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# HOLOCENE CROSSROADS

## — Managing the Risks of Cultural Evolution —

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## SYNOPSIS

The steady growth of hominin cranial capacity during the Lower and Middle Paleolithic (L/MP) supported the emergence of controlled vocalizations, orchestrated mimetic techniques, deductive tracking skills and exogrammatic information storage. 'Exograms' are defined as memory traces stored outside the brain as consciously-sequenced information packages meant to stabilize abstract calibrations of reality. The first instances of their use document the universal emergence of a species-specific objective state of consciousness. Although the ability to produce them is a biological development, the transmission of exogrammatic meaning becomes culturally-conditioned. As all the faculties listed above were in place long before the Aurignacian, the Upper Paleolithic (UP) 'revolution'—unlike the L/MP transition—cannot be attributed to changes in the size or shape of the cranium. The period was rather characterized by accelerated cognitive specialization to deterministically-predictable cultural niches constructed in unreliable environments. By adapting to their calibrated models of reality, archaic populations underwent rapid physiological/psychological transformations. It is contended that the UP 'creative explosion' illustrates the attempt to counter cognitive losses inherent in cumulative cultural evolution and incipient self-domestication.

Unfortunately, by considering the cumulative type of cultural evolution as the 'natural choice' of all cognitively modern humans, gene-culture coevolution theory implies that the 'ratcheting' of innovations is the only index of 'progress.' In the modelling of the theory the stress is placed on social complexity, the absence of which would render small and isolated populations vulnerable to the 'treadmill effect,' the inevitable consequence of impaired social learning. However, the anthropological literature documents isolated hunter-gatherer groups that have developed intricate exchange networks that do not necessarily rely on technological innovation and function only in low demographical settings. Not only that the biases upon which transmission depends in cumulative cultural evolution—prestige, skills, success—are unknown, but certain 'leveling mechanisms' inhibit these very parameters and thus, no cultural models can rise to prominence. Contrary to the predictions of the theory, these societies do not seem to be plagued by cultural 'loss' and, instead of hopelessly running the treadmill and living in poverty, they have developed egalitarian and, to an extent, 'affluent' societies.

Populations following a non-cumulative type of cultural evolution—known in anthropology as 'immediate-return' hunters-gatherers—are often described as 'pedomorphic,' due to their markedly neotenous morphological features and cognitive attitudes. On the other hand, populations that follow a cumulative type of cultural evolution are surprisingly 'robust' phenotypes. In the case of the latter, a cultural 'sudden jump' seems to have occurred during the Late Pleistocene which, in its turn, resulted in the entrenchment of archaic behavioral traits and the establishment of hierarchical societies. Conversely, with certain isolated hunters-gatherers, a cultural 'regression' seems to have taken place during the Early Holocene. The adoption of a cultural 'primitivism'—immediate-return subsistence—offered a degree of evolutionary flexibility that allowed for a neotenal leap. This, in its turn, enabled the reduction of archaic behavioral traits and the emergence of egalitarian societies.

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# INTRODUCTION

## The 'ABC of Modernity' Reconsidered

Unfortunately, most approaches to the development of hominin symbolling abilities adopt a linear understanding according to which, abstract representations are classified as expressions of inferior cognitive abilities and iconographic illustrations as self-evident signs of higher cognition.

According to the paleosemiotic interpretation pioneered by E.V. Culley (2016; Supplementary Graphic Material [SGM] p. 2) – notches, engravings and abstract geometrical patterns are labeled as *ancestral* and *emergent* symbolling abilities, while naturalistic/illustrative engravings and paintings are categorized as *fully-mobilized* expressions of cognitive modernity. Culley – without explaining the reason – attributes all the Upper Paleolithic 'emergent' abilities to Neanderthals and the 'mobilized' symbolling faculties to 'anatomically modern humans.'

*Cognition*, *anatomy* and *behavior* are presented as inseparable parts of a presumed punctuation that had bypassed the cognitively, anatomically and behaviorally inferior Neanderthals. However, the recent discovery of arguably pre-*Homo sapiens sapiens* paintings in La Pasiega Cave (Hoffman et al. 2018) casts doubt on Culley's linear classification: apparently, Neanderthals were in the possession of *fully-mobilized* symbolling abilities long before the Upper Paleolithic 'cognitive explosion,' more than 66,000 years (66 ka) ago.

Cognitive expressions that predate Period F in the table (123-191 ka) are simply ignored and not even considered worth to be designated as 'ancestral.' However, the deliberate engravings on a tibia fragment of the forest elephant from Bilzingsleben, Germany (>325 ka, Bednarik 2014a) or the stone plaque bearing seven engraved lines from Wonderwerk Cave, South Africa (c. 300 ka, ibid. 2013) display the same cognitive standards that define 'emergent' symbolling abilities.

Adding a theoretical Period G (>350-191 ka) to the table and defining its products as witnesses to an emerging symbolling ability is recommended. However, by doing so, we would only extend the linear concept backward in time, without addressing the problem of the transition between emergent (abstract) and mobilized (iconic) representations. But the archaeological record documents both Lower and Middle Paleolithic (L/MP) examples of iconic understanding and Upper Paleolithic (UP) instances of abstract representation, which means that the relationship between them is rather complementary than linear. For example, the Acheulian naturally shaped scoria pebble inserted to the Period G line/Levantine column of the table (Goren-Inbar 1986; Bednarik 1994) points to the existence of such an iconic sense at already 250 ka ago (SGM p. 2).

