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What made us human? Biological and cultural evolution of *Homo sapiens*

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The science of human evolution has recently been changing rapidly, and we know that *Homo sapiens* is the last surviving branch of a once-luxuriant tree of hominid species. Until very recent times, our lineage shared the planet with several other human species, such as those containing *Homo neanderthalensis*, *Homo erectus* and *Homo floresiensis.* Following its biological and anatomical birth in Africa around 200,000 years ago *Homo sapiens* spread around the world, following multiple paths of expansion that we can now track using the techniques of molecular biology, ancient DNA studies and paleoanthropology. In this global, ecological and demographic scenario, at one point our species began to express cognitively modern behaviors: a "symbolic intelligence" so peculiar that scientists view it as the hallmark of human creativity and uniqueness itself. Was there a gap between our biological birth and our intellectual birth? Was the process a gradual or a punctuational one? What triggered the so-called Paleolithic Revolution? How did our cultural evolution interact with our biological evolution? What might have been the role of other human species? Is articulate language our "secret weapon"?

This Special Issue addresses these questions, gathering the contributions presented in the meeting held in the beautiful context of the Erice International School of Ethology[1] from October 14th – 19th, 2014. Very importantly, the versions published here have been updated with the latest findings and the most recent literature. The workshop was the second in a program of meetings dedicated to human evolution and human uniqueness, and followed the first workshop held in June 2012, titled *Evolved Morality. The biology and philosophy of human conscience*[2].

The meeting involved prominent experts in primatology, paleoanthropology, genetics, anthropology, ethology and philosophy, and originated in discussions between paleoanthropologist Ian Tattersall, philosopher of science Telmo Pievani and ethologist Stefano Parmigiani, on how best to shed light on deep questions that necessarily require a cross-disciplinary effort.

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[1] Directors of the School: Prof. Danilo Mainardi & Prof. Stefano Parmigiani.

[2] De Waal F. B. M., Churchland P. S., Pievani T. & Parmigiani S. (eds.) 2012. *Evolved Morality. The biology and philosophy of human conscience.* BRILL, Leiden-Boston.

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In the context of paleoanthropology and morphology, **Karen Baab** carefully explores the principal evolutionary scenarios proposed to explain the presence of *Homo floresiensis* on the remote Indonesian island of Flores in the Late Pleistocene. **William Harcourt Smith** focuses his analysis on bipedalism, a defining trait of hominins. Hominin fossil discoveries of the last few years show that there was more locomotor diversity than previously thought, arguing for a subdivision of the term itself, and confirming that morphological experimentation was a key feature of hominin evolution. The group coordinated by **Giorgio Manzi** presents the first detailed description of, and the computer-assisted reconstruction of cranial vault morphology in, two fossil fragments found in the Acheulean layer of Gombore II (Melka Kunture formation, Upper Awash, Ethiopia), dating to 875±10 ka. They conclude that these remains may fill the phenetic gap between *Homo ergaster* and *Homo heidelbergensis.* **Thomas Plummer** and **Laura Bishop** present recent archeological findings from the oldest Oldowan site of Kanjera South, on the Homa Peninsula of southwestern Kenya, with an emphasis on the peculiarities of the paleo-habitat. The uses of the artifacts from the site are discussed, and consideration is given to the impact of this material culture on the evolution of features such as cooperation and brain and body size. **Jeffrey Schwartz** presents a thorough morphological analysis of a wide set of hominin samples. On this basis he challenges many common assumptions that are taken for granted by taxonomists, and concludes that an entire *Homo sapiens* clade needs to be invoked to explain the morphological diversity he documents.

The evolution of the human brain and cognition is addressed from various different perspectives.

Emiliano Bruner and colleagues assume an "embodied cognition" perspective, viewing cognition and the visuospatial integration system defining it as the ability to coordinate the nervous system (the inner environment) with the outer environment, through the interface of the body. Since material culture has had a huge impact in human evolution, they analyze evolutionary neuroanatomy, manipulative behaviors, and hand evolution. **Dean Falk** discusses a set of hominin infant developmental features that might have played a pivotal role in determining the evolution of modern human brain development. **Antonella Tramacere** and **Pier Francesco Ferrari** provide a comparative perspective on primate empathic abilities, with a focus on the mirror neuron system of mouth/face action and expression.

Another major focus is represented by the evolution of language and human modern cognition. **Philip Lieberman** recapitulates some of the main features of the classical debate on language evolution. He argues against a punctuationist view and in favour of the role of basal ganglia in supporting the neural circuits involved in linguistic tasks. **Giuseppe Longobardi** and colleagues apply the methods of population genetics to historical linguistics investigation. In particular, they address the formal study of syntactic variation (parameter theory) in the biolinguistic program, and the reconstruction of relatedness among languages (phylogenetic taxonomy). **Ian Tattersall** provides an evolutionary framework within which the gap might have been bridged between a putatively non-symbolic and non-linguistic ancestor, and modern humans who are able to manipulate information symbolically and to communicate linguistically.

Rob DeSalle addresses the molecular genetic information that sheds light on the past of *Homo sapiens*. Systematics usually relies on phylogenetic trees to depict the relationship among species and higher taxa; however, within a species recombination and admixture produce a much more reticulated pattern, in which hierarchical structuring is difficult to recognize. DeSalle discusses which models should be preferred in the interpretation of the past of our species, and why.

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As for the ecology of human evolution, **Andrea Parravicini** and **Telmo Pievani** offer a multi-level view of human phylogeny. Stressing the importance of ecological factors such as climate instability, they analyze the macroevolutionary patterns emerging from recent discoveries, and suggest in what ways they may reflect some pivotal features of human evolution.

In the realm of evolutionary medicine, **Paola Palanza** and **Stefano Parmigiani** touch upon a very topical theme: the impact of human evolution studies on medicine and psychology degree programs. In order to better understand human body and mental pathologies, students of these disciplines should be taught to deal not only with mechanisms (proximate cause), but also with ultimate cause, namely the phylogenetic bases underlying specific structures or functions.

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