

FITTING THE LADDER TO THE TREE: A COMMON SENSE VIEW ON THE COGNITIVE EVOLUTION OF THE PLEISTOCENE HUMAN LINEAGE

BY

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Abstract

The mismatch between the human paleoanthropological 'tree' and the paleo-cognitive 'ladder' has been recently attributed to epistemological biases affecting the mainstream narratives on cognitive evolution. The present paper takes issue with such a perspective and argues for a rather continuous cognitive development along the human lineage, as documented archaeologically by the early emergence of a 'familiar' human mind and by the cumulative features of Pleistocene cultural evolution in general. These facts seriously question the paleo-cognitive relevance of the acknowledged branchy taxonomy and point strongly towards a more anagenetic view on human biological evolution. Moreover, as the prerequisites for complex behavior and a consistent ability for cultural transmission were already among the capacities of the Homo erectus grade, the scope of further major cognitive changes, as usually invoked in connection to the emergence of Homo sapiens sapiens, appears limited.

Keywords: Paleolithic, cognition, paleoanthropology, cultural evolution, Homo erectus.

1. INTRODUCTION

Human phylogenetic evolution is conventionally depicted as a branching tree¹, with several hominin² species living side by side at least on a world scale and in geological temporal terms³. Cognitive evolution is, however, subject to a different representation. It is often described as a progressive, unilinear ladder, with primate-like brain sizes and minds on the lower end and the modern *sapiens* cognition and cerebral volume on the other⁴. As part of the mainstream 'Out of Africa' model, many scholars picture the last step as a speciation event⁵,

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¹ R. Lewin, R. A. Foley, *Principles of Human Evolution*, Blackwell, Malden, 2004; I. Tattersall, *Language and the origin of symbolic thought*, in *Cognitive Archaeology and Human Evolution*, (eds. S. A. de Beaune, F. L. Coolidge, T. Wynn), Cambridge Univ. Press, Cambridge, 2009, pp. 109–116; B. Wood, *Reconstructing human evolution: Achievements, challenges, and opportunities*, in *Proceeding of the National Academy of Sciences (USA) (PNAS)*, 107 (suppl. 2), 2010, pp. 8902–8909.

² For the use of 'hominin' instead of 'hominids', see *Ibidem*.

³ The contemporaneity between *Homo ergaster* and robust Australopithecus in Africa, or the parallel chronology of *Homo neanderthalensis*, *Homo sapiens sapiens* and late *Homo erectus*, including *Homo floresiensis*, between 200 and 30 kyr BP provide typical examples. See C. Finlayson, *Biogeography and evolution of the genus Homo*, in *Trends in Ecology and Evolution (TEE)*, 20 (8), 2005, pp. 457–463.

⁴ Cf. M. Langbroek, *Trees and ladders: A critique of the theory of human cognitive and behavioural evolution in Palaeolithic archaeology*, in *Quaternary International (QI)*, 127, 2012, pp. 4–14.

⁵ R. Klein, *The Human Career. Human Biological and Cultural Origins*, Chicago Univ. Press, Chicago, 1999; P. Mellars, *Why did modern human populations disperse from Africa ca 60,000 years ago? A new model*, in *PNAS*, 103, 2006, pp. 9381–9386.

finally separating the ‘fluid’ minds of Anatomically Modern Humans (AMH) from the less proficient counterparts of archaic hominins⁶.

The linear shape of cognitive evolutionary narratives certainly owes a lot to the referential framework used, essentially based on primate ethology, developmental psychology and extant hunter-gatherers’ ethnography⁷. However, synthetic narratives on Pleistocene cultural evolution embrace a similarly accretive perspective, connecting key innovations, such as complex technologies⁸, expanded social networks⁹ or symbolically mediated behavior¹⁰, to a gradual increase in brain size¹¹ and major cognitive steps. Although no longer pictured as a smooth and continuous growth crowned by the climax brought about by the Eurasian Upper Paleolithic¹², the increasingly complex cultural adaptation experienced at least on the long run by Pleistocene humans is largely acknowledged.

On a first view, the triple mismatch between somatic, cognitive and cultural evolution seems to be at least in part a matter of scale or focus. Yet, the analytical split between the fundamentally discontinuous biological evolutionary framework, punctuated by speciation events, and the rather incessant growth of cognitive abilities and behavioral complexity remains disconcerting. Taken at face value, it may indeed leave the impression that ‘hard’ paleoanthropological data, buttressed by the scientifically solid neo-Darwinian evolutionary theory, are overlooked by the largely speculative, qualitative and teleologically oriented narratives forged in the social sciences. Unquestionably, focusing on the gradual side of cognitive evolution may smooth out a great deal of synchronic variability and hide potentially idiosyncratic behaviors of ancient hominins¹³. Past differences in brain structure, organization or ontogenetic development¹⁴ make perfect evolutionary sense and their behavioral outcomes are worth a careful assessment. Whether they provide enough support for a branchy depiction of human *cognitive* evolution is a different matter, however.

The admittedly qualitative perspective defended in the following lines grows on the premise that somatic and cultural changes display a strong co-evolutionary connection. There are solid grounds to infer that cognition followed a similar path, if not necessarily the same rhythm – and there are many theoretical and empirical arguments in support of a more fluid (and likely faster) itinerary towards the sapient mind.

⁶ E.g., S. Mithen, *Prehistory of the Mind*, Thames and Hudson, London, 1996; L. Gabora, *Contextual focus: A cognitive explanation for the cultural transition of the middle/upper Paleolithic*, in *Proceedings of the 25th annual meeting of the cognitive science society, Boston MA, July 31–August 2*, (eds. R. Alterman, D. Hirsch), Lawrence Erlbaum Associates, Hillsdale NJ, 2003; F. L. Coolidge, T. Wynn, *Implications of a strict standard for recognizing modern cognition in prehistory*, in *Cognitive Archaeology and Human Evolution* (eds. S. A. de Beaune, F. L. Coolidge, T. Wynn), Cambridge Univ. Press, Cambridge, 2009, pp.117–128. In a rather dramatic reading, ‘[t]he abruptness and synchronicity of this Old-World-wide elimination of competing hominid forms suggests that, whatever it was about *Homo sapiens sapiens* that suddenly positioned our species as the sole hominid on the planet, it cannot simply have been an extrapolation of preexisting evolutionary trends in the human lineage. For a simple incremental addition to those trends, if indeed trends they were, is highly unlikely to have resulted in the wholesale elimination of all the competing lineages that had embodied them’ (emphasis mine, I. Tattersall op. cit. [n. 1], pp. 109–111). The statement raises many issues. First, we do not know if the ‘elimination’ of preexisting hominids actually took place ‘abruptly’ and in a truly ‘competing’ environment. Especially in the better-documented case of Neanderthals, cultural and genetic assimilation were possible and even likely (J. Zilhão, *Neandertals and Moderns Mixed, and It Matters*, in *Evolutionary Anthropology [EvA]*, 15, 2006, pp. 183–195). Moreover, according to the branchy taxonomy defended by I. Tattersall, several similar replacements must have happened before the advent of AMH. Apparently, they do not deserve an equally dramatic description.

⁷ M. Langbroek, op. cit. (n. 4).

⁸ N. Pigeot *Réflexions sur l’histoire technique de l’homme. De l’évolution cognitive à l’évolution culturelle*, in *Paléo*, 3, 1991, pp. 167–200; S. A. de Beaune, *The invention of technology*, in *Current Anthropology (CA)*, 45 (2), 2004, pp. 139–162; C. Gamble, *Origins and revolutions. Human identity in earliest prehistory*, Cambridge Univ. Press, Cambridge, 2007.

⁹ M. M. Lahr, R. A. Foley, *Towards a Theory of Modern Human Origins: Geography, Demography, and Diversity in Recent Human Evolution*, in *Yearbook of Physical Anthropology (YPhA)*, 41, 1998, pp. 137–176.; R. A. Foley, C. Gamble, *The ecology of social transitions in human evolution*, in *Philosophical Transactions of the Royal Society, Biological Sciences (PhTRS-B)*, 364, 2009, pp. 3267–3279.

¹⁰ M. Donald, *The Origins of the Modern Mind. Three Stages in the Evolution of Culture and Cognition*, Harvard Univ. Press, Harvard, 1991; F. d’Errico, C. B. Stringer, *Evolution, revolution or saltation scenario for the emergence of modern cultures?* in *PhTRS-B* 366 (1567), 2011, pp. 1060–1069; C. S. Henshilwood, B. Dubreuil, *The Still Bay and Howiesons Poort, 77–59 ka. Symbolic Material Culture and the Evolution of the Mind during the African Middle Stone Age*, in *CA* 52 (3), 2011, pp. 361–400.

¹¹ R. I. M. Dunbar, *The social brain hypothesis*, in *EvA*, 6, 1998, pp.178–190.

¹² The revolutionary status of the Eurasian Upper Paleolithic is still defended by some scholars – e.g. R. Klein, op. cit. (n. 5), P. Mellars, op. cit. (n. 5), I. Tattersall, op. cit. (n. 1) –, often in connection to the ‘superior’ mind of its conventional maker, *Homo sapiens sapiens*.

¹³ M. Langbroek, op. cit. (n. 4).

¹⁴ E.g. P. Gunz, S. Neubauer, B. Maureille, J.-J. Hublin, *Brain development after birth differs between Neanderthals and modern humans*, in *Current Biology (CB)*, 20, 2010, R921–R922.

It is perhaps useful to start by stating the obvious: irrespective of massive geographical shifts, genetic bottlenecks, drawbacks, drift, stasis episodes, evolutionary dead-ends and continental recolonizations, an *uninterrupted* phylogenetic chain connects genetically (at least one branch of) the first hominins to *Homo sapiens sapiens*, and culturally (some of) the first choppers to, say, Magdalenian backed bladelets. Some key aspects of hominin cognitive evolution, including the early-acquired capacity for *culturally mediated behavior*, display therefore an indisputable continuity, pointing to an evolutionary trend that transcended paleoanthropological grades – and ultimately question at least the paleo-cognitive relevance of the acknowledged biological taxonomy. More than being just the passive *expression* of cognitive stages, culture likely enhanced human cerebral and somatic development, providing a strong co-evolutionary feedback. Thanks to its own dynamics, bouncing between swift acceleration and dogged conservatism, cultural evolution may provide better explanation for the asynchronies/asymmetries noticed between the paleoanthropological tree and behavioral innovations/stasis episodes, usually associated to cognitive leaps/deficiencies. In fact, if not simply forged by taphonomy, which is often the case, many ‘mysterious’ behavioral choices of past hominins might be better explained as cultural rather than cognitive idiosyncrasies. This ultimately suggests that some of the acknowledged paleoanthropological taxonomic divisions are over-emphasizing somatic features of limited behavioral relevance, and the mismatch between the paleoanthropological tree and the cognitive/cultural ladder owes a lot to both theories and to the very nature of the record they are built upon.

