Evolution In The Symbolic Dimension: The Devil Is In The Details

By: **Susan Lappan** and Jae Chun Choe

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Evolution in Four Dimensions argues convincingly that non-genetic inheritance systems have the potential to be agents of evolution and that, in some circumstances, acquired information can be heritable. However, we found the authors' four-dimensional approach to evolution problematic, and doubt that symbolic evolution can be adequately modeled as a distinct dimension of organismal evolution.

Lappan, S., & Choe, J. (2007). Evolution in the symbolic dimension: The devil is in the details. Behavioral and Brain Sciences, 30(4), 373-374. doi:10.1017/S0140525X07002312. Publisher version of record available at: https://doi.org/10.1017/S0140525X07002312

Evolution in the symbolic dimension: The devil is in the details

Published online by Cambridge University Press: **17 December 2007**

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Evolution in Four Dimensions argues convincingly that non-genetic inheritance systems have the potential to be agents of evolution and that, in some circumstances, acquired information can be heritable. However, we found the authors' four-dimensional approach to evolution problematic, and doubt that symbolic evolution can be adequately modeled as a distinct dimension of organismal evolution.

Behavioral and Brain Sciences , Volume 30 , Issue 4 , August 2007 , pp. 373 - 374

DOI: https://doi.org/10.1017/S0140525X07002312

There is growing recognition of the importance of epigenetic and behavioral inheritance systems as potential agents of evolution. However, the evolutionary importance of each system and the relationships among different inheritance systems cannot be rigorously examined or modeled in the absence of a coherent conceptual framework. Jablonka & Lamb's (J&L's) ambitious efforts to construct this framework result in a fascinating and thought-provoking compilation of information and ideas, which together comprise a compelling argument that there may be more to heredity than genes.

The principal success of *Evolution in Four Dimensions* (Jablonka & Lamb Reference Jablonka and Lamb 2005) lies in its presentation of a convincing, well-supported argument that traits acquired in an organism's lifetime can under some circumstances be heritable. Although this is no longer a new or particularly controversial idea among many behavioral scientists and ecologists, its presentation in this volume is unusually clear-sighted. The presentation and careful explanation of selected research on epigenetic and behavioral inheritance and the use of thought-provoking examples make it clear that the near-universal anti-Lamarckian bias in the biological sciences is based more on the uncritical acceptance of dogma than a logical interpretation of available evidence.

Unfortunately, J&L are less successful at clarifying the relationships among inheritance systems and their larger implications for evolution and natural selection. While the delineation of four distinct modes of inheritance is helpful as a heuristic device, we find the notion that they function as distinct “dimensions” of evolution, forming a coherent four-dimensional whole, problematic. For most living things, which neither behave nor employ symbols, information can only be transmitted from one generation to the next through genetic and possibly epigenetic inheritance. Therefore, the authors' argument that a four-dimensional approach to evolution is of general applicability is a stretch. More important, the authors' failure to provide broadly applicable definitions for key terms such as *evolution*, *inheritance*, and *information*, and the unexplored assumption that evolution can be reduced to the inter-generational transmission of information, make it difficult to evaluate their four-dimensional model.

We are particularly unconvinced by the argument that behavioral inheritance and symbolic inheritance comprise distinct dimensions of evolution. We agree with the authors that the evolution of language and the ability to explain and interpret our experiences is a key to understanding human uniqueness. However, although the authors outline differences in the ways in which behavioral and symbolic information are coded, a compelling argument that the means of transmission for behavioral and symbolic information are mutually independent is not presented. Is it possible to produce or transmit complex symbolic information without behaving? If not, then can behavior and symbols really be said to represent two distinct dimensions of evolution? Even if we accept the authors' multi-dimensional approach to evolution, describing symbolic inheritance as a special case of behavioral inheritance may be more appropriate.

Symbolic evolution must have included at least two phases: (1) the evolution of the ability to create, acquire, and use symbols (the evolution of "explaining man"), and (2) the ongoing development of symbolic systems. These two steps may have occurred through different processes, and may have different implications for human evolution. The evolution of linguistic beings from nonlinguistic ancestors likely involved an interaction among genetic, developmental, and behavioral processes, which were related to the fitness of the organisms themselves. Although it is not yet clear when or where symbolic communication first appeared, the growing body of fossil, archaeological, and genetic evidence for the recent replacement of other *Homo* species by a new species, *Homo sapiens*, adept in the use of symbolic communication (e.g., Caramelli et al. Reference Caramelli, Lalueza-Fox, Vernesi, Lari, Casoli, Mallegni, Chiarelli, Dupanloup, Bertranpetit, Barbujani and Bertorelle 2003; Serre et al. Reference Serre, Langaney, Chech, Maria Teschler-Nicola, Paunovic, Mennecier, Hofreiters, Possnert and Pääbo 2004; Sokol et al. Reference Sokal, Oden, Walker and Waddle 1997), demonstrates the potential evolutionary importance of the ability to use language. Indeed, we were disappointed by the authors' failure to include relevant information from fields such as paleontology, archaeology, and neuroscience in this otherwise well-researched volume.

Following the evolution of the human capacity to create, produce, and transmit language, symbolic systems have continued to change and diversify through processes that might more reasonably be described as being independent of genomic or behavioral evolution. In their discussions of the symbolic inheritance system, J&L do not examine the nature of the symbolic entity that is reproduced or the mechanism of competition among variant symbols. The idea that symbolic inheritance represents a fourth dimension of evolution that is complimentary to the other three, cannot be rigorously evaluated in the absence of a clear explanation of what exactly is meant by symbolic evolution and how it relates to the organisms producing the symbols. The latter omission highlights a key difficulty with the authors' argument. If symbolic evolution is completely decoupled from the symbol-producing organisms' fitness and behavior, and transmission is independent of reproduction, then the analogy to biological evolution is an interesting thought exercise, but it would be difficult to support the argument that symbolic variation represents a fourth distinct dimension of biological evolution.

The other main argument presented in the volume, that the production of variation may occur via non-random as well as random processes, has important implications and should be carefully examined. Although the authors provide interesting examples of mechanisms by which appropriate variants may be generated (as opposed to being merely selected) by the interactions of organism with environment, we are not convinced that directed genomic evolution is common. Indeed, the failure of organisms to evolve traits that would be useful seems to be more the rule than the exception, and the diversity of different solutions that evolution has created to the same ecological problems cautions against the interpretation that the environmentally directed generation of useful variants in limited regions of the genome is a more important mechanism of evolution than random variation coupled with selection.

The book uses an interesting twist on standard scientific writing by framing the discussion as an actual dialogue between the authors and a fictional devil's advocate, Ifcha Mistabra. While we found this approach entertaining, this particular devil seemed to function mainly to set up straw men for the authors to knock down, rather than to address serious challenges to their ideas. We wish that our own critics would be so kind.

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