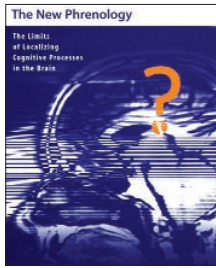


The Emperor's new modules

The New Phrenology: The Limits of Localizing Cognitive Processes in the Brain by William R. Uttal, MIT Press, 2001. \$39.95/£27.95 (255 pages) ISBN 0 262 21017 7



For the final exam of an undergraduate cognitive psychology course, I once posed a question in which students were asked to imagine a newly discovered

alien life form that moved around on wheels, made beeping noises, and tracked certain stimuli with its antennae. Students were to describe a program of research that would enable a better understanding of the creatures' cognition. I imagined that the students would draw liberally from the wide array of paradigms that had been discussed in the class – habituation, conditioning, visual search, and so forth – but by far the most common proposal was to capture the life form, take it apart, and identify the subcomponents within it. This overwhelming urge to decompose any complex system into simpler parts as a crucial first step towards understanding its function is a strategy that pervades, not just undergraduate classrooms, but all of the modern sciences. Indeed, some have suggested that the 'divide-and-conquer' strategy is the primary mental tool that humans possess for understanding such systems [1]. It should come as little surprise, then, that researchers interested in the human mind have been drawn irresistibly to research techniques that attempt to decompose our complex mass of brain tissue and what it represents into simpler subcomponents.

In *The New Phrenology*, William Uttal provides a clear and detailed history of this endeavor, and at the same time, outlines a compelling argument against many of its primary goals. The book argues that (1) logical and pragmatic

problems exist that will prevent us from ever defining the subcomponent systems that mediate cognitive processes (even if we presume that truly separable subsystems do exist), and (2) even if we did possess an accurate decomposition, such knowledge would allow us to predict nothing about how the system as a whole would function under ordinary circumstances. Uttal takes great pains to clarify his belief that the brain does not function according to the undifferentiated 'mass action' theory proposed by Lashley [2]. It is abundantly clear, for instance, that sensory and motor functions are each strongly associated with particular segments of the brain. However, Uttal paints a dim picture of the prospect of ever extending this level of understanding to higher, more complex cognitive processes.

The book seems likely to evoke heated controversy. A quote commonly attributed to Tolstoy seems especially appropriate, 'I know that most men, including those at ease with problems of the greatest complexity, can seldom accept even the simplest and most obvious truth if it be such as would oblige them to admit the falsity of conclusions which they have delighted in explaining to colleagues, which they have proudly taught to others, and which they have woven, thread by thread, into the fabric of their lives.' If we are to believe Uttal, then we will be obliged to give up on a goal in which cognitive science has greatly invested. Some of the most compelling findings in the history of the field are based on the notion of anatomical localization of cognitive processes. For instance, patients with damage to Broca's area have been found to exhibit almost no cognitive deficits except for a profound loss of the ability to use language [3]. Functional MRI studies have shown that this area exhibits an increase in blood flow during speech related activities. Such findings suggest that this region of the cortex is specialized for language. Uttal disputes this assertion. Is this area responsible for *all* processing associated with speech, or is it simply a critical line of communication between other areas that are? Does the damage to this region affect processing in this area only, or does

Broca's area perform a regulatory function such that other areas are impacted when it is damaged? The fMRI data are similarly suspect. In any scan of cortical activity, there is guaranteed to be a region of maximum and/or most consistent activation. The high level of certainty required for inclusion in most publications (typically $p < 0.001$) might rule out other areas that are critical to language processing, but for which the activation is more variable from stimulus to stimulus or person to person. Such ideas are supported by less-often cited researchers who note that, 'No discrete localization of lesions producing various types of agnosia and apraxia [has] been found. ... [A]ny acute lesion to any gross part of the left hemisphere will produce some disturbance in speech' (Ref. [4], p. 78). By presenting case after case of this type, Uttal suggests that localization has never been well demonstrated for any cognitive process. Uttal also outlines principled reasons that would lead one to expect the localization enterprise to fail: brain regions are not sharply demarcated in the brain, regions have complex interconnections, lesion experiments can confirm necessity but not sufficiency, and so on.

The New Phrenology will be especially useful for consumers (as opposed to producers) of cognitive neuroscience research. My impression from talking with many practitioners of the brain-mapping enterprise is that they are quite aware of the technical and theoretical limitations of their approach. Indeed, a close reading of many cognitive neuroscience source papers will reveal this. Conclusions that are stated initially with appropriate caution, however, are often taken by others as evidence for much broader claims, with greater confidence than is warranted.

Uttal does not suggest that we abandon cognitive neuroscience but suggests that there is good reason to revise our methods and our goals. Like Fodor's *Modularity of Mind* [5], this book indicates that we are likely to make the most progress when our research is grounded in the quantifiable reality of sensory stimulus and physical action. Determining what can and cannot be known would *not* amount to admitting

defeat; it would be an enormously important achievement for the psychological and brain sciences. In the realm of physics, researchers who gave birth to quantum mechanics and chaos theory first had to accept that their current methods of investigation and the scientific goals that accompanied them were unachievable. This remarkable book suggests that cognitive science might currently be in this same exciting phase of development.

