Developing a distributed language network

Human Language and Our Reptilian Brain: The Subcortical Bases of Speech, Syntax, and Thought
by Philip Lieberman, Harvard University Press, 2000. $42.00 / £27.50 (224 pages)
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Language is either:
(1) Innatitudinal, genetically transmitted, and discretely localized;
(2) Learned and systemically based.
These are the two black-and-white alternatives that Philip Lieberman offers for the ontology and neural implementation of language in his book, Human Language and Our Reptilian Brain. Ever since Chomsky argued for the poverty of the stimulus in language acquisition and for the universal constraints on how languages can be organized, linguists and psychologists have debated the existence of universal grammar – the hypothesized innate cognitive constraints on what can constitute a human language. In recent years, such arguments have been combined with evolutionary psychology to argue for the adaptive value of human language, which is argued to have shaped the relevant cortical areas through evolutionary time.

In response to these trends, Lieberman attempts to prove Chomsky and his followers wrong, by illustrating how many cortical and subcortical areas (including his favourite, the basal ganglia) interact to produce linguistic competence. Throughout the book, Lieberman’s argument against Chomsky centres on the issue of cortical organization, specifically distributed cortical organization. Although I agree with the importance of understanding the biological implementation of language, I was dissatisfied with the implicit links (in my view, mistaken) between cortical organization and three other fundamental issues in the cognitive neuroscience of language: innate developmental constraints, domain specificity and generality, and evolutionary adaptationism.

The discussion of cortical organization and its implied connection to these other issues is based in part on Fodor’s book, The Modularity of Mind. Researchers in psychology and neuroscience often refer to Fodor when supporting or opposing any combination of the qualities that he attributed to modular input systems. Although these qualities – which include information encapsulation, speed, automaticity, domain specificity, fixed neural architecture, and high ontogenetic constraint – are common to some systems, they are independent empirical issues. Chomsky’s unfortunate term ‘language organ’ also seems to have motivated the conflation that forms the core of Lieberman’s argument: that the lack of a highly localized language centre in the brain can inform us about the degree of innate developmental constraints on language. Chomsky’s core insight, that the innate constraints on language go beyond simple associative laws, is agnostic to the manner of neural implementation, and to equate the two issues is to set up an easily refutable straw man.

Although the book promises from page one to prove that language is learned and not innate, surprisingly little direct discussion of development or learnability occurs in any chapter. Lieberman does briefly discuss some research on the genetics of language, which includes a study of a family (referred to as ‘KE’) with an inherited language disorder known to result in a reduction of volume of the basal ganglia striata. He concludes, ‘In short, the deficits of Family KE demonstrate that the neural capacity for human language has an innate, genetic basis. However, their behavioral deficits in all likelihood derive from impairment of the striatal components of the functional language system’ (p. 130). He is unclear in what other way genetic involvement would have been more legitimate. Certainly the development of all complex traits involves a multitude of genetic input, which makes it unlikely to find any single mutation that would correspond to a full yet selective disruption of any cognitive ability. What Lieberman might be implying is that because the genetic involvement affects a phylogenetically old subcortical structure known for its involvement in other domains, the impairment is unlikely to be specific to language. But this is a possible argument against domain specificity and adaptationism, not one regarding the degree of innate constraint on the relevant developmental programs.

The informative chapter on the basal ganglia and their involvement in language processing suffers from a related problem: the implication that domain generality disproves innateness. The basal ganglia are often implicated in the programming of motor sequences. This basic computational ability might be the basis for basal ganglia contributions to syntactic processing, as suggested by Lieberman’s interesting empirical work showing the similarity of Parkinson’s patients and hypoxic climbers to Broca’s aphasics with regard to speech production and perception. Granted, this is an extremely relevant point for anatomical models of language processing, emphasizing its distributed basis. It is also a compelling example of domain-general mechanisms in syntactic processing. However, this again does not address the basic issue of the degree of innate developmental constraints. One can recognize that, although knowledge underlying language acquisition might be domain general, it could at the same time be highly innately constrained.

Domain generality can have important implications for the issue of evolutionary adaptationism. The more domain general a brain function is, the less likely it evolved in response to a particular domain of interest. More primitive motor programming and sequencing mechanisms might be able to account for the emergence of syntax within the context of cultural transmission. If this is the case, then syntax per se would not be considered an adaptation in the strictest sense of the word in spite of being innately constrained. However, this is only true if all syntactic mechanisms are domain general, not just some. It is entirely possible that the systems we use for syntax (and for phonology and semantics) have been maintained and evolutionarily tweaked in response to selection pressures for language. Indeed, if language is an adaptation it hardly could have evolved in any other way. Surprisingly, Lieberman himself argues for a similar scenario in his discussion of the human vocal tract:

‘Neanderthal speech simply was not as efficient a medium of vocal
Comparing cognition in animals, and researchers

The Evolution of Cognition

Thanks to the cognitive revolution that occurred in the middle of the 20th century, the field of animal cognition has expanded, from the study of learning processes in rats and pigeons in the laboratory, to encompass virtually any kind of cognitive processes in any animal species. If the 19 chapters that constitute The Evolution of Cognition are representative of current research on animal cognition, then the news is good. The reader will be convinced that animal cognition is an exciting and vibrant field of research where conceptually sophisticated theories and important empirical findings are produced almost on a daily basis.

As in any rapidly growing discipline, controversies abound in contemporary animal cognition as to how cognitive processes should be defined and studied in animals, and whether and how the animal data should be extrapolated to humans. The book does an excellent job of representing this heterogeneity of approaches and their associated controversies. If animal cognition researchers with antithetical positions agree to present their research in the same volume and make efforts to cite each other's chapters as much as they do in The Evolution of Cognition, then once again the news is good and all of us can feel optimistic about the future of this field. If, however, this book is representative of how scientists currently study the evolution of cognition, then, I am afraid, the news is not so good.

There are three basic ways in which contemporary research addresses the evolution of cognition, all of which are represented in this book. In the first approach, researchers formulate hypotheses, design experiments and collect data on animal cognitive abilities, using the conceptual framework and experimental procedures typical of the discipline in which they were trained (e.g. comparative psychology, cognitive psychology, or ecology). They then provide a few speculations as to how or why this or that cognitive ability might have evolved. In the second approach, researchers strive to formulate a set of clever propositions about how and why certain cognitive abilities may or may not have evolved. Great effort is made to ensure that the propositions are presented in logical order and the arguments are internally consistent. Less care is taken to ensure that the propositions are built upon a well-specified body of theories or empirical data. In the third approach, evolutionary theory is used to generate specific hypotheses about the distribution and characteristics of cognitive abilities in animal species, which are then tested with empirical data. This approach usually entails the recognition that: (1) cognitive abilities are likely to evolve as adaptations to the environment; (2) cognitive abilities have benefits and costs and both must be taken into account; and (3) the comparative study of the adaptive value of cognitive abilities in different animal species must be conducted in light of information about their phylogenetic history.

The editors of The Evolution of Cognition, Cecilia Heyes and Ludwig Huber (who deserve credit for their efforts at introducing and integrating the heterogeneous content of this volume) maintain that all the comparative research on animal cognition covered is equally evolutionary. Thus, it might appear that students of operant conditioning in rats, categorization in pigeons, imprinting in chicks, memory in scrub jays, and language learning in chimpanzees, are all equally committed to unraveling the evolution of cognition. In reality, not all animal research is truly comparative and not all comparative research is truly evolutionary.

References