. The heavy bias is both obvious and inexcusable. There is serious debate as to the nature of linguistic knowledge, and its neural implementation. At least three major theoretical approaches are roughly discernible in the field: Chomskyan linguistics (Pinker's pet), connectionism, and cognitive linguistics. Only the first, however, is given any airtime at all. The second receives only a few scattered mentions (as the 'obviously wrong-headed' associationist alternative), and the third ignored entirely. It would have been a big improvement had any of the contributions even sketched one of the alternate accounts, if for no other reason than to argue against it openly. As it stands, however, an outsider would have no clue that she or he is being fed such a one-sided view. Overall, the section reads more like a polemic than an intellectually honest attempt to explore neurolinguistics, its theories, and data, in an evenhanded manner helpful to the interested outsider.

The usefulness of *The Cognitive Neurosciences* to those already knowledgeable within cognitive neuroscience is difficult to judge. Again, theoretical biases within at least some sections are troublesome. In addition to troubles already mentioned regarding the section on language, many contributions from other sections seem preoccupied with defending one or another form of modularity, while none seem to question any modularity theses. This bias is, unsurprisingly, consistent with Gazzaniga's own views on the matter. On the other hand, most contributions not only reflect current research, but are genuinely quite fascinating. Furthermore, most include extensive bibliographies. This, together with the sheer number of contributions, make it likely that the volume can serve well as an entry point into the literature of whatever particular issue may be of interest (provided, again, that precautions are observed for potential biases).

Although *The Cognitive Neurosciences* is chock-full of interesting empirical results and makes a good effort to *correlate* the cognitive with the neuroscientific, there is no theoretical insight, no broad attempt at integration, no sustained effort at portraying the trees as a forest (though there are a few individual *contributions* for which this blanket generalization is false). One reason for this is that in most sections one can clearly separate the contributions which deal with neuroscience from those which deal with cognition. And even among those contributions which address both sides of the explanatory gap, most provide mere correlations of the form "cortical area X (or neurobiological phenomenon X, etc.) seems crucial for cognitive function Y". This gap is more a reflection of the state of the field and our current understanding than a shortcoming of the volume, however. Less forgivable is the failure to recognize and grapple with the reason for this gap -- our inadequate understanding of representation. The goal of *understanding* psychology in terms of neurobiology (rather than merely correlating the former with the later) is the goal of understanding how some entities, *representations*, can be subject to both physical and psychological laws. Though the field is not at the point yet where such theoretical apparatus can be presented with any confidence, it is clear that in the years to come true headway in understanding the mind in terms of the brain will be made only when we are in a position to say something about representation. Accordingly, in a volume whose intended goal is to define the emerging field of cognitive neuroscience, the lack of any integrated, sustained discussion of theories of representation, regardless of how tentative, schematic or incomplete such theories may be at present, is a serious lacuna.

References:

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