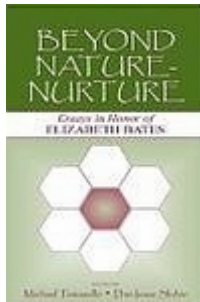


## **Emergentism: Elizabeth Bates's Vision of Language and Cognitive Development**

A review of



**Beyond Nature-Nurture: Essays in Honor of Elizabeth Bates**

by Michael Tomasello and Dan Isaac Slobin (Eds.)

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Reviewed by

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Reviewing this edited volume turned out to be a very challenging task, because it covers a wide range of issues regarding biological foundations and psychological mechanisms underlying language functions and language development. My task as a reviewer is to try to (a) understand the underlying logic of Elizabeth Bates's thinking on the basis of this edited volume, as all chapters one way or another bear the imprint of her theoretical influence, and (b) evaluate the significance of her and her colleagues' work in a broader context of research on human cognitive development, while deferring judgment and evaluation of specific pieces of evidence, interpretations, and conclusions to experts in respective areas.

## **Nativism: Searching for the Key in the Wrong Place?**

It is well known that Chomsky (1988), with his proposal for universal grammar, among others, has inspired generations of researchers to search for innate structures, rules, and intuitions for a broad range of knowledge and skills that cannot be explained by mere inductive learning. Related to this assumption of innateness are three key concepts: *domain specificity*, *modularity*, and *genetic programming*. Domain specificity in this context refers to some innate principles and rules governing children's learning and cognitive development. The notion of modularity goes one step further, assuming special brain structures that are hard wired to handle specific types of information (Fodor, 1983). Genetic programming stresses the deterministic role of genes in structuring and sequencing ontogeny, including such notions as specific genes triggering brain mechanisms for language development (e.g., Pinker, 2001). The facts that most children rapidly and uniformly master language without formal instruction and that the language capacity of some children with severe cognitive impairment is spared lend support to this nativist view.

Bates (1979) started her work with the conviction that a viable theory of language development does not need to resort to these innateness assumptions. A root metaphor underlying Bates's work is that language is a new machine made of old parts. Bates did not deny that language is a special capacity, but she posited that components (e.g., fine motor control, perceptual abilities, processing speed, and the ability and motivation to imitate) that help shape language capacity are not prespecified as language proper. To use the metaphor of boat building, materials available (e.g., wood) are important for building something afloat, but one builds a boat instead of something else not because of the nature of the available material but because one has to survive in the water. The material has no specification as to what it will become (a boat or a tricycle). By the same token, biology constrains but does not determine developmental outcomes. For Bates, language is a gift to humans through phylogeny, but not a kind of gift that is well packaged and delivered to the newborn, only to be unfolded when the time comes. Rather, language, as an evolutionary breakthrough, is a result of cooptation of many parts of the brain functions that were initially for other uses. This view is in stark contrast to strong nativist claims about the preordained nature of language, still a mainstream perspective in cognitive science.

## **Bates's Emergentism: A Road Increasingly Traveled**

Both nativists and empiricists can be minimalists in their basic assumptions about development (e.g., it is all genes or it is all learning). Consider Herbert Simon's (1996) famous parable of an ant traveling through the treacherous pathway to its home and his

assertion that human beings, like ants, are quite simple: “The apparent complexity of our behavior over time is largely a reflection of the complexity of the environment in which we find ourselves” (p. 53). Bates, like Simon, was a generalist who discounted the importance of prespecification of rules and modules in favor of neural plasticity and cognitive flexibility; to use Bates's frequently quoted words, “nature is a miser” (p. xviii). Bates was also close in spirit to Simon and ecological psychologists (e.g., Neisser, 1999) who stress the interface of the organism and its environment rather than the human genome as holding the key to understanding what the organism becomes and the process of becoming (i.e., development). However, Simon almost sounded like a behaviorist when he drew the analogy between ants and humans. Bates was a much more nuanced generalist, as she took painstaking efforts to understand how the “old parts” are put together through *phylogeny* and *ontogeny* in a way that is capable of producing something qualitatively different from these parts. In other words, she attempted to show that language is indeed an *emergent property* of human development: Continuity of development gives rise to discontinuity in outcomes.

In most general terms, emergentism is a belief that the origins of a new function, structure, or capacity cannot be explained by its constituent components alone (i.e., *reductionistic* explanations) but must be understood as an emergent phenomenon with its new organizational principles and developmental underpinnings. Emergentists refute the existence of prespecification for developmental pathways (thus, the notion of genetic blueprints is plain wrong) or innate modular devices driving developmental or learning processes; in Kelso's (2000) words, “there is no ghost in the machine, instructing the part how to behave” (p. 65). Observed emergent phenomena are explained by the collective behavior or function of a cluster of components, none of which plays a leading role in orchestrating the process of forming new patterns, structures, and functions (Clark, 1997). Because emergent forms and functions typically have a high degree of complexity, interactions of these components at different levels of analysis need to be carefully examined (Elman et al., 1996). Emergentism and dynamic systems theory share some family resemblance, as both are interested in the real-time, self-organizing nature of functioning and development (Kelso, 1995).

Bates's emergentist theory, on the basis of her quoted remarks as well as descriptions given by the authors in this volume (e.g., introduction, Chapters 5 and 8), includes at least the following interrelated propositions: (a) The emergence of humans' symbolic capability in the form of language is an integral part of *general cognitive development*; there is no language acquisition mechanism that cannot be explained by general developmental mechanisms (e.g., communication intent, comprehension, means–end analysis, imitation). (b) Language development is dynamic, constrained by multiple components that have their own developmental trajectories and threshold requirements; the dynamic interplay of these components contributes to the varied timing of language development (e.g., linguistic precocity and delay) and diverse developmental pathways and trajectories. (c) Language acquisition follows *functionalist* principles in that functional activities and contexts constrain

developmental outcomes (recall Simon's, 1996, parable) and in that all components (pragmatics, grammar, and lexicon) evolve as solutions to the problem of communication and verbal (symbolic) representation. (d) Specific aspects of language acquisition are not all-or-none occurrences (e.g., a sudden switch on of a specific brain mechanism or modular device for the development of a specific function) but undergo nonlinear changes because of both biological maturation and real-time interaction of relevant components at multiple levels, so that there is no direct one-to-one relation between genotype and phenotype.

Two lines of work that Bates and her colleagues have pursued to implement her vision of emergentism permeate this volume. The first is the competition model of language acquisition and online processing (Chapters 3, 4, and 6). The competition model is a distinctly emergentist and dynamic one in that there is no centrally driven process, no Chomskian rule-based system governing information processing, no Fodorian modular devices parsing different types of information. Rather, different linguistic cues present in the functional environment compete for distinction and acquisition. The outcomes depend on the human perceptual capability of picking up relevant cues online in detecting and constructing the structure and meaning of a sentence (see Chapters 3 and 4). Researchers have carried out the competition model in great computational detail to elucidate such a wide range of issues as child language acquisition, aphasia, and adult sentence processing.

The second line of work involves better understanding the biological basis of linguistic and cognitive development. Although strongly against nativism, Bates was, ironically, the most eager to map out how brain mechanisms (Bates's "old parts" at the genetic and neural levels), social environment, and task structure interact to produce the unique human language capability. Recent developmental neurobiology and neuropsychology (Chapters 7, 8, and 9) strongly suggest that relations between psychological functions and the development of biological mechanisms and structures are considerably more dynamic (likely bidirectional) and complex than nativists suggest, and mapping functions (and their breakdown) onto corresponding structures (from Paul Broca on; see Eling, 1994) is an extremely tricky enterprise. Evidence seems to support an *equipotential*, rather than *phrenological*, view of neural organization. Karmiloff-Smith (Chapter 8) nicely summarizes the sentiment of the authors in the section on biology and language:

The neuroconstructivist, emergentist approach embodies that of regulatory control... with ontogeny seen as the prime force for turning a number of domain-relevant processes progressively into domain-specific outcomes in the adults. This does not imply that the infant brain is a single, homogeneous learning device. On the contrary, there is, no doubt, much heterogeneity in the initial gross wiring of the brain. But, contrary to what is often claimed, this heterogeneity bears little resemblance to the ultimate functional structures that can only emerge through interaction with a structured environment. (p. 232)

## **An Evaluation: Putting All Parts Back in the Epigenetic Landscape**

In a time when psycholinguistics was lopsided in favor of nativism, Bates's work provided a more balanced approach that treated language development as problematic rather than predetermined. The role of real-time, ongoing structure–function mapping and bootstrapping, as realized in the competition model and connectionist modeling (Elman et al., 1996), cannot be explained away by either innate constraints or environmental constraints but has its own ontological significance and developmental consequences. Likewise, developmental pathways and trajectories need to be carefully charted rather than assumed. The present volume does not just pay lip service to going beyond nature–nurture but makes a real commitment to do so.

Psychological research has a history of looking at one component in isolation and trying to understand how it develops and realizes itself in the mind–brain, be it memory, language, or a component in the language system, with the atomist assumption that somehow it can develop as an autonomous entity. However, the key functional question, “What is language (or memory) for?” often gets obscured along the way (see Glenberg, 1997, for a critique of the memory research). In effect, Bates asked us to shift our focus to how the mind develops and uses language as a symbolic system in solving communication and representation (or comprehension) problems. As such, she has changed the way we think about language development. In essence, Bates's emergentism is a distinctly new brand of functionalism beefed up by probabilistic epigenesis, the dynamic systems perspective, connectionist modeling, and integration of a wide range of empirical research in both lab and natural settings (see Tomasello, 2005, for a similar functional approach). Bates's functionalism resurrects many functional elements in development that would otherwise be considered irrelevant and trivial and brings them back into the epigenetic landscape. Moreover, development becomes truly a result of the reciprocal interaction of the person with his or her genetic potential and biological preparedness and the physical and social environments, with their affordances and constraints.

It is not trivial to note that Bates stressed the distinction between formal linguistic models and psychological explanations of language acquisition and treated them as two separate enterprises (see p. xxviii). Pioneering psycholinguists such as Chomsky (1997) also attempted to naturalize or psychologize linguistics. However, the way they derived conclusions (e.g., universal grammar, poverty of the stimulus, or the existence of well-formedness rules) was through formal analysis of language structures, making assumptions that can hardly hold in actual functional and developmental contexts (e.g., Agassi, 1997; Elman et al., 1996; but see Wexler, 1999). Moreover, theories developed from such formal analysis are fundamentally nondevelopmental: No specification regarding ontogeny, from simple to increasingly complex, differentiated organization. It takes a different kind of




evidence for explaining language development rather than relying on purely linguistic analysis (but see Chomsky, 1997). In effect, by stating that language is made of “old parts,” Bates opened a much broader agenda for studying linguistic forms, properties, and functions in a way more in keeping with the goals and principles of developmental psychology. Empirically, such efforts of psychologizing language development have proved fruitful, as is evident in this volume—for example, tracing nonlinguistic origins (gestures) of language (Chapter 1); identifying commonalities and individual differences in trajectories of vocabulary development (Chapter 2); mapping the functional connectivity of lexicon and grammar in language development (Chapter 5); examining neural underpinnings of language as a form of embodied cognition (Chapter 9); and elucidating interrelated attentional, perceptual, and conceptual processes underlying language comprehension (Chapter 11).

Bates's legacy goes beyond language development. Bates will be remembered, as this volume attests, for her deep insights into the evolution and workings of the mind, for her efforts to broaden the horizon for research on language development as an integral part of cognitive development, and for her persistent inquiry into the complexity of the nature–nurture issue, not only in terms of how nature constrains nurture but, more important, in terms of how nurture (including being there in real-time or situated activity of the body, the mind–brain, and its engaged environment; Clark, 1997) gives nature its contour and shape. The generativity of her vision, in terms of producing new theoretical predictions, encompassing a wide range of language phenomena, and creating innovative research techniques, is truly remarkable, as shown throughout this edited volume dedicated to her honor and memory, and deservedly so.

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## References

- Agassi, J. (1997). The novelty of Chomsky's theories. In D. M. Johnson & C. E. Erneling (Eds.), *The future of the cognitive revolution* (pp. 136–148). New York: Oxford University Press. PsycINFO
- Bates, E. (1979). *The emergence of symbols: Cognitive and communication in infancy*. New York: Academic Press.
- Chomsky, N. (1988). *Language and problems of knowledge*. Cambridge, MA: MIT Press. PsycINFO
- Chomsky, N. (1997). Language and cognition. In D. M. Johnson & C. E. Erneling (Eds.), *The future of the cognitive revolution* (pp. 15–31). New York: Oxford University Press. PsycINFO

- Clark, A. (1997). *Being there: Putting brain, body, and world together again*. Cambridge, MA: MIT Press.
- Eling, P. (1994). Paul Broca (1824–1880). In P. Eling (Ed.), *Reader in the history of aphasia* (pp. 29–54). Amsterdam: John Benjamins.
- Elman, J. L., Bates, E. A., Johnson, M. H., Karmiloff-Smith, A., Parisi, D., & Plunkett, K. (1996). *Rethinking innateness: A connectionist perspective on development*. Cambridge, MA: MIT Press. 
- Fodor, J. A. (1983). *The modularity of mind*. Cambridge, MA: MIT Press.
- Glenberg, A. (1997). What memory is for. *Behavioral and Brain Sciences*, 20, 1–55.  
- Kelso, J. A. S. (1995). *Dynamic patterns: The self-organization of brain and behavior*. Cambridge, MA: MIT Press. 
- Kelso, J. A. S. (2000). Principles of dynamic pattern formation and change for a science of human behavior. In L. R. Bergman, R. B. Cairns, L.-G. Nilsson, & L. Nystedt (Eds.), *Developmental science and the holistic approach* (pp. 63–83). Mahwah, NJ: Erlbaum. 
- Neisser, U. (1999). Ecological psychology. In R. A. Wilson & F. C. Keil (Eds.), *The MIT encyclopedia of the cognitive sciences* (pp. 255–256). Cambridge, MA: MIT Press.
- Pinker, S. (2001, October 4). Talk of genetics and vice versa. *Nature*, 413, 465–466.
- Simon, H. A. (1996). *The sciences of the artificial*. Cambridge, MA: MIT Press.
- Tomasello, M. (2005). *Constructing a language: A usage-based theory of language acquisition*. Cambridge, MA: Harvard University Press.
- Wexler, K. (1999). Innateness of language. In R. A. Wilson & F. C. Keil (Eds.), *The MIT encyclopedia of the cognitive sciences* (pp. 408–409). Cambridge, MA: MIT Press.
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