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**Niccolo Leo Caldararo, *Big Brains and the Human Superorganism: Why Special Brains Appear in Hominids and Other Social Animals*
Rowman & Littlefield, 2017.**

Reviewed by Andrew Targowski

This book scrutinizes why humans have big brains, what big brains enable us to do, and how specialized brains are related to eusociality in animals. The humans have the most advanced eusociality among animals, which is defined by the following characteristics: supportive family care (including care of offspring from other individuals), overlapping generations within a colony of adults, and a division of labor into reproductive and non-reproductive groups. The division of labor creates specialized behavioral groups within an animal society that are sometimes called castes. Eusociality is distinguished from all other social systems because individuals of at least one caste usually lose the ability to perform at least one behavior characteristic of individuals in another caste.

In the first part of the book, the author discovers why brains expanded so slowly, and then why they stopped growing. This book hones down the number of theories on brain size evolution to a few, and these few lend themselves to testable hypotheses that lead to logical and practical explanations for the phenomenon. At the essence of this book is data resulting from original, previously unpublished research on brain size in several social mammals. These data support the idea that evolution of the brain in humans is the result of social interaction.

This book also traces the products of the social brain: ideology, religion, urban life, housing, and learning and adapting to dense, complex social interactions. It uniquely compares brain evolution in social animals across the animal kingdom and examines the nature of the human brain and its development within the social and historical context of complex human social structures. Caldararo proves that the reductions in human brain size follow the achievement of humans' enhanced eusociality, mainly triggered by domestication and complex social factors.

The second part of "Big Brains" scrutinizes the evolution of human consciousness as well as the idea of human cognition and the mind in the context of the physical means of function—that is, electrons, bonding, complex molecules and synapses. These physical means networks have formed a feature of life that Caldararo calls "humankind," with a uniform response to the environment. By this, he means "uniform" regarding "seeing" by mediating part of the spectrum of light. Also, learning by responding to physical states like greater or lesser amounts of heat provides a biological framework. And, the "mind" provides each being with a map of cognitive and behavioral responses to these stimuli. He calls this map "culture."

Then, he discusses whether the mind can exist without “culture” or “language.” Can one be human without language? Or is the mind a creation of environmental stimuli about the organism, retained and reused as brief encounters, which evolve into a collective and continuous experience of consciousness? Since this implies learning at the cellular level, and interaction of neurons in neural nets is ancient in the history of multicellularity (as Arendt noticed it), one would imagine so would be the “mind” or “consciousness.”

The author begins his investigation when stable life was invented, along with the domestication of plants and animals, from the earlier collecting platform of behavior that evolved from the Primate heritage beginning with Sahelanthropus over seven million years ago. That means it took a long time before the civilization started. Eventually, he addresses the problem of the mind and how human attempts to understand the mind are tied to ideas of cosmology, with humans as the center of creation, gods’ meanings, and the “reason” for the perceptions we have, such as the universe of stars. What can we learn about reality from this brain that can relate the life we find on Earth to that on the stars, and in fact, is what we call life so interrelated that we cannot separate ourselves from it?

Caldararo argues that central to our understanding of what the brain does for us is the effort to examine learning and its context, as well as the costs of learning and technology. In the past, the adults taught the children. He assesses that this has been true for almost 99 percent of human history. Today, we are increasingly learning from technology—television, computers, smartphones (which, of course, are computers)—and this learning takes place in different contexts: alone, in groups (class, workshops, etc.), and in virtual assemblies. Some scientists and health care professionals think that the way we are living is creating learning disabilities like ADD/ADHD, dyslexia, and autism spectrum disorders.

Descriptions of the educational setting in ancient Rome seem like those in the nineteenth century of rapidly industrializing England. What is not surprising for Caldararo is that the education of the children of rich and poor are still remarkably different in the twenty-first century, as they were in the nineteenth century, or the feudal past, due to economic inequality.

The author argues that the process of self-domestication has set us on the road to the kind of animal society, characterized by increased complexity and specialization, which some insects also have. But he reminds us that humans are the only animals that have self-domesticated, become food producers, and eliminated all their predators. Though cooperative defense against predators was not found to correlate with larger brains, the evolution of sociality may still arise as a defense against predation, and we see that parental care is associated with an attack on the young in both the prey and the predator.