2. MAPPING PAST COGNITION. SOME EPISTEMOLOGICAL ISSUES

As recently asserted in a collective volume¹⁵ and reviewed by T. Wynn¹⁶, several approaches dominate the research on past cognition today. The first are the linguistic approaches essentially connecting the emergence and evolution of human mind to the syntactical structures of language. The second, more action-oriented bulk emerged from the technologically based paleo-cognitive approach initiated many decades ago by A. Leroi-Gourhan. The third important theoretical stance is inspired by cognitive and developmental psychology; it tends to reduce cognition to mental representations and brain functioning. In their proximity, one could find the burgeoning family of evolutionary psychologists/sociobiologists, for which the human mind is a huge collection of computational modules individually designed by natural selection¹⁷.

Leaving aside its neural support¹⁸, cognition is largely immaterial. It does leave, however, material traces, especially artifacts – the bread and butter of archaeology. The methods commonly used for the retrospective assessment of past hominins cognition either rely (1) on the intrinsic properties of artifacts or (2) describe the sequences of action producing those artifacts (i.e., *chaînes opératoires*).

The first method (1) grows on conventional (mostly lithic) typologies, traditionally designed for mapping ‘cultural’ units. It usually evaluates artifacts’ morphometric features or formal complexity. Unfortunately, lithic tools are certainly no ‘smoking guns’¹⁹ for past cognition and relying on the shape of stone tools entails at least two disadvantages: the risk of *equifinality* (which often attracts the ‘minimum competence’ solution²⁰),

¹⁵ *Cognitive Archaeology and Human Evolution*, (eds. S. de Beaune, F. L., Coolidge, T. Wynn), Cambridge Univ. Press, Cambridge, 2009.

¹⁶ T. Wynn, *Whither evolutionary cognitive archaeology? Afterword*, in *Cognitive Archaeology and Human Evolution*, eds. S. A. de Beaune, F. L. Coolidge, T. Wynn), Cambridge Univ. Press, Cambridge, 2009, pp. 145–150.

¹⁷ For a comprehensive argumentation, see J. Tooby, L. Cosmides, *Conceptual Foundations of Evolutionary Psychology*, in *Handbook of Evolutionary Psychology*, (ed. D. M. Buss), John Wiley & Sons, New Jersey, 2005, pp. 5–67; for a review, see also S. M. Downes, *Some Recent Developments in Evolutionary Approaches to the Study of Human Cognition and Behavior*, in *Biology and Philosophy (BPh)*, 16, 2001, pp. 575–595.

¹⁸ Neuroimaging, much like brain casts are certainly instructive for past hominin cognition (A. Kyriacou, E. Bruner, *Brain Evolution, Innovation, and Endocranial Variations in Fossil Hominids*, in *PaleoAnthropology [PA]*, 2011, pp. 130–143). However, they provide at best indirect hints regarding the chronology of phylogenetic changes experienced by human cognition, so far better mapped by the much richer archaeological evidence.

¹⁹ F. L., Coolidge, T., Wynn, *Implications of a strict standard for recognizing modern cognition in prehistory*, in S. A. de Beaune, F. L. Coolidge, T. Wynn (eds.), op. cit. (n. 15), p. 122.

²⁰ If the simplest procedure for making the artifact is emphasized, then an underassessment of actual prehistoric abilities becomes highly likely. While definitely required, prudence can go excessively far. For instance, the Lower Paleolithic wooden spears at Schöningen eventually show, among other elaborated features, a ‘decoupling of need and satisfaction’. See M. N. Haidle, *How to think a simple spear*, in S. A. de Beaune, F. L. Coolidge, T. Wynn (eds.), op. cit. (n. 15), p. 69. One may wonder if such a decoupling was not already involved in the making of the first handaxe a million years or so before.

and the by now well-known *finished artifact fallacy*²¹. Method (2) offers the notable advantage of being able to follow carefully extended sequences of action; it depends, however, on qualitative evaluations of deliberation, planning, choice and ultimately complexity. Our argumentation will invoke both these methods, regularly employed in designing the trait-lists/constellations of knowledge²², themselves associated, for better or worse, to various cognitive stages. However, before reaching to that, some other pressing issues have to be dealt with.

Archaeologists describe the generation of the archaeological record using the now famous uniformitarian principle – similar outcomes suppose similar causes. This explanatory pattern is usually applied to the natural processes implicated in the formation of the archaeological record. It is also applied to past human action, that is, to cultural formation processes, although the casuistic here is far richer and the actualistic models in use (e.g. ethnographic analogies) much more disputed. This common practice suggests that uniformitarianism is at least to a certain extent applicable to ancient *minds* as well. Less problematic in the case of ancient *Homo sapiens sapiens*, at least in theory, this spontaneous propensity raises, however, thorny epistemological issues in the case of past hominin minds.

Following the Piagetian tradition of developmental psychology or not, all paleo-cognitive approaches above take the modern sapient mind as the fully formed outcome of a long evolutionary sequence. Explicitly or not, such a perspective assumes that the modern mind is likely *superior* to its previous counterparts, to which also shares at least some *identity*. When it comes to ancient mind reading, despite honest claims to the contrary²³, most researchers proceed more or less subtly through ‘reverse engineering’, inferring the missing parts in the case of extinct hominins. Unfortunately, more often than not peeling the cognitive onion leaves the door open for a blatant retrospective racism²⁴. While this is a serious issue to reflect upon, the ‘identity plus superiority’ stand has some deep epistemological ramifications.

After all, does the modern human mind really provide the relevant standard for understanding past hominin species cognition? A dangerous but very real possibility is that we might never know. For a positive answer, one must minimally assume an uninterrupted phylogenetic continuity of cognitive development, punctuated by merely *quantitative* additions. If, however, one or more truly *qualitative leaps* were involved, then an accurate understanding of extinct hominin minds, and of animal intelligence altogether, becomes exceedingly difficult²⁵. In biological terms, such leaps would entail derived features belonging exclusive to *Homo sapiens sapiens* cognition or for that matter, extinct hominin lineages²⁶. Darwinian orthodox thinking holds every species as adaptively unique in respect to its environment: no hierarchy of complexity or teleology is allowed within this theoretical structure. By drastically limiting the range of both ethnographic and primatological analogies, such orthodoxy raises the potentially insolvable²⁷ problem of dealing with mutually incommensurable ‘worldviews’ and behavioral patterns. The paradox is obvious and a little amusing: because of their unique evolutionary status, as postulated by a scientific theory designed to prove precisely their ontological connection to the animal world, humans cannot truly understand animal minds!

The oft-experienced alternative is to allow an exception from orthodox Darwinism and admit that the generally blind nature of biological evolution omitted the general evolution of intelligence and especially excepted, in the last several million years or so, a certain primate lineage. In fact, the inter-species hermeneutic circle cannot be broken unless we postulate, perhaps arrogantly, that the human mind provides a reasonable proxy for any (past or present) kind of intelligence in the Universe, to which is also intimately connected. Put differently, evolution conspired for its best shot, the modern human mind. Unfortunately, it is also the only mind we know *from inside*. Thus, accepting that modern evolutionary synthesis has certain limits when it comes to humans is selling a paradox for a tautology. The ‘identity plus superiority’ postulate is all the more suspicious as we know our

²¹ This rather common error amounts to inferring intentions and mental templates from the arbitrary state of preservation of artifacts, which may simply be the results of a long life cycle of production and use.

²² Technological ‘modes’ are much more popular today than, say, convergent sidescrapers – and for good reasons. However, when ‘typical’ reduction sequences simply replace ‘typical’ artifacts, technology may easily become the new typology. In the present paper, the lithic modes are used as no more than convenient shortcuts.

²³ T. Wynn, *op. cit.* (n. 16), p. 146.

²⁴ For an excellent critique, see J. D. Speth, *News flash: negative evidence convicts Neanderthals of gross mental incompetence*, in *World Archaeology* (WA), 36 (4), 2004, pp. 519–526.

²⁵ See for a comprehensive treatment of the same issue, D. Lestel, *Originile animale ale culturii*, Ed. Trei, București, 2004, *passim*; D. Dennett, *Tipuri mentale*, Ed. Humanitas, București, 2006, *passim*.

²⁶ M. Langbroek, *op. cit.* (n. 4).

²⁷ The idiosyncratic behavioral patterns invoked by the defenders of this perspective are at best suspect and at worst illusory: they stretch imagination usually towards the primate extreme (see *Ibidem* and references therein).

mind is a biologically limited kind of mind: it is tuned for perceiving only certain environmental clues, has a limited processing ability and so on. Why should it be the best? Can we make sure that human cognition has kept *all* crucial features of previous patterns of cognition, to which it added only several quantitative layers? In theory, it is quite possible that some features vanished along our evolutionary trajectory; after all, we have lost many senses when compared to other animal species that retained them. It is equally possible that we have become unable to understand or even perceive the existence of certain forms of intelligence.

We cannot dissipate all these doubts. The tautology gets milder, however, if we resume our inquiry to understanding the emergence of *our* kind of mind and focus on some tightly connected, recent phylogenetic stages. From such an inclusive perspective, what we know for sure is that human mind is a *concept-structured*²⁸ mind, which can (re)cognize similar minds and can only describe other, by default simpler forms of intelligence²⁹. While this may seem as an over-simplistic, common-sense description of the human mind³⁰, it certainly captures the essence of what *we* know about thinking in general. If we cannot avoid the common sense, perhaps we should embrace it.

For many scholars, common sense is the science's worst enemy and this applies especially to the very source of common sense, the human mind. Challenging taken-for-granted views is often the engine of scientific inquiries and it usually works well. However, defying common sense entirely may lead to rather bizarre conclusions: for instance, that the Early Upper Paleolithic pendant-use, bone technology or complex foraging strategies may stand for modern behavior but not for sapient cognition³¹! A similar defiance of common sense led many scholars to promote a flagrant confusion between cognitive and cultural evolution. For instance, Lower or Middle Paleolithic hominins can never provide enough evidence for abilities easily granted to AMH on similar archaeological contexts³². Double standards are mercilessly applied especially to Lower Paleolithic hominins, regularly pictured as genetically inept, humble and conservative 'ecological creatures'. In order to exist, most Lower Paleolithic innovations – e.g. controlled fire-use, symbolic marks or systematic transfer of technological knowledge – need to have been first 'habitual', 'consistent', 'recurrent'. However, if cognition is indeed a matter of innate individual capabilities – which is not necessarily and entirely true³³ –, than a *single* chronologically secure and well documented case of 'innovative' behavior is logically enough to prove the actual capacities of an *entire clade*³⁴. Put differently, a *single* stratigraphically secure Neanderthal burial should suffice in proving that *all* Neanderthals were able to bury their dead; the reasons for the rarity of a particular practice should be further searched either into the arbitrariness of their cultural universe or into the realm of taphonomy. 'Straws in the wind'³⁵ or not, *first occurrences*, no matter how deceptive they will eventually

²⁸ The very definition of 'other' or for that matter, 'own' mind, provides a peremptory proof for a *qualitatively* unique mind, for which we have no proof of being present among other species, at least not to any comparable extent. See for similar arguments, E. J. Lowe, *Personal Experience and Belief: the Significance of External Symbolic Storage for the Emergence of Modern Human Cognition*, in *Cognition and Material Culture: the Archeology of Symbolic Storage*, (eds. C. Renfrew, C. Scarre), McDonald Institute for Archaeological Research, Cambridge, 1998, pp. 89–96.