Peter M. Vishton

Dept of Psychology, Northwestern University, Evanston, IL 60201, USA.
e-mail: vishton@northwestern.edu

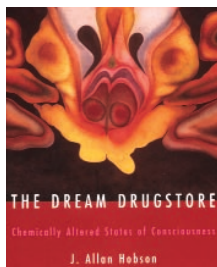
References

- 1 Kosslyn, S.M. *et al.* (1990) Components of high-level vision: a cognitive neuroscience analysis and accounts of neurological syndromes. *Cognition* 32, 203–277
- 2 Lashley, K.S. (1950) In search of the engram. *Symp. Soc. Exp. Biol. New York* 4, 454–482
- 3 Broca, P. (1861) Remarques sur le siège de la faculté du langage articulé, suivies d'une observation d'aphémie (perte de la parole). *Billions de la Société Anatomique de Paris* 36, 330–357
- 4 Penfield, W. and Roberts, L. (1959) *Speech and Brain Mechanisms*, Princeton University Press
- 5 Fodor, J. (1983) *The Modularity of Mind: An Essay on Faculty Psychology*, MIT Press

Trips for everyone

The Dream Drugstore: Chemically Altered States of Consciousness

by J. Allan Hobson, MIT Press, 2001. £19.50
(xv + 333 pages) ISBN 0 262 082 934



In his latest book, Hobson pursues his grand project of re-conceptualizing psychology by offering a new theory of the 'brain–mind'. The central theme of the book is that

manifestations observed in various states of altered consciousness have some similarities and might be attributed to a common mechanism, namely an alteration of the balance between aminergic (essentially serotonergic and adrenergic) and cholinergic neuromodulation. This aminergic/cholinergic (a/c) balance

represents the third axis of the Activation–Input–Modulation (AIM) model, a 3-D state space which is an attempt adequately describe all states of consciousness. In the AIM model, the first dimension describes the general activation of the central nervous system. It measures the rate at which the brain–mind processes information and can be estimated by the EEG power density in the high frequency range. The second axis reflects the source of cerebral input, that is, the extent to which the brain–mind is processing external input. The waking brain tends to be influenced by external stimuli during sleep, it is driven by internally generated signals.

The AIM model was originally designed to distinguish wakefulness from REM and non REM sleep. It elegantly explains the sleep/waking and the REM/non REM sleep cycles and has led to exciting hypotheses on the cerebral bases of dreaming activity. However, Hobson wants to go beyond normal sleep/waking phenomena. He poses that many other states of altered consciousness are also accounted for by the model, and especially by an alteration in the a/c modulatory equilibrium: the hypnotic trance, the schizophrenic, hypnagogic and hypnapompic hallucinations, the good and bad trips induced by recreational drugs (LSD, opioids, mescaline, MDMA...)... At some point, the reader realizes that the AIM model is far too restrictive to embrace the specific features of all these conditions. Indeed, a higher dimensional state space would be necessary to account for many aspects of these states. For instance, some important neuromodulatory systems are conspicuously absent from

the model (e.g. the dopaminergic and histaminergic systems) although the model include them indirectly through the complex interactions between the various neuromodulatory systems. Likewise, the AIM model awkwardly deals with the action of a single drug on different neuromodulatory systems. Finally, some state-specific features are not explained by AIM model. For instance, what differentiates lucid dreaming from normal dreams is probably neither the global brain activation, nor the source of inputs nor the neuromodulatory context.

Nevertheless, the critical element in this book is the Hobson's approach in itself. It is important to have recognized these mental states as scientifically approachable objects and to try to group and categorize them on objective criteria. In this respect, the book provides a pleasurable attempt toward a unitary view on all these states of altered consciousness. The importance of this strategy is illustrated by the number of daring, but readily testable, hypotheses that permeate throughout the book.

There is no doubt that this book, as the others by Hobson, will leave a persistent influence on the ways we think about the levels and contents of consciousness. This volume should be recommended to a wide range of readers, not only professionals as psychiatrists, neurologists, psychologists, neuroscientists, or neurophilosophers, but any individual interested in brain–mind function.

Pierre Maquet

Wellcome Dept of Cognitive Neurology, University College London, 12 Queen Square, London, UK WC1N 3BG.
e-mail: p.maquet@fil.ion.ucl.ac.uk

Book reviews

Books and other types of publication – including software, CD-ROMs, films, art exhibitions, etc. – can be considered for review in *Trends in Cognitive Sciences*. Please send any ideas or proposals for specific items to the Editor.

Publishers: send copies of books or software you would like to be reviewed to the Editor at the address below.

Readers: would you like to review a particular book or other publication? Contact the Editor via e-mail with your proposal.

Trends in Cognitive Sciences
Elsevier Science London, 84 Theobald's Road, London WC1X 8RR.
e-mail: tics@current-trends.com