He noted that insect eusociality was a successful adaptation to many challenges but failed to eradicate the species' predators, while humans appear to have achieved this at the end of the Mesolithic and the dawn of the Neolithic periods.

The author passes to the civilizing of humans, reminding us that now and then an alligator or tiger kills a human, usually a child or person unaware, but we are not threatened in general by such animals. Our teaching has changed from an individual context to a mass setting, parallel to the mass media that have gone from scrolls and parchment, clay tablets, or newsprint to machines like computers. Thus, he considers that humans evolved to a kind of "superorganism."

He noticed that as our sheer numbers in communications have increased, the density of our living arrangements and arguments become greater. Therefore, the needs for providing solutions for these masses must change the way humans communicate. Shorter and faster signals are delivered with more general references and are sent out on microwaves like texting, which can influence millions—and perhaps billions—in ways human society has never achieved before, inflicting surrender or submission. He reminds us that organizing others to build, fight or surrender requires useful forms of communication. Surrender and conversion are complex behaviors that we have learned so far.

The brain as the advanced thinking personal device is the pretext for the author to analyze our brain-based worldview—i.e., whether the universe is anthropocentric or indifferent? He reminds us that we often argue that humans have produced the only complex societies, domestication of plants and animals, structures, language and art. This claim is an erroneous argument as numerous animals have achieved these features of social life, including art. Are humans then the pawns of the accident, and is the human mind a blank slate floating in a sea of a coincidence that it must learn to see as rationality or fated reactions of accidental molecules? Caldararo asks why it took so long to develop human culture and complex human society. And he replies that human physiology, especially the biology of the brain, might have been crucial in this long process of becoming who we are today. It is possible that the evolution of the human mind, under social selection, is already closing, partly because of self-domestication and advanced learning.

The author uses the brain factor in analyzing racism as a human disease, the housing crisis, and homelessness (he lives in California where 25% of all homeless people in the U.S. live) and so forth—all urgent issues of our contemporary civilization. He is right since the brain and its mind are responsible for the morale of our superorganism. It looks like a "software" driven mind today is not yet fully ready to successfully cope with these issues.

Caldararo's comprehensive analysis of the human brain in the central perspectives like biological and social is similar to Darwin's theory of evolution with compelling evidence in his 1859 book *On the Origin of Species*. Since then, it took 158 years to have a theory of the brain evolution, which indeed controlled human development.

Unfortunately, in the twenty-first century, due to the very rapid development of information technology and artificial intelligence, there is a claim that computers will be thinking faster than humans by about 2025, and we will face the rise of the singularity of a new human race. Ray Kurzweil is the author of this prediction; he also asserts that in the future, everyone will live forever. In a 2013 interview, he said that in 15 years, medical technology could add more than a year to one's remaining life expectancy for each year that passes, and we could then "outrun our deaths."

This review's author thinks that the human brain reached some well-functioning framework, but the mind has been transforming from a limited one into a bio-digital and bio-virtual hybrid. In its virtual side, it operates on data, information, concepts, knowledge, and wisdom provided by 2.5-plus billion users of the social networks, like Facebook, Instagram, Twitter, and Quora.

Hence, Caldararo's quest for the understanding of the evolution of the brain is not yet finished. He has to answer the question: is it possible that due to the virtual side of the mind, the meat-constructed brain will shrink as not used in full? What will change in our civilization due to our shrinking brain? The following table reflects this challenge.

Table 1. The Possible Outcomes of the Hybrid Mind (Bio-Digital)

Animals	Nervous System - Neurons in Billion	Cerebral Cortex – Neurons in Billion	Number of Neurons in Virtual Mind	Cerebral Cortex in Hybrid Brain –Neurons
Human	100	20	Unlimited	Bigger or lower than in a meat-developed brain
African elephant	257	10-40	possibility	“ “
Chimpanzees	28	6.2	possibility	“ “
Rhesus macaque	6.4	1.7	possibility	“ “
Tufted capuchin	3.6	1.1	possibility	“ “
Capuchins	1.1	0.6	never	
Shrew	0.26	0.021	never	
Brown rat	0.20	0.031	never	
Ant species	0.00025	.10 cubic mm	never	

In the meantime, this book is the must read to learn about the human brain, for all those who claim that technology will replace the human brain very soon.