²⁹ D. Dennett, op. cit. (n. 25).

³⁰ This should not be taken to imply a revival of the 'Standard Social Science' mind model – a content-free, general-purpose learning mechanism – that provoked evolutionary psychologists so much discontent (J. Tooby, L. Cosmides, op. cit. [n. 17]), although their own modular perspective on human mind was (and still is) poorly backed up by archaeological evidence (but see S. Mithen, op. cit. [n. 6], for an heroic attempt to conjure some empirical support). Evolutionary psychology may be right in decrying the persistent use of 'folk categories' like 'attention', 'memory', 'reasoning' or 'learning' (J. Tooby, L. Cosmides op. cit. [n. 17], p. 45). However, until their own models would become capable to approach archaeological case studies, these categories are largely unavoidable. There are in fact many convincing arguments *against* a massively modular phylogeny of intelligence (C. P. van Schaick, J. M. Burkart, *Social learning and evolution: the cultural intelligence hypothesis*, in *PhTRS-B*, 366 [1567], 2011, pp. 1008–1016).

³¹ F. L. Coolidge, T. Wynn, op. cit. (n. 17). Paradoxically, the statement involves one of the defenders of an early origin of a more or less familiar mind (or at least 'operational intelligence'), T. Wynn. Fortunately, the authors themselves are aware that their standards revolving around 'enhanced working memory' may be found too strict.

³² Cf. W. Roebroeks, R. Corbey, *Periodisations and double standards in the study of the Palaeolithic*, in *Hunters of the Golden Age. The Mid Upper Palaeolithic of Eurasia 30,000–20,000 BP*, (eds. W. Roebroeks, M. Mussi, J. Svoboda, K. Fennema), Leiden Univ. Press, Leiden, 2000, pp. 77–86.

³³ D. S. Wilson, J. J. Timmel, R. R. Miller, *Cognitive cooperation. When the Going Gets Tough, Think as a Group*, in *Human Nature (HN)*, 15 (3), 2004, pp. 225–250.

³⁴ B. Dubreuil, *Paleolithic public goods games: why human culture and cooperation did not evolve in one step*, in *BPh*, 25, 2010, pp. 53–73.

³⁵ I. Tattersall, *Macroevolutionary Patterns, Exaptation, and Emergence in the Evolution of the Human Brain and Cognition*, in *Human Brain Evolution. The Influence of Freshwater and Marine Food Resources*, (eds. S. C. Cunnane, K. M. Stewart), Wiley-Blackwell, New Jersey, 2010, p. 6.

prove for the incessantly changing archaeological chronological frameworks, *do matter*³⁶. Curiously, this common-sense observation is often overlooked and meandering explanations are built in order to avoid its implications: Occam's razor looks too blunt for many modern analysts of paleo-cognition.

A more indulging, empirical and qualitative understanding of cognition will be preferred in the following, based on our (evolved) capacity for recognizing human-like intelligent behavior³⁷. There is a strong empirical support in defending an early age for the emergence of such a familiar mind. Moreover, if modern human cognition is not the result of natural selection alone – and I think it is not – there are no theoretical reasons to have it lingering submissively along the branches of the paleoanthropological tree.

3. TRIMMING OUT THE PALEOANTHROPOLOGICAL TREE

Synthetic paleoanthropological perspectives³⁸ include into the human phylogenetic tree at least the following hominin grades: **(1) possible hominins** (*Ardipithecus ramidus*, *Orrorin tugenensis*, *Sahelanthropus tchadensis*, *Ardipithecus kadabba*), with a chronology generally in excess of 4 Ma; **(2) archaic hominins**, i.e. Australopithecus (ca. 4–2.4 Ma) and Megadont/Paranthropus (2.3–1.4 Ma); **(3) transitional hominins**, *Homo habilis* and *Homo rudolfensis* (2.4–1.6 Ma); **(4) premodern Homo**, a bushy grade including several taxa, such as *H. erectus* (1.8 Ma – 30 ka BP), *H. heidelbergensis/rhodesiensis* (600–100 ka BP), *H. ergaster*, *H. antecessor*, *Homo floresiensis* (74–17 ka BP), and *Neanderthals* (200–28 ka BP); and **(5) Anatomically modern humans**, from ca. 200 ka BP on, with physical features ‘indistinguishable from the morphology found in at least one regional population of modern humans’³⁹.

As an outcome of the natural science of biology, bolstered with metric details and at times shielded by a difficult terminology, the branchy tree of the human lineage might indeed intimidate humanistic-minded scholars. However, despite the hard look, in both theory⁴⁰ and practice the proposed structure is more equivoque than usually thought: ‘[...] when all is said and done a taxonomy is just a hypothesis; it is not written on stone tablets’⁴¹. For instance, paleoanthropologists who prefer a more anagenetic interpretation of the fossil record naturally identify fewer species, contrary to those defending a more cladogenetic representation who will stress in turn a more complicated taxonomy⁴². Even worse, paleoanthropologists often use different species *concepts*, further complicating the picture⁴³.

Leaving aside the generally poor preservation of fossils themselves, anthropometric features seldom allow for straightforward conclusions⁴⁴; opposing interpretations can grow on the same fossil data⁴⁵. What is even worse, only a tiny amount of metric variables (11%) was common between the defenders of various evolutionary scenarios – a decade ago at least⁴⁶! With such a minor input of empirical crosschecking, paradigmatic autism can easily take control of taxonomic polemics. While providing a promising complement

³⁶ See R. G. Bednarik, *The Human Condition*, Springer, New York, 2011, for a throughout and occasionally radical argumentation.

³⁷ See D. Dennett, op. cit. (n. 25), for an instructive approach.

³⁸ I use here the synthetic outline recently proposed by B. Wood, op. cit. (n. 1); for alternative readings, see R. Lewin, R. A. Foley, op. cit. (n. 1); C. Finlayson, op. cit. (n. 3); I. Tattersall, op. cit. (n. 1).

³⁹ B. Wood, op. cit. (n. 1), p. 8904.

⁴⁰ K. M. Weiss, *Agnology. How can we handle what we don't know in a knowing way?*, in *EvA*, 21, 2012, pp. 96–100.

⁴¹ B. Wood, op. cit. (n. 1), p. 8908.

⁴² The problem has actually wider connotations: „In disciplines dealing with living organisms, it is often possible to group theorists according to their tendency either to seek or to oppose generalizations. This is sometimes referred to as the opposition between “lumpers” and “splitters.” The former tend to model reality along a few generalized classes or distinctions, whereas the latter have a propensity either to divide models into multiple classes to gain precision or to reject generalizations altogether in favor of particularistic accounts. Lumpers argue that science produces relevant knowledge by making generalizations from limited data, whereas splitters see generalizations as a threat to exactitude” (B. Dubreuil, *Human Evolution and the Origins of Hierarchies. The State of Nature*, Cambridge Univ. Press, Cambridge, 2010, p. 140).

⁴³ B. Wood, op. cit. (n. 1), pp. 8907–8908.

⁴⁴ K. L. Baab, K. P. McNulty, F. J. Rohlf, *The Shape of Human Evolution: A Geometric Morphometrics Perspective*, in *EvA*, 21, 2012, pp. 151–165.

⁴⁵ Compare, for instance, K. Harvati, *The Neanderthal Taxonomic Position: Models of Intra- and Inter-Specific Craniofacial Variation*, in *Journal of Human Evolution (JHE)*, 44, 2003, pp. 107–132, with E. Trinkaus, *European early modern humans and the fate of the Neanderthals*, in *PNAS*, 104 (18), 2007, pp. 7367–7372.

⁴⁶ C. M. Willermet, G. A. Clark, *Paradigm crisis in modern human origins research*, in *JHE*, 29, 1995, pp. 487–490.

to fossils physical descriptions, genetic studies are equally open to divergent interpretations⁴⁷. Coupled with the patently imprecise chronologies and random fossil sampling, the resulting tree is not only branchy, but also certainly a bit shakier than one would wish.

It is worth highlighting that the tree also focuses on the ‘organism’s hard-tissue phenotype’⁴⁸. Apart from the otherwise informative data on energetics, pathologies, diet or locomotion, most *behavioral* features of past phenotypes, especially those of direct relevance for cognitive evolution, stay out of the paleontology’s reach – in archaeology’s hands. That explains why, although generally maintaining the structure above, models incorporating archaeological data⁴⁹ naturally tend to focus mostly on the last three grades: the ‘transitional hominids’ (or the first toolmakers, 3–1.7 Ma); *Homo erectus* (or the Acheulean maker, 1.6 Ma – 800 ka); the Middle Pleistocene/*Homo heidelbergensis* grade (700–500 ka); the Neanderthals/archaic *Homo sapiens* and Anatomically Modern Humans grade (Mousterian/Middle Stone Age, 200–40 ka BP; Upper Paleolithic/Late Stone Age). Alternative models⁵⁰ recognize comparable grades and behavioral clusters, separated by key transitions: (1) African ape to terrestrial bipedal ape (around 4 Ma); (2) terrestrial bipedal ape (*australopithecine*) to ‘early *Homo*’ (around 2 Ma); (3) Early *Homo* to *Homo heidelbergensis* (1–0.8Ma); (4) *Homo heidelbergensis* to larger-brained *Homo* (from 500 ka), and (5) larger-brained *Homo* to *H. sapiens* (from 200 ka).

Archaeologically based models share several themes. First, there is a total agreement that the emergence of basal hominin sociality⁵¹, as part of our primate heritage, should be attributed to the very first evolutionary stages, possibly before the emergence of the *Homo* genus. One should also note the tendency of cutting down the bushy paleoanthropological taxonomy into *behaviorally* meaningful units. Although maintaining some boundaries, most models group the ‘larger-brained’ hominins like Neanderthals and *Homo sapiens sapiens* into the same grade. Finally yet importantly, they both look for the roots of somatic and behavioral ‘modernity’ *well before* the acknowledged emergence of AMH and certainly long before the advent of Eurasian Upper Paleolithic.

Empirically, fitting the cultural/cognitive evolutionary ladder to the paleoanthropological tree might appear like a challenging exercise, especially as the Pleistocene fossil archive is by orders of magnitude poorer than the already scanty Paleolithic archaeological record. Nevertheless, one should not push the ‘bushy’ aspect of the paleoanthropological tree too far and thus overemphasize the mismatch between the models. Brain increases – the very locus of cognitive changes – provide a first cautionary tale.

Larger brains are adaptively expensive: their benefits had to outweigh their costs in terms of metabolic demands, higher risks of accident or diseases, changes in female anatomy etc.⁵²; a strong selective pressure must have been at work to help biological evolution make this investment. Significantly, the increase in brain size along the human phylogeny experienced only *two* major bursts: one associated to the conventional emergence of the genus *Homo* (ca. 2 Ma ago, but see below), and one associated to *H. heidelbergensis* (ca. 500 ka ago).

Moreover, in conformity to the Darwinian logic, for which form has to precede function, later developments are generally exaptations of preexisting features. Even the defenders of the late advent of modern cognition admit that the neural substrate for all key cognitive abilities might have been in place well before seeing it manifested in material culture⁵³. The discrepancy between the paleoanthropological taxonomy and lithic modes, for instance, is notorious⁵⁴. Biological changes, including the increases in brain sizes, seem to have preceded the conventional cultural accomplishments of each hominin species: *Homo erectus* preceded

⁴⁷ T. D. Weaver, C. S. Roseman *New Developments in the Genetic Evidence for Modern Human Origins*, in *EvA*, 17, 2008, pp. 69–80. For a critical review of the use of genetic evidence in paleoanthropological matters, see R. G. Bednarik, op. cit. (n. 36), pp. 34–40 and references therein.

⁴⁸ B. Wood, op. cit. (n. 1), p. 8908.

⁴⁹ C. Finlayson op. cit. (n. 3); J. A. J. Gowlett *Deep Roots of Kin. Developing the Evolutionary Perspective from Prehistory, in Early Human Kinship. From Sex to Social Reproduction*, (eds. N. J. Allen, H. Callan, R. Dunbar, W. James), Oxford Univ. Press, Oxford, 2008, pp. 41–57.

⁵⁰ R. A. Foley, C. Gamble, op. cit. (n. 9); see also C. Finlayson, op. cit. (n. 3).

⁵¹ Apart from the very propensity for social life, the set of plesiomorphic features includes: ‘more prolonged parental relationships, which might be either sex or both, kin based relationships among resident adults, sex-based patterns of dispersal, more or less prolonged relationships between adult males and females, with one or more partners, some degree of tolerance of the presence of other members of the ‘society’, a lack of equivalent tolerance for members of another group (or at least a different pattern of behaviour) and some degree of structured or repeated style of relationship between individuals (e.g. dominance, submission, friendliness, aggression, etc.)’ (R. A. Foley, C. Gamble, op. cit. [n. 9], p. 3268; see also J. A. J. Gowlett, op. cit. [n. 49]; H. S. Kaplan, P. L. Hooper, M. Gurven, *The evolutionary and ecological roots of human social organization*, in *PhTRS-B*, 364, 2009, pp. 3289–3299).

⁵² L. C. Aiello, P. Wheeler, *The expensive tissue hypothesis*, in *CA*, 36, 1995, pp. 199–222.

⁵³ I. Tattersall, op. cit. (n. 1).

⁵⁴ F. L. Coolidge, T. Wynn, op. cit. (n. 19).

the Acheulean, *Homo heidelbergensis* the prepared core technology, *Homo sapiens sapiens* the Upper Paleolithic technological constellation and so on. If not related to differential research focus⁵⁵ or to highly unequal data sets – with the fossil record by orders of magnitude smaller than the archaeological contexts – this suggests that lithic technology is nothing but a *late echo* of mental capacities which appeared earlier, presumably in response to different pressures and manifested in behaviors of limited archaeological visibility. Put differently, the lithic innovations provide just the *terminus ante quem* for previous cognitive changes.

More important, however, is the technological *continuity* or at least *identity*, which apparently ignored the species' split. This leaves dramatically few options for paleoanthropology, forced either to design explanations for a consistent inter-species behavioral transfer and/or an analogous behavioral repertoire⁵⁶, or to take current taxonomy as describing at least in part cognitively similar (and possibly genetically compatible⁵⁷) varieties at subspecies level⁵⁸.

I am certainly not in the position to take issue with the existing paleoanthropological divisions. Nevertheless, it can be suggested that a more anagenetic representation might fit better current archaeological data. At least some physical features can be interpreted as resulting from isolation/genetic drift with no particular adaptive underpinnings⁵⁹. Certainly, 'palaeodemes' provide a better concept than 'species' for the morphological diversity recorded⁶⁰. The Neanderthal/AMH polymorphism provides a case at point. Taken for decades as separated species, they recently proved not only cognitively similar⁶¹, but also genetically compatible⁶². This is hardly surprising. While there is no clear standard for the minimum genetic or skeletal differences needed to identify species from the classic biological standpoint of reproductive isolation, the mammalian rates for hybrid non-viability range between 2 and 4 Ma, considerably longer than the most generous estimation of Neanderthal/AMH split (500 ka)⁶³ – and also much longer than most, if not all, earlier splits along the paleoanthropological chain. Although not undisputed⁶⁴, the incorporation of the Neanderthal lineage into the *sapiens* grade dissolved at least in their case many previously puzzling cases of 'unexpectedly modern' behavior. Although much more challenging empirically, given the poorer skeletal database, a comparable reframing might be possible for older hominins like *H. erectus*⁶⁵ or *H. heidelbergensis*⁶⁶, both clearly capable of familiarly human behaviors.

As a general observation, if variations in ontogenetic and epigenetic development indeed played a crucial role in human evolution, deepening the regional/temporal morphological variations of the *Homo*

⁵⁵ There are many instances when even these technological innovations show a rebel, much younger chronology. Significantly, they tend to appear in archaeologically poorly known areas, like Africa (S. McBrearty, A. S. Brooks, *The Revolution That Wasn't: A New Interpretation of the Origin of Modern Humans*, in *JHE*, 39, 2000, pp. 453–563).

⁵⁶ If the 'disconnect between anatomical and behavioral innovation actually makes eminent sense, for there is quite obviously no place that any innovation can arise, other than *within* species' (I. Tattersall, op. cit., n. 1, p. 112, original emphasis), I wonder what additional 'eminent sense' can be found for the variable use of Mode 2, 3 and 4 technologies by *H. heidelbergensis*, *H. neanderthalensis* and *H. sapiens* in various areas of Europe and Middle East.

⁵⁷ R. M. Harding, G. McVean, *A structured ancestral population for the evolution of modern humans*, in *Current Opinion in Genetics & Development (COGD)*, 14, 2004, pp. 667–674.

⁵⁸ There is also a third option, according to which each of the earlier hominins reinvented *on a higher level of complexity* its own stone technology, a hypothesis that seems surprisingly reasonable to some paleoanthropologists at least (I. Tattersall, op. cit. [n. 35], p. 3)!

⁵⁹ The Neanderthals supposedly cold adapted features (see T. C. Rae, T. Koppe, C. B. Stringer, *The Neanderthal face is not cold adapted*, in *JHE*, 60, 2011, pp. 234–239 and references therein) provide a good example.

⁶⁰ R. A. Foley, *In the Shadow of the Modern Synthesis? Alternative Perspectives on the Last Fifty Years of Paleoanthropology*, in *EvA*, 5, 2001, pp. 5–14.

⁶¹ J. Zilhão, op. cit. (n. 6).

⁶² For genetic evidence, see P. D. Evans, N. Mekel-Bobrov, E. J. Vallender, R. R. Hudson, B. T. Lahn, *Evidence that the adaptive allele of the brain size gene microcephalin introgressed into Homo sapiens from an archaic Homo lineage*, in *PNAS*, 103 (48), 2006, pp. 18178–18183; J. D. Wall, M. F. Hammer *Archaic admixture in the human genome*, in *COGD*, 16 (6), 2006, pp. 606–610; for skeletal evidence, see E. Trinkaus, op. cit. (n. 45).

⁶³ C. M. Barton, J. Riel-Salvatore, J. M. Anderies, G. Popescu, *Modeling Human Ecodynamics and Biocultural Interactions in the Late Pleistocene of Western Eurasia*, in *Human Ecology (HEc)*, 39 (6), 2011, pp. 705–725 and references therein.

⁶⁴ K. Harvati, op. cit. (n. 45).

⁶⁵ For such a perspective on *H. erectus*, see B. Asfaw, W. H. Gilbert, Y. Beyene, W. K. Hart, P.R. Renne, G. W. Gabriel, E. S. Vrba, T. D. White, *Remains of Homo erectus from Bouri, Middle Awash, Ethiopia*, in *Nature (Nat)*, 416, 2002, pp. 317–320.

⁶⁶ Anthropometric arguments are not entirely missing: '[t]here is undoubtedly a gradation in morphology that makes it difficult to set the boundary between anatomically modern humans and *H. heidelbergensis*, but the variation in the later *Homo* fossil record is too great to be accommodated in a single taxon' (B. Wood, op. cit., n. 1, p. 8904; see also R. A. Foley, op. cit. [n. 60], pp. 9–10).

genus, the same phenotypic plasticity, including complex niche construction, might have limited the scope of speciation events.

4. SKETCH OF A FAMILIAR MIND

Human adaptive success outcompetes by orders of magnitude the accomplishments of any animal species. The most popular explanation for this unique status is our superior cognitive abilities. Evolutionary psychologists describe the human ‘cognitive niche’⁶⁷ as including unique features like an elaborate technological know-how, high levels of cooperation and complex, grammatically structured communication – all requiring crucial cognitive pre-adaptations. Technologies are acquired through individual or social learning, asking for high level of attention, coordination and especially for the ability to imitate the behavior of others⁶⁸. Cooperation requires the recognition of other individuals, a good memory of their actions and the ability to classify those actions in relation to a reciprocity ‘contract’. It also asks for an array of moral emotions needed to initiate, sustain or break cooperation and punish cheaters. Intentional, causal and strategic thinking are also crucial components of human cognition⁶⁹. One may add a powerful capacity for associative/analogical thinking, connected itself to the associative structure of memory, both underpinning creativity⁷⁰. How did all these come into being?

The explanation of evolutionary psychology is that human brain is essentially a modular information-processing device⁷¹ designed by natural selection in an ‘Environment of Evolutionary Adaptedness’ (EEA)⁷². It is not however entirely clear how and when each module evolved and what was the exact timing of their superior integration⁷³. In general, it is supposed that small increments in know-how, cooperation or communication altered the selective pressures on their social environments, leading to a runaway process towards greater intelligence⁷⁴. The increase in brain size and the improvement of cognitive abilities noticed during the Pleistocene was thus the autocatalytic effect of living in the cognitive niche and complex social settings⁷⁵. The ‘social intelligence’ hypothesis⁷⁶ provides the most coherent diachronic expression of such a perspective.

There is, however, another evolutionary stream, which played a crucial role in human adaptive success and may bring light into our cognitive phylogeny: *cultural evolution*. Hominins were being social long before becoming cultural. The positive correlation between social skills, group complexity and brain size show that intelligence provides clear advantages in competitive social contexts⁷⁷: it helps manipulating complex situations, providing a fast positive feedback; it may further help in imitating and improving goal-oriented behaviors, that is, in acquiring *culture*⁷⁸. In fact, most derived human features⁷⁹ are underpinned by unique

⁶⁷ S. Pinker, *The cognitive niche: Coevolution of intelligence, sociality, and language*, in *PNAS*, 107 (Suppl. 2), 2010, pp. 8993–8999; see also J. Tooby, L. Cosmides, op. cit. (n. 17).

⁶⁸ True imitation (that is, the ability to copy processes and not outcomes) is often associated with the very birth of the human condition (M. Donald, op. cit. [n. 10]; M. Alvard, *The Adaptive Nature of Culture*, in *EvA*, 12, 2003, pp. 136–149; D. E. Lyons, A. G. Young, F. C. Keil, *The hidden structure of overimitation*, in *PNAS*, 104, 2007, pp. 19751–19756).

⁶⁹ D. Dennett, op. cit. (n. 25).

⁷⁰ L. Gabora, *The cultural evolution of socially situated cognition*, in *Cognitive Systems Research (CSR)*, 9, 2008, pp. 104–114; S. A. de Beaune, *Technical invention in the Palaeolithic: What if the explanation comes from the cognitive and neuropsychological sciences?*, in *Cognitive Archaeology and Human Evolution*, (eds. S. A. de Beaune, F. L. Coolidge, T. Wynn), Cambridge Univ. Press, Cambridge, 2009, pp. 3–14.

⁷¹ However, see C. P. van Schaick, J. M. Burkart, op. cit. (n. 30).

⁷² J. Tooby, L. Cosmides, op. cit. (n. 17). The EEA looks suspiciously like a mythical *illo tempore*. If there was indeed a dominant feature of Pleistocene environment, it was certainly its (increasing) instability, which, among others, allowed and improved the capacity for, and indeed dependence on, cultural transmission (P. J. Richerson, R. Boyd, R. L. Bettinger, *Cultural Innovations and Demographic Change*, in *Human Biology [HB]*, 81 [2–3], 2009, pp. 211–235).

⁷³ However, see S. Mithen, op. cit. (n. 6), for a coherent attempt.

⁷⁴ S. Pinker, op. cit. (n. 67).

⁷⁵ For some evolutionary theorists, social and ecological intelligence, acting as separated domains, reinforced each other (S. M. Reader, Y. Hager, K. N. Laland, *The evolution of primate general and cultural intelligence*, in *PhTRS-B*, 366 [1567], 2011, pp. 1017–1027). For others, the integrated web-like structure of human memory and cognition make this modular distinction largely irrelevant (e.g. L. Gabora, op. cit. [n. 70]).

⁷⁶ R. I. M. Dunbar, *The social brain hypothesis*, in *EvA*, 6, 1998, pp. 178–190.

⁷⁷ Most extant primates display clear signs of ‘Machiavellian intelligence’ and this correlates well with their group size and larger brain volume (R. W. Byrne, *Machiavellian Intelligence*, in *EvA*, 5, 1997, pp. 172–180).

⁷⁸ ‘Large brains in mammals are most likely to be a consequence of the intellectual challenges arising from permanent social living, including the consequent opportunities for enhanced learning’ (*Ibidem*, p. 176).

⁷⁹ Cf. R. A. Foley, C. Gamble, op. cit. (n. 9).

mechanisms associated with the capacity for culture, here minimally understood as socially transmitted information⁸⁰. Humans display a unique propensity for, and indeed dependence on, social learning⁸¹, which by necessity affected both the ontogenetic and the phylogenetic development of cognition. An increasing number of studies suggest that cultural practices have extensively altered biological pressures acting on our species⁸²: hominins opened not only a cognitive, but also a ‘cultural niche’⁸³. Culture allows a rapid adaptation to changing environments⁸⁴, fast access to information about past or present events, improved coordination and coherent collective action⁸⁵. More importantly, once established, culture displays a strong *cumulative* tendency, allowing far more complex adaptations than would have been possible by natural selection alone or by relying plainly on individual intelligence, no matter how creative⁸⁶. According to a Darwinian logic, culture could not appear simply because it was adaptively advantageous⁸⁷. In spite of the obvious benefits brought by accumulated cultural information, ‘[s]election’ is unlikely to favor the cognitive abilities to transmit complexity that doesn’t exist⁸⁸. An exaptation of some other preexisting cognitive abilities is therefore likely.

On a theoretical level, the very emergence of culture thus asks for a population in which observational learning is *already* widespread, which points in turn to another crucial cognitive acquisition: the ‘*theory of mind*’, that is, the ability to represent others as intentional agents⁸⁹. The simplest theory of mind is about understanding the perspective of another participant. Apes can do that; however, they cannot ‘put into equation the perspective the other participant has on their perspective on him’⁹⁰. Understanding this ‘second-order’ intentionality⁹¹, today in the cognitive range of a few-years old human, is about understanding *yourself*; having one plainly equals *self-consciousness*. Moreover, any such representation of yours/other minds requires ordering *concepts* – a most prominent feature of human thinking⁹², if not the hallmark of thinking itself⁹³.

The presence of mental representations of the physical and social world, and even the capacity for abstract relational judgments⁹⁴, is also documented in apes, pointing to an organizational change of their brains that had taken place before the separation of extant primate genres. Put differently, similar abilities must have characterized our last common ancestor as well. However, human ability to copy behaviors is based massively on the capacity for *meta*-representation or ‘representational re-description’⁹⁵. It requires having *the concept of a concept*⁹⁶, a symbolic representation that amounts to a *qualitative* leap in cognition.

⁸⁰ M. Alvard op. cit. (n. 69), p. 136; see also A. Whiten, *The scope of culture in chimpanzees, humans and ancestral apes*, in *PhTRS-B*, 366 (1567), 2011, pp. 997–1007. Focused merely on culture’s transmissibility features, the definition clearly underscores the structural, emergent and conceptual components of culture (D. Read, *From Behavior to Culture: An Assessment of Cultural Evolution and a New Synthesis*, in *Complexity [CPLX]*, 8 [6], 2003, pp. 17–41; see also L. Gabora, op. cit., n. 70), but suffices to our argumentation here.

⁸¹ R. Boyd, P. J. Richerson, J. Henrich, *The cultural niche: Why social learning is essential for human adaptation*, in *PNAS*, 108 (suppl. 2), 2011, pp. 10918–10925. Social learning is common among many animal species. However, their ‘traditions’ are often ruined by independent individual learning and do not necessarily take the form of group-wide phenomena. Cumulative features, if any, are ‘rudimentary’ (A. Whiten op. cit. [n. 80], p. 1001). More important, in no other species learning relies on *natural pedagogy*, an ‘asymmetric but cooperative social learning system’ unique to humans (G. Csibra, G. Gergely, *Natural pedagogy as evolutionary adaptation*, in *PhTRS-B*, 366, 2011, p. 1155).

⁸² W. H. Durham, *Coevolution: Genes, Culture, and Human Diversity*, Stanford Univ. Press, Stanford 1991; R. Boyd, P. J. Richerson, J. Henrich, op. cit. (n. 81); C. P. van Schaick, J. M. Burkart, op. cit. (n. 30). In his provoking appraisal of human evolution, R. Bednarik (op. cit. [n. 26]) argues that many deleterious somatic and neurological aspects typical of AMH are connected to a process of rapid cultural ‘domestication’ initiated in Late Pleistocene times.

⁸³ R. Boyd, P. J. Richerson, J. Henrich, op. cit. (n. 81).

⁸⁴ P. J. Richerson, R. Boyd, R. L. Bettinger, op. cit. (n. 72).

⁸⁵ M. Alvard, op. cit. (n. 68).

⁸⁶ R. Boyd, P. J. Richerson, J. Henrich, op. cit. (n. 81).

⁸⁷ J. Henrich, R. McElreath, *The Evolution of Cultural Evolution*, in *EvA*, 12, 2003, pp.123–135.

⁸⁸ M. Alvard, op. cit. (n. 68), p. 143.

⁸⁹ *Ibidem*. The spontaneous tendency to infer ‘intentions’, which expands well beyond our own species (to animals, plants etc.), is powerfully hardwired in human brains (D. Dennett, op. cit. [n. 25]), suggesting a deep phylogenetic origin for this propensity.

⁹⁰ E. Reuland, *Imagination and recursion: Issues in the emergence of language*, in *Cognitive Archaeology and Human Evolution*, (eds. S. A. de Beaune, F. L. Coolidge, T. Wynn), Cambridge Univ. Press, Cambridge, 2009, p. 131.

⁹¹ D. Dennett, op. cit. (n. 25), p.138.

⁹² E. J. Lowe, op. cit. (n. 28).

⁹³ D. Dennett, op. cit. (n. 25), *passim*.

⁹⁴ R. W. Byrne, op. cit. (n. 77).

⁹⁵ The term coined by A. Karmiloff-Smith is meant to express a capacity for ‘recursively operate on or manipulate the contents of thought and thereby refine an idea or motor act, or retrieve an event from the past through the linking of associations’ (cf. L. Gabora, op. cit. [n. 70], p. 111). While RR certainly enhanced humans’ ability to imitate, it also allowed culture to embrace its transformational/Lamarckian character so alien to Darwinian selective processes.

⁹⁶ E. J. Lowe, op. cit. (n. 28), *passim*.

Disentangling intelligence from concept use is possible and many life forms act intelligently in a total lack of conceptual thinking⁹⁷. Separating concepts from *language* is a more challenging⁹⁸ and perhaps futile exercise⁹⁹. Revealing intent through communication¹⁰⁰ and shared concepts would have made the next step in better understanding others, dramatically improving social coordination and the effectiveness of cultural transmission¹⁰¹. Certainly, according to the evolutionary logic, the need for language is not enough to have it emerging; nor does language fossilize. There are nevertheless strong theoretical and empirical arguments to defend an early emergence of the language faculty¹⁰².

In sum, although greatly different in their causal inferences, both the ‘cognitive niche’ and the ‘cultural niche’ theories agree that human intelligence is an adaptation to a knowledge dependent and socially interdependent lifestyle. The empirical expectations they entail for Pleistocene archaeology are, however, quite different. In evolutionary psychology’s model, social learning relies on human behavioral plasticity and innate rationality. The improvisational intelligence of gifted individuals spurs innovation that spreads fast through imitation; adaptive behaviors will therefore tend to be common¹⁰³. Behavioral ecology comes with a virtually identical view: cultural norms maximize fitness; therefore, culture is adaptive and plays a minor role in explaining any particular adaptive behavior¹⁰⁴. A corollary of these assumptions would be that past technologies measure with reasonable accuracy past intelligence and more to the point, cognitive stages.

However, if models of cultural evolution gradually accumulating and creating adaptive packages far beyond the causal understanding of the individuals who use them¹⁰⁵ are correct, a certain mismatch between actual cognitive capabilities and their material expression is to be expected¹⁰⁶. Thus, while it seems reasonable to expect an evolutionary tight connection between the emergence of concept-structured thinking (and likely language faculty), and the generic capacity for cultural transmission, once the latter was deployed a diversification of cultural paths and different rates of cultural evolutionary change are theoretically expectable¹⁰⁷. The

⁹⁷ D. Dennett, op. cit. (n. 25), *passim*.

⁹⁸ For some scholars (e.g. E. Reuland, op. cit. [n. 90], *passim*) it is possible to have recursion, extensive manipulations of internal representation of the world and even iconic symbols without taking the full advantage of language. We can indeed imagine an internally talkative, but externally mute, modern brain functioning. Do we really have to?

⁹⁹ D. Dennett, op. cit. (n. 25), *passim*.

¹⁰⁰ Hiding intent is probably evolutionary synchronous to revealing it – and both entail consistent adaptive advantages (*Ibidem*).

¹⁰¹ G. Csibra, G. Gergely, op. cit. (n. 81).

¹⁰² See R. Bednarik, op. cit. (n. 36) and references therein.

¹⁰³ This should be particularly true for the vague EEA (i.e. Pleistocene times) of evolutionary psychology. Evolutionary psychologists are actually at pains trying to demonstrate the maladaptive features of human cognition in modern contexts (J. Tooby, L. Cosmides, op. cit. [n. 17]).

¹⁰⁴ Cf. M. Alvard, op. cit. (n. 68). There is a certain experimental support that many aspects of cultural transmission are adaptive (T. J. H. Morgan, L. E. Rendell, M. Ehn, W. Hoppitt, K. N. Laland, *The evolutionary basis of human social learning*, in *PhTRS-B*, 279, 2012, pp. 653–662). However, postulating that *all* aspects of culture are adaptive is at best useless and at worst false. In fact, while *generally* adaptive, culture retains many maladaptive behaviors (P. J. Richerson, R. Boyd, *Not by Genes Alone. How Culture Transformed Human Evolution*, Chicago Univ. Press, Chicago, 2005, pp. 148–190).

¹⁰⁵ R. Boyd, P. J. Richerson, J. Henrich, op. cit. (n. 81). In the original formulation, the authors had in mind truly complex technologies. It is highly unlikely that such complexity was ever involved in the Lower Paleolithic artifact production, for instance. However, by ‘adaptive packages’ I mean much more than the manifested technological expertise: environmental knowledge, functional routines, symbolic associations, all potentially imbedded in ‘socio-technical’ systems (B. Pfaffenberger, *Social Anthropology of Technology*, in *Annual Review of Anthropology [ARA]*, 21, 1992, pp. 491–516), irrespective of their preserved technological simplicity.

¹⁰⁶ As many archaeological examples show, macro-cultural evolution entails uneven steps, which mirror punctuated equilibria while maintaining nevertheless a ladder-like aspect (R. L. Bettinger, *Macroevolutionary Theory and Archaeology: Is There a Big Picture?*, in *Macroevolution in Human Prehistory. Evolutionary Theory and Processual Archaeology*, [eds. A. M. Prentiss, I. Kuijt, J. C. Chatters], Springer, New York, 2009, pp. 278–296). The explanation likely stands in the very properties of cultural transmission, which deals with conceptually structured packages quite resilient to piecemeal change (L. Gabora, op. cit. [n. 70]). The similarly emergent properties of ‘cultural systems’, mimicking the biological *Baupläne*, might be viewed as a scalar consequence of this wide-encompassing psychological propensity, as much as the organizational outcome of distinct culture evolutionary paths (e.g. M. Rosenberg, *Proximate Causation, Group Selection, and the Evolution of Hierarchical Human Societies: System, Process, and Pattern*, in *Macroevolution in Human Prehistory. Evolutionary Theory and Processual Archaeology*, [eds. A. M. Prentiss, I. Kuijt, J. C. Chatters], Springer, New York, 2009, pp. 23–50).

¹⁰⁷ ‘One of the primary outcomes of the capacity for culture is particular sets of behaviour, mostly homogeneous within populations, and different between them. Culture, therefore, produces ‘cultures’ (R. A. Foley, M. M. Lahr, *The evolution of the diversity of cultures*, in *PhTRS-B*, 366 [1567], 2011, p. 1080). The demographic networks sustaining cultural information play a crucial role in this respect (e.g. S. Shennan, *Demography and Cultural Innovation: a Model and its Implications for the Emergence of Modern Human Culture*, in *Cambridge Archaeological Journal [CAJ]* 11[1], 2001, pp. 5–16; J. Henrich, *Demography and cultural evolution: Why adaptive cultural processes produced maladaptive losses in Tasmania in American Antiquity [AmAnt]*, 6, 2004, pp. 197–221).

immense cultural range of cognitively similar AMH provides a peremptory argument. The mismatch may vastly exceed in complexity a simple asynchrony, such as the species/lithics evolutionary delays mentioned earlier. More importantly, mixing imitation, imbricated concepts and ‘good-enough’ solutions, the socially constituted behavioral ‘average’, and especially the modest package archaeology has access to (e.g. technology), will certainly lay *below* the individual cognitive capacities. Put differently, much like us, ancient hominins were (potentially much) more clever than their technologies.

5. EMERGENCE OF A FAMILIAR MIND

Despite their formal logic and theoretical clarity, both the cognitive and cultural niche theories score poor on empirical matters. They stay vague in terms of actual phylogenetic steps and certainly avoid climbing the paleoanthropological branches. This is hardly surprising: fitting actualistic descriptions of modern human psychology or micro-evolutionary models to the coarse scale of Pleistocene paleoanthropological and archaeological record is a risky undertaking. Some remarks can nevertheless be made.

For instance, there are currently powerful arguments to defend the idea that, however defined¹⁰⁸, ‘behavioral modernity’ should be clearly separated from the conventional stage of the Eurasian Upper Paleolithic. There is a growing agreement that at least AMH’s genetically compatible ‘cousins’, the Neanderthals, were capable of behaviors basically indistinguishable from their *Homo sapiens sapiens* contemporaries, ranging from efficient hunting of large mammals, long-distance transfer of raw materials, complex lithic technologies, habitat structuring, symbolic burial contexts, pigment and animal parts’ use for decoration etc.¹⁰⁹. If cognitive modernity has a birth certificate, it should therefore have been emitted before the phylogenetic division of the two sapient ecotypes¹¹⁰. Naturally, this points towards the presumed common ancestor of both, the *H. heidelbergensis* grade¹¹¹. However, there are arguments to push at least some aspects of modern cognition to older evolutionary stages.

The emergence of genus *Homo* is conventionally associated to at least two major behavioral innovations for which there is currently a strong archaeological support: stone tools making and meat eating¹¹². In fact, the use of stone tools for butchery predates considerably (ca. 3.4 Ma) the paleoanthropological evidence for the emergence of *Homo* around 2.6 Ma¹¹³. This reversal of the pattern ‘anatomy first/lithics after’ raises two possibilities: (1) the simplest Mode 1 stone tools were in the behavioral range of pre-*Homo* primates and therefore should not be connected to any cognitive leap associated to the emergence of genus *Homo*; (2) the current pattern is transient and the origin of the genus *Homo* will be pushed further in the past by new fossil finds. While it is obviously impossible to confirm hypothesis (2), the first possibility, however, asks for a few comments.

Although subject to distinct functional pressures and evolving in quite limited design spaces¹¹⁴ lithic technology is still the best-preserved and common indicator of cognitive competences¹¹⁵. First lithic technology

¹⁰⁸ The continually expanding check-list include, as a rule: ‘[e]xploitation of coastal environments; greater complexity of food gathering procedures, such as the use of nets, traps, fishing gear; complex use of fire for cooking, food conservation; ecosystem management; producing and hafting stone tools; invention of specialized tool-kits to adapt to extreme environments; higher population densities approaching those of modern hunter–gatherers; complex tools, the styles of which may change rapidly through time and space; structures such as huts that are organized for different activities; long-distance transport of valued materials; formal artifacts shaped from bone, ivory, antler, shell; musical traditions; sea crossing and navigation technology; personal ornamentation in the form of body painting and personal ornaments; art, including abstract and figurative representations; evidence for ceremonies or rituals; complex treatment of the dead [...]’ (F. d’Errico, C. B. Stringer, op. cit. [n. 10], p. 1061). It is worth mentioning that in many modern populations, some of these features are either totally lacking or would simply leave no archaeological traces.

¹⁰⁹ For a recent review, see *Ibidem*.

¹¹⁰ C. Finlayson, op. cit. (n. 3).

¹¹¹ J. A. J. Gowlett, op. cit. (n. 49).

¹¹² R. A. Foley, C. Gamble, op. cit. (n. 9). Albeit largely neglected in classical scenarios, a reliance on *aquatic* resources, pointing to a currently underestimated set of behaviors, seems also to have been implicated in *Homo*’s brain emergence and development (see contributions in *Human Brain Evolution. The Influence of Freshwater and Marine Food Resources*, S. C. Cunnane, K. M. Stewart [eds.], Wiley-Blackwell, New Jersey, 2010).

¹¹³ I. de la Torre, *The origins of stone tool technology in Africa: a historical perspective*, in *PhTRS-B*, 366 (1567), 2011, pp. 1028–1037.

¹¹⁴ M. W. Moore, *The design space of stone flaking: implications for cognitive evolution*, in *WA*, 43(4), 2011, pp. 702–715.

¹¹⁵ For instance, intentional modification of wood occurred as early as 1.5 million years ago in East Africa (M. Dominguez-Rodrigo, J. Serrallonga, J. Juanterres, L. Alcalá, L. Luque, *Acheulian stone tools from Peninj [Tanzania]*, in *JHE*, 40, 2001, pp. 289–99). Intentional modification of bones displays an even older chronology (A. Echassoux, *Comportements de subsistance et modifications osseuses à l’aube de l’Acheuléen à Konso, Éthiopie*, in *L’Anthropologie [Anthr.]*, 116 [3], 2012, pp. 291–320).

(Mode 1) is indeed simple: it resumes to the recurrent production of simple cutting edges and crushing tools. Whether the first knapped lithic tools are beyond extant ape cognitive capabilities is still disputed, as a throughout guidance from a preexisting mental schema is not yet proven¹¹⁶. However, preferential selection and transport of raw material¹¹⁷ and the accurate correlation between the length of the operational sequence and the quality of the raw material¹¹⁸ have no counterpart among primates. The motor abilities proven in the case of long reduction sequences from Lokalalei (Kenya), for instance, already exceed any known ape capabilities¹¹⁹, suggesting that some aspects of the mind of first toolmakers were already missing any true analogies among extant primates.

Things are already much different for the Acheulean (Mode 2). The Early Acheulean (1.6–0.9 Ma) and contemporary industries come with a range of technological innovations (elaborate flake production, large cutting tools), further elaborated during later stages of the technocomplex¹²⁰. While learning the skills for making the simplest Oldowan technology takes hours to a modern knapper, the Acheulean one requires hundreds of hours¹²¹. Deliberate practice, (language assisted) teaching/learning¹²² and a strong social support were clearly required. Stereotyped *actions* were enough for producing Oldowan tools. Stereotyped *forms*, however, as handaxes are, require far more: abstract planning¹²³ and thus *concepts*¹²⁴. Obsessive *focus* and a ‘sense of perfection’¹²⁵, peculiar features of modern human mind, seems also to have been present¹²⁶. Handaxes are certainly ‘best shots’, at least in what Lower Paleolithic stone tools are concerned; nevertheless, much like any technology, they are just an actualization of by definition cognitive superior abilities¹²⁷.

¹¹⁶ R. W. Byrne, *The manual skills and cognition that lie behind hominid tool use*, in *Evolutionary origins of great ape intelligence*, (eds. A. E. Russon, D. R. Begun), Cambridge Univ. Press, Cambridge, 2004, pp. 31–44; M. W. Moore, op. cit. (n. 114).