By the same token, the anthropological literature mentions cultures that favor abstract patterns over naturalistic illustrations (Sreenathan et al. 2008) to such an extent that, until recently, it was firmly believed that people belonging to such cultures were so primitive that they did not even develop iconographic understanding – a presumption that has implicitly presented them as cognitively not yet 'modern.' I would suggest the opposite: cognitive modernity seems to have been in place for more than 300,000 years, at least in its species-specific biological aspect, which had assumed various culture-specific variations during the last tens of millennia.

Cognitive expressions that were not carved in stone but, say, drawn in sand or painted hundreds of thousands of years ago did not survive the test of time. Ocher was consciously hoarded during the Lower Paleolithic (Bednarik 2013) but, unfortunately, we will never know what was it meant for.

The *transition from abstract to iconic* cannot be dated, mostly because there are *no clear-cut abstract or iconic 'periods.'* For example, dots, lines and naturalistic depictions are featured in both the Neanderthal illustration from La Pasiega and in the famous stag mural from the Axial Gallery in Lascaux (Taylor 2017). Therefore, instead of 'periods,' cultural contexts in which either abstract or iconic representations were preferred should be considered.

Any inquiry into the origins of paleoart should focus on *why?*, rather than on *when?*. Undoubtedly, iconographic potential was present long before the Aurignacian, when it underwent a 'big-bang' and became obsessively applied, never to be discarded again. Why did the application of iconic abilities become suddenly important, as opposed to L/MP contexts when, although the ability was arguably extant, it was not regularly resorted to?

I hypothesize that the etiology of iconic expression – that is, its sudden preference over abstract representation – lies in altered environmental contexts that trigger out the application of this latent cognitive potential. By environmental change I do not necessarily mean climatic fluctuations – although these must also be considered – but mostly *transitions of a cultural nature*.

The impact of such changes becomes evident in the well-known examples of chimpanzee and bonobo cognitive abilities, as summarized by Roffman et al. (2016 and references therein). Why Kanzi's cousins in the African rainforest do not draw or develop complex tool technologies, given that the ability to do so is, arguably, extant? Why is it that such a potential becomes realized only in artificial – laboratory, zoo, captivity – environments? Apparently, externally-imposed criteria trigger out cognitive and behavioral responses that do not take too much of an effort in the case of primates. In human proximity and, with a little help from researchers, drawing and tool-making become 'meaningful' – the rewards that follow the exhibition of such abilities are rather social – like, displays of affection and appreciation – than restricted to food. Punishment is usually not considered in primate experiments, in contrast with the training of the infamous painting elephants of Thailand, where it assumes a central role. Moreover, these elephants do not apply a latent cognitive ability but follow blindly human commands (Scharfstein 2006; Sreenathan et al. 2008).

Another example of extant cognitive abilities that manifest themselves only in an artificial environment is the already mentioned case of certain 'primitive' hunters-gatherers. When I visited the Andaman Islands in 1994, the Jarawa exhibit at the Port Blair museum presented them as Stone Age 'savages' engaged in a perpetual struggle for survival for which they were cognitively, behaviorally and technologically unfit. Recently, the Andamanese tribes were featured in scholarly articles as examples of isolated groups exposed to cultural loss because of their reduced demographical strength and presumed lack of social complexity (Henrich 2004). In the past decades, however, civilization has reached them in the form of the Andaman Trunk Road. Anthropologists have also made contact and discarded some of their earlier misconceptions and presumptions. But, in lack of evidence, the researchers were still firmly convinced that the Jarawa had not developed complex symbolling faculties, the measuring stick of which is the absence/presence of the ability to produce Lascaux-style naturalistic 'art.' They were thus considered to be only half-way to 'modernity,' at a primitive stage of abstract doodling.

One day, a Jarawa boy was hit by a truck and dispatced to the hospital. Imagine his trauma, which could not have been less than that undergone by a UFO abductee – the monster that hit him while walking on the back of the black asphalt serpent, and the white-clad hospital staff doing strange experiments with his body, accompanied by the beeps of flashing instruments. He was given pencils and paper, nurses do that with child patients. The boy Emmy started to draw feverishly, mostly plants and animals from his natural environment (Sreenathan et al. 2008). The images were drawn with an eye to detail and at an artistically sophisticated level (SGM p. 4). His 'art' was the product of his uneasiness in a bizarre new environment, and the plants and animals of his trusted jungle-world were reproduced with accuracy and detail, giving voice to his yearning for something lost.

Did the boy effectuate an evolutionary leap and, all of a sudden, become cognitively modern? Of course not: after investigating the incident and, to their surprise, anthropologists discovered that Jarawa children do habitually trace naturalistic forms in sand or mud. Only that this habit was considered a meaningless childhood pastime by the elders, who cultivate exclusively abstract representational skills because, as they explained, only such patterns possessed *meaning* (ibid.). In a strange hospital environment, the childish ability for iconic representation became, all of a sudden, imbued with significance.

I would suggest that the Eurasian Upper Paleolithic (UP) *obsession with detail* (understood as *local processing bias* by Spikins et al. 2018) and *stress on iconicity* might be explained with the degree of elaboration of an *artificial*, i.e., *cultural environment* in which 'childish' abilities had suddenly gained in importance and meaning – I will return to the role played by children (Snow 2013) because of their specific cognitive faculties (Charlton 2006) during the Western Eurasian UP, later on.

A parallel can be drawn between the contemptuous portