

Book Review

A review of *The Symbolic Species: The Co-Evolution of Language and the Brain*, by Terrence Deacon, 1997. New York: W.W. Norton, 527pp. ISBN 0393317544. \$29.95 USD. Hardcover.

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Terrence Deacon's background in neuroscience and evolutionary anthropology provide the foundation for *The Symbolic Species: The Co-Evolution of Language and the Brain*. His provocative theory describing the co-evolution of language and the brain is systematically laid out in three sections. First, he examines language and its dependence on symbolic reference, which he posits is virtually unique to the human species. Second, Deacon explores how both the human brain's evolution differs from that of other species. Third, Deacon elaborates on the conditions and biases necessary for natural selection. Deacon sophisticatedly weaves together these three sections to form a compelling account of how the emergence of symbolic reference and language have directly influenced brain evolution through a process of co-specification. This evolutionary path prompted the rise of an interdependent system that was vital for human development and adaptation.

In part one of his text Deacon provides an examination of current theories of human language acquisition and origin. He poses the question, "Why are there no simple languages?" (p. 12). Deacon believes that the answer lies in the human species' ability to use symbolic reference systems. Iconic, indexical, and symbolic referential associations are interdependent in a hierarchical structure. Without the first two, symbolic reference is impossible. Many animals that humans consider intelligent have acquired iconic and indexical reference, however they are unable, without significant orches-

trated and socially supported teaching, to move to the symbolic level (pp. 69–101). Deacon rejects Chomsky's theory of universal grammar and posits an alternative theory in which language adapts to children's correct guesses in order to evolve. Children's distractible and immature minds are unable to hold extensive details and patterns and therefore less interference occurs in learning. Language is highly adaptive and self-selects for easier reproduction by children (pp. 101–142).

In part two Deacon examines various elements and conditions of brain development. Deacon suggests that in order for brain size to be considered valid and significant in the evolution of language, it must be examined within contexts of function. The assumption that brain to body ratios is directly correlated to unused computational power is challenged. Rather, brain to body size is dependent on several factors, which include size, function, lifespan, processing time, and neuron connections. Another important component in the intelligence and brain size debate is related to a species' dependence on novel learning strategies and the reconfiguration of information to learn in new contexts. In several varying experiments involving brain cell or tissue transplant, the flexibility displayed implies that the brain does not need overhauling every time the body is altered, but rather the size and functions of a particular region contribute to selection for or against specific traits (pp. 165–224).

Deacon continues to build his thesis as he examines the vocal differences of mammals, aquatic mammals, and birds. In order to control sound production and breathing, more autonomy over the vocal system is needed as is demonstrated in the case of birds, whales, and dolphins. Selection for autonomy in vocal tract widened the sounds reproducible by humans (p. 253–255). In chapter nine, Deacon compiles extensive data on brain injury and brain stimulation in both primate and human subjects by studying several language-impaired patients. Using exceptions like Williams Syndrome, Autism, Aphasia, and brain injuries in both humans and animals, Deacon presents several issues of interference, associative relationships, stimulus response, and abstract associations. Based upon these discussions, Deacon suggests that the prefrontal cortex, which is more developed in humans, is not a symbol processor, but rather is highly intertwined in the use of language (pp. 254–278). Finally, Deacon examines the various locations of language within the brain noting that the distribution of language processing is varied and not necessarily dependant on linguistic or neurological functions (pp. 279–318).

Part three of Deacon's lengthy text connects sections one and two to develop a co-evolutionary theory of homo sapien development. Deacon discusses an evolutionary timeline situating symbolic reference association, brain development, and language abilities within known anthropological

facts. Deacon proposes that due to a dietary shift toward meat, new reciprocal social groupings developed. In order to protect reproductive privilege and reciprocity, symbolic referencing gained significance so that social contracts provided stable group relationships and food supplies. The development of symbolic reference produced several selection biases, which contribute significantly to the evolution of language and the brain (pp. 376–411). To conclude, Deacon describes the significance of co-evolution in relation to consciousness, with questions regarding conscious machines and the questions of sentience and personhood.

Deacon's strength as an author allows him to address difficult questions and problematic theories without disparaging comments as he blends together perspectives from neuroscience, anthropology, linguistics, and philosophy into a unique and comprehensive theory that few others have undertaken. Instead of presenting an unsolvable thesis, he reverses the questions and assumptions of previous theories. Deacon's central thesis articulates that what makes humans unique is our capacity for symbolic reference. This complex system of interrelationships of token to token, along with our highly developed prefrontal cortex, separates us from primates and is responsible for human consciousness.

The text, although extremely challenging and dense, is worth persistent reading. Deacon's examples of animal research are fascinating and provide critical insights into animal behavior. These anecdotal examples are often the most accessible part of Deacon's text and provide the reader with a much-needed respite before more neuroanatomical terminology is required.

One significant critique of Deacon's text centers on his limited discussion of tool use within historical contexts. Deacon seems to unproblematically accept the theory that tool use contributes to a shift in diet. Rather than posit a challenge to this theory, Deacon uncritically accepts other theorists' suggestions, which suggest that the advent of tool use leads to a change in dietary habits towards meat, which in turn leads to necessitated alteration in social groupings so meat can be provided to those unable to hunt. Deacon argues that these alterations to social groupings have propelled the co-specification of language and brain development towards its current state. Another significant limitation derives from Deacon's use of the term "symbolic reference system." This term is used within several other disciplines, which may result in confusion as to Deacon's intended meaning. Lastly, Deacon describes his purpose in writing this text as reaching "the broadest possible scientific audience and, [he] hope[s], to a scientifically interested lay audience" (p. 14). With this goal in mind his evidentiary conclusions should be more obvious to the reader than they appear. Regardless of these limitations, this text merits a very close reading to capture the breadth and depth of Deacon's sophisticated analyses.

Deacon's text presents language as a complex system that self organizes for maximum replicability and reproduction. This self-organizing system co-evolved with the brain from symbolic reference into a unique system of communication and abilities, propelling human evolution into its present state. Viewing language and the brain as self-organizing systems enables educators to adopt a more complex and dynamic systems approach to learning. As educators grapple with the expanding field of brain-informed research, inherent ethical questions need to be considered. Deacon's text can be used as a starting point to begin to grapple with some of these thought-provoking ethical questions: Can we build conscious machines? Who and what will be considered conscious in the future? "Will we know when we have crossed this [ethical] line" (p. 461)? Drawing upon Deacon's sophisticated theories, educators might shift these questions to ask: Can classroom collectives be considered conscious entities? What might current conceptions of teaching and educational research look like if we understand teaching and learning as an emergent and co-specified engagement? Educators who are interested in exploring complexivist sensibilities will find Deacon's text a useful prompt in helping to further understand and explore our current educational teaching and research engagements as a complex and dynamic system.