¹¹⁷ J. A. J. Gowlett, op. cit. (n. 49).

¹¹⁸ I. de la Torre, op. cit. (n. 113); D. Stout, *Stone toolmaking and the evolution of human culture and cognition*, in *PhTRS-B* 366 (1567), 2011, pp. 1050–1059.

¹¹⁹ R. W. Byrne, op. cit. (n. 116).

¹²⁰ In the African Late Acheulean, the use of soft hammer, predetermined flake and even blade production are clearly attested (D. Stout, op. cit. [n. 118]). Archaeologically secure contexts delivering handaxes appear much later in Europe. Most of them are of Middle Pleistocene age and are associated to *H. Heidelbergensis*. However, if a second wave of African immigrants was involved, as it seems likely, the impressive almost 1 Ma delay in comparison to the earliest African occurrences bears little relevance to the European hominin paleo-cognition (J. M. Jiménez-Arenas, M. Santonja, M. Botella, P. Palmqvist, *The oldest handaxes in Europe: fact or artifact?*, in *Journal of Archaeological Science [JAS]*, 38, 2011, pp. 3340–3349).

¹²¹ D. Stout, op. cit. (n. 118), p. 1057.

¹²² Accurate formalization and actual language use during learning technologies are not necessary or indeed practiced on a large scale in ethnographic contexts (but see G. Csibra, G. Gergely, op. cit., n. 81). Verbal instructions do not always intervene in the process itself, but as a later formal exchange of impressions. A linguistic way of cognition, however, is always present (N. Uomini, *Prehistoric handedness and prehistoric language*, in *Cognitive Archaeology and Human Evolution*, [eds. S. A. de Beaune, F. L. Coolidge, T. Wynn], Cambridge Univ. Press, Cambridge, 2009, pp. 37–56).

¹²³ That the *recovered* shape does not necessarily match the actual ‘mental template’ in the past is indisputable: the artifacts were abandoned likely when unusable, after an unknown number of use/reduction cycles. Even if their symmetrical shape was simply an allometric effect of resharpening (e.g. R. Ioviță, S. McPherron, *The handaxe reloaded: A morphometric reassessment of Acheulian and Middle Paleolithic handaxes*, in *JHE*, 61, 2011, pp. 61–74), those repeated interventions point at minimum to the selection and unusual focus on the individual object. In fact, at least for the later stages of the Lower Paleolithic (e.g. Boxgrove), there are direct hints that handaxes were the desired product (T. Wynn, *Archaeology and cognitive evolution*, in *Behavioral and Brain Sciences [BBS]*, 25, 2002, p. 427).

¹²⁴ J. Pelegrin, *Cognition and the emergence of language: A contribution from lithic technology*, in *Cognitive Archaeology and Human Evolution*, (eds. S. A. de Beaune, F. L. Coolidge, T. Wynn), Cambridge Univ. Press, Cambridge, 2009, pp. 95–108; D. Stout, R. Passingham, C. Frith, J. Apel, T. Chaminade, *Technology, expertise and social cognition in human evolution*, in *European Journal of Neurosciences (EJN)*, 33, 2011, pp. 1328–1338.

¹²⁵ R. Bednarik, op. cit. (n. 36), p. 127, 182. Handaxes’ shape and volumetric features were certainly affected by many functional factors, which cannot (and should not) be discriminated from aesthetic goals like symmetry, at least when an emic perspective is envisaged.

¹²⁶ The spatial abilities presumably documented by the symmetrical shape of handaxes (T. Wynn, op. cit. [n. 123]) are of marginal interest here. First, we are most likely dealing with an exaptation of previous perceptual and cognitive capacities, some already present among other animal species. Secondly, by taking symmetry as a proxy of cognitive progresses of Lower Paleolithic hominins, there is the risk of applying double standards: what about the symmetry/lack of symmetry of many later stone tools including the Middle Paleolithic handaxes (R. Ioviță, S. McPherron, op. cit. [n. 123])?

¹²⁷ I exclude by default the interpretation (e.g. K. R. Coventry, J. Clibbens, *Does complex behaviour imply complex cognitive abilities?*, in *BBS*, 25, 2002, p. 406), empathically supported by some archaeologists as well (McPherron 2000), that, much like spider webs’ sophistication, handaxes were mechanical by-products that actually exceeded the cognitive recognition and competence of their makers. Such an argument makes no evolutionary sense. We are descendants of a primate lineage that never manifested such DNA coded phenotypic expressions like spider webs. Handaxes are not the result of genetically coded behaviors, but a (late) development of distinct cognitive abilities; they are also an obvious elaboration of a previous technological trend, pointing to social learning and inter-generation information transmission, which place their production squarely into the realm of culture.

Some other clusters of concepts seem to have been at work during the Acheulean times. *Fire* provides a case at point. Systematic fire use was clearly among the capacities of *H. erectus* at least 800 ka ago, as the finds at Gesher Benot Ya'aqov (Israel) suggest¹²⁸. Not only was fire control able to have risen consciousness in a manner early lithic technology could not¹²⁹, but the very ability to make and maintain fire requires an extended chain of actions¹³⁰, planning and a good environmental knowledge¹³¹.

Unusual behaviors toward death raise similar issues. The first documented interest towards the corpses of conspecifics stands in the cannibalized remains of at least six individuals in Atapuerca (Unit TD6, Spain), belonging to *H. antecessor* and dated around 780 ka BP¹³². No symbolic significance has been proved for this context, currently associated to dietary cannibalism. However, the temporal extension of the practice suggests it was well integrated into the behavioral repertoire of these hominins. Similarly puzzling is the intentional 'caching' of human bodies¹³³ in the neighboring settlement at Sima de los Huesos. The accumulation and mortality profile of the (minimally estimated number of) 28 *H. heidelbergensis* individuals, dominated by prime adults¹³⁴ and dated in excess of 350 ka, point to a conceptually structured treatment of conspecifics, which has nothing to do with 'phenotypic plasticity' or protochronic spurs of individual intelligence. Such behaviors lay plainly in the realm of *cultural practices*.

Monitoring cognitive potential through the evaluation of remarkable technological accomplishments or behavioral innovations help us fighting the time-honored habit of relying on minimal competence solutions; it also helps us counteracting the effects of differential preservation, especially unfair to the archaeological record older evolutionary stages. However, an additional way of recognizing the emergence of a familiar mind is by documenting its prowess in *cultural transmission capability*; a salutary perspective for archaeology, which due to the nature of its material record is better in describing long-term processes than short time events.

The supposed Oldowan and Acheulean monolithic shape unconcerned conservatism led many scholars¹³⁵, including key defenders of co-evolutionary theories¹³⁶, to invoke hominin cognitive limits and doubt the importance of cultural learning at this evolutionary stage. There is indeed little in the Early African lithic industries to grant cultural transmission¹³⁷ a key role. Surely, culture requires by definition *enduring* traditions, but some other factors could mimic its action. In a relatively stable environment, individual learning might still have been advantageous and cultural learning could have played a limited role¹³⁸.

However, we should not lose sight of the impressive niche expansion that took place *before* the advent of Acheulean. *Homo erectus* reached Southwestern and even Northern Asia already by 1.7 Ma, with Mode 1 tools¹³⁹. Such a huge niche extension makes the condition of environmental identity highly unlikely. Social coordination, communication and a good environmental knowledge were minimally required for such a

¹²⁸ N. Alperson-Afil, N. Goren-Inbar, *Out of Africa and into Eurasia with Controlled Use of Fire: Evidence From Gesher Benot Ya'aqov, Israel*, in *Archaeology and Ethnology of Eurasia (AEEA)*, 4 (28), 2006, pp. 63–78, Surprisingly, given the challenges raised by colder environmental settings, secure contexts documenting a 'habitual' fire use appear much later in Europe (W. Roebroeks, P. Villa *On the earliest evidence for habitual use of fire in Europe*, in *PNAS* 108, 2011, pp. 5209–5214).

¹²⁹ M. Rossano *The archaeology of consciousness*, in *Cognitive Archaeology and Human Evolution*, (eds. S. A. de Beaune, F. L. Coolidge, T. Wynn), Cambridge Univ. Press, Cambridge, 2009, pp. 25–36.

¹³⁰ B. Dubreuil, op. cit. (n. 34).

¹³¹ A much more extended and elaborated planning-depth, plus innumerable technological skills and superior environmental knowledge would have been required by the first seafaring experiences – if such they were – involved in the successful colonization of Flores Island around 1 Ma (R. Bednarik, op. cit. [n. 36]).

¹³² Y. Fernández-Jalvo, J. C. Díez, I. Cáceres, J. Rosell, *Human cannibalism in the Early Pleistocene of Europe (Gran Dolina, Sierra de Atapuerca, Burgos, Spain)*, in *JHE*, 37, 1999, pp. 591–622.

¹³³ E. Carbonell, M. Mosquera, A. Ollé, X. P. Rodríguez, R. Sala, J. M. Vergès, J. Arsuaga, J. M. Bermúdez de Castro, *Les premiers comportements funéraires auraient-ils pris place à Atapuerca, il y a 350 000 ans ?*, in *Anthr*, 107, 2003, pp. 1–14.

¹³⁴ J. M. Bermúdez de Castro, M. E. Nicolás *Palaeodemography of the Atapuerca-SH Middle Pleistocene hominid sample*, in *JHE*, 33, 1997, pp. 333–355.

¹³⁵ R. G. Klein, op. cit. (n. 5); S. McPherron, *Handaxes as a measure of the mental capabilities of early hominids*, in *JAS*, 27, 2000, pp. 655–666; M. Alvard, op. cit. (n. 68).

¹³⁶ E.g. P. J. Richerson, R. Boyd, op. cit. (n. 104).

¹³⁷ 'Clearly, transmission implies continuity but continuity does not necessarily implies transmission. It might arise, for example, from the continuity of environmental conditions or of a particular function' (S. Shennan, *Descent with modification and the archaeological record*, in *PhTRS-B* 366 [1567], 2011, p. 1072).

¹³⁸ Experimentally, a certain reluctance to imitation and limited reliance on social information is present when the tasks at hand are considered simple enough and the risk of failure minor (T. J. H. Morgan, L. E. Rendell, M. Ehn, W. Hoppitt, K. N. Laland, op. cit. [n. 104]).

¹³⁹ C. Finlayson, op. cit. (n. 3).

successful behavioral extrapolation. While ‘adaptive radiation’ was clearly a part of the story¹⁴⁰, ‘surfing the ecological tide’ must have been still a challenge for such physiologically poorly equipped primates with limited predator abilities¹⁴¹. Improved social and communication skills and an effective use of learned knowledge were likely involved. Moreover, only some unremitting selective pressures may explain why hominin brain nearly tripled its size during the Lower Paleolithic, reaching close to its modern size already with *H. Heidelbergensis* – with no particular accurate echo in lithic technologies.

More important, however, is the fact that, although spanning huge intervals of unusual technological conformism, Oldowan and especially Acheulean industries include both temporal and geographical variants. Albeit sluggish, the Early Paleolithic technological change is *cumulative*. ‘Elaborate flake production and shaping methods build on previously established technologies by adding levels of hierarchical structure and/or modifying the content of existing sub-processes’¹⁴². The *rates* of change are indeed very slow, but taken at face value they seem to follow the quite uniform exponential curve of technological change which continues from Neolithic to modern times¹⁴³. At least in the case of Acheulean handaxes, evidence for geographical drift and multiple founder effects points strongly towards cultural transmission¹⁴⁴.

Conservatism *per se* does not prove the lack of cultural transmission; it may actually prove its effectiveness. Culture is by definition a community level phenomenon highly dependent of the demographical networks sustaining it. As later prehistory abundantly shows, cultural stasis or fatal information loss are always possible¹⁴⁵. ‘Differential survival’, including extinction of certain cultural variants or stubborn preservation of others, is actually imbedded in the very logic of information transmission and may simply point to conformist biases¹⁴⁶, fitness peaks in the adaptive landscape¹⁴⁷, low populations¹⁴⁸ or functional pressures¹⁴⁹ – all highly likely in the Lower Paleolithic social and natural environment, and none indicative for cognitive incompetence.

In sum, *H. erectus* was at minimum able to follow, learn and teach quite complex sequences of action, to aim for odd shapes, to control fire and to act in peculiar ways towards death. We, the descendants of this clade, describe these accomplishments by using definable concepts and the related words. Cognitively, we have no other possibility, but there are no reasonable arguments, written in bones or stones, against the idea that *H. erectus* made a similar conceptual separation. Our anthropocentric tendency to think conceptually and causally may indeed lay the burden of deliberate purpose on many animal reflex behaviors. However, the accomplishments above, while familiar to us, have no counterparts in the animal kingdom, past or present. By simply acknowledging this unique status, defying any quantitative treatment, we are forced to admit that a human mind, modular or not, was already in place.

6. DISCUSSION AND CONCLUSIONS

At the boundary between the Early and Middle Pleistocene, the Acheulean settlement at Geshert Benot Ya’aqov (Israel) brought evidence for diverse foraging (including processing if not hunting of large mammals, and exploitation of fish and edible plants), multicomponent quarrying, skillful knapping of handaxes in difficult raw material (basalt), and systematic fire use, spanning a temporal sequence of minimum 50 ka¹⁵⁰.

¹⁴⁰ Hominins clearly left Africa in tandem with a distinct biotope association, suggesting a gradual extension of their familiar ecological niche, at least into Europe and Caucasus; they were not followed, however, by their animal fellow travelers into Southern and Central Asia, for instance (J. M. Jiménez-Arenas, M. Santonja, M. Botella, P. Palmqvist, op. cit. [n. 120]).

¹⁴¹ P. J. Brantingham, *Hominid–Carnivore Coevolution and Invasion of the Predatory Guild*, in *Journal of Anthropological Archeology (JAA)*, 17, 1998, pp. 327–353.

¹⁴² D. Stout, op. cit. (n. 118), p. 1055.

¹⁴³ *Ibidem*.

¹⁴⁴ S. J. Lycett, N. von Cramon-Taubadel, *Acheulean variability and hominin dispersals: a model-bound approach*, in *JAS*, 35, 2008, pp. 553–562.

¹⁴⁵ R. Boyd, P. J. Richerson, J. Henrich, op. cit. (n. 81).

¹⁴⁶ P. J. Richerson, R. Boyd, op. cit. (n. 104).

¹⁴⁷ R. L. Bettinger, op. cit. (n. 106); S. L. Kuhn, *Questions of Complexity and Scale in Explanations for Cultural Transitions in the Pleistocene: A Case Study from the Early Upper Paleolithic*, in *Journal of Archaeological Method and Theory (JAMT)*, 2012, in press, 10.1007/s10816-012-9146-3.

¹⁴⁸ T. Hopkinson, *The Transmission of Technological Skills in the Palaeolithic: Insights from Metapopulation Ecology*, in *Investigating Archaeological Cultures. Material Culture, Variability, and Transmission*, (eds. B. W. Roberts, M. Vander Linden), Springer, New York, 2011, pp. 229–244.

¹⁴⁹ S. Shennan, op. cit. (n. 137).

¹⁵⁰ N. Goren-Inbar, *Culture and cognition in the Acheulean industry: a case study from Geshert Benot Ya’aqov*, in *PhTRS-B*, 366 (1567), 2011, pp. 1038–1049.

This case study documents a behavioral complexity that several decades ago was skeptically attributed to Middle Paleolithic hominins at best; it also strongly points to a millennially effective transmission of cultural information; equally importantly, it demonstrates the massive biases of the Lower Paleolithic archaeological record, which makes such contexts rather the exception than the rule. Gesher Benot Ya'aqov reveals no puzzling behaviors outside the range of modern foragers' flexibility and gives no signs of 'idiosyncratic' cognitive trends¹⁵¹; it simply documents the partially accumulated and poorly preserved work of a familiar mind, acting in a peculiar social and cultural context, across a geological time span. If there is a lesson to learn from such finds, it is that many time lags and asynchronies noticed between Pleistocene somatic and cultural evolution are likely the outcome of the highly selective and fragmented nature of the archaeological record.

Archaeologists often borrow the standpoint of their sources; there is also a good chance that, eager to escape from the apparently threatening shadow of social and cultural anthropology¹⁵², paleoanthropologists too failed victims to their own descriptive rigor and expanding fossil database. For the (many) defenders of a recent cognitive break, the sustained trend towards increased cerebralization and superior cognitive integration within a single lineage is very unlikely to have been supported by natural selection¹⁵³; consequently, a syncopated picture of repeated projects and extinctions is proposed, correlated to a sequential neural evolution, both expressed in the acknowledged bushy tree. They are certainly right on one point: natural selection *alone* is a blind, lazy and ruthless evolutionary engine. If, however, another faster and more forgiving evolutionary stream had taken, at least in part, the responsibility of somatic changes, their rhythm and meaning would have been very different – and they certainly were. To their great dismay, E. Mayr's outdated unilinear stadial scheme¹⁵⁴ seems fortuitously more relevant for *cognitive* evolution than the current bushy tree.

For increasingly many archaeologists, the blueprint of modernity was already established 300 ka¹⁵⁵ or 400¹⁵⁶ ka ago. For a few brave souls, the boundary should be pushed much earlier¹⁵⁷ – and the present argumentation rises in their partial defense. Early *Homo* and especially the *Homo erectus* grade displays a far superior behavioral complexity than generally acknowledged, reinforcing the view that many cognitive prerequisites for 'modern' behavior were already in place before the emergence of *H. heidelbergensis*. If many features attributed to 'our' mind display a much older chronology, the inescapable conclusion is that the sapient threshold, if real, is likely misplaced.

Although an unreliable friend, often showing up late in order to plead for preexisting cognitive capacities, and severely affected by differential preservation, material culture mirrors human cognitive abilities better than brain casts – and certainly better than mandibles, with or without teeth. To be clear, I do not mean to question the anthropometric or genetic support of the current paleoanthropological taxonomy, just the extent to which the documented variability entailed *speciation* events and/or cognitive *leaps*. For instance, the recent African origin of modern humans is largely accepted today¹⁵⁸; so are the geographical isolation, long parallel existence and eventual extinction of previous hominins. The picture above contradicts, however, both the rather continuous growth of brain volume *across* the hominin lineage and the massive evidence for long-term cultural continuity. Both seem to argue strongly for a more or less continuous gene flow, naturally involving multiple compatibility areas in cultural, somatic and cognitive terms¹⁵⁹. The problem does not stand in the phyletic tree being too complicated, but in our current inability to trace the demic movements/isolation events that would make sense for both continuity and change. Unfortunately, the random nature of fossil records is too often forgotten.

¹⁵¹ *Contra* M. Langbroek, op. cit. (n. 4).

¹⁵² The (now fading) popularity of an anagenetic view on the emergence of *Homo* genus is definitely connected to the uniqueness of human condition defended by cultural anthropology – R. A. Foley, op. cit. (n. 60).

¹⁵³ I. Tattersall, op. cit. (n. 35).

¹⁵⁴ Cf. R. A. Foley, op. cit. (n. 60).

¹⁵⁵ E. Hovers, A. Belfer-Cohen, „Now you see it, now you don't” – modern human behavior in the Middle Paleolithic, in *Transitions before the Transition. Evolution and Stability in the Middle Paleolithic and Middle Stone Age*, (eds. E. Hovers, S. L. Kuhn), Springer, New York, 2006, pp. 295–304.

¹⁵⁶ J. A. J. Gowlett, op. cit. (n. 49).

¹⁵⁷ E.g. R. Bednarik, op. cit. (n. 36).

¹⁵⁸ F. H. Brown, I. McDougall, J. G. Fleagle, *Correlation of the KHS Tuff of the Kibish Formation to volcanic ash layers at other sites, and the age of early Homo sapiens (Omo I and Omo II)*, in *JHE*, 63, 2012, pp. 577–585.

¹⁵⁹ Compatibility explicitly means the possibility for interbreeding. It may have happened that the African originated AMH replaced most archaic hominins, but their 'superiority', if any, could have simply stood in their demographic/genetic vitality (J. Zilhão, op. cit. [n. 6]).

To sum up our ‘common sense’ argumentation, human cognitive evolution must have been rather gradual than branchy, as the continuity of cultural transmission and the related cumulative features peremptorily show. In the same time, it entailed an early *qualitative* leap, proved by the enormous niche expansion and evolutionary success of the *Homo erectus* grade and by its ability for acquiring and transmitting extra-somatic information through learning. It is possible and even likely that this evolutionary leap was followed by quantitative additions in terms of superior memory, processing abilities or focus capacities. However, the latter were likely fully manifested by *H. heidelbergensis*¹⁶⁰. No cognitive revolution was therefore needed for the emergence of AMH or for that matter, Neanderthals, which leaves the burden of explaining the changes associated, for instance, to the Eurasian Upper Paleolithic mainly to a balance between environmental changes, cultural innovation and restructuring demographic networks.

More importantly, as Pleistocene archaeology amply documents, *Homo sapiens* is not „another unique species”¹⁶¹: cultural capabilities made it simply unique in many respects. Consequently, due to an enormous number of emergent features, human origins will always defy in part the otherwise impressive retrodictive power of Darwinism, for as Hume once noted, qualitatively unique events cannot simply be explained causally. This constation made even leading paleontologists to admit lucidly: ‘Human culture and language really do free us from certain kinds of predictability. By introducing enormous complications into the explanatory machinery, they probably put much of human behavior and human history beyond the reach of science. The key human peculiarity [...] is the reflexivity that language brings to human psychology’¹⁶². If one replaced ‘science’ with ‘paleoanthropology’, there could be hardly better closing remarks for the present argumentation.

¹⁶⁰ B. Dubreuil, op. cit. (n. 34).

¹⁶¹ Cf. R. A. Foley, op. cit. (n. 60).

¹⁶² M. Cartmill, *Paleoanthropology: Science or Mythological Charter?* in *Journal of Anthropological Research (JAR)*, 58 (2), 2002, p. 195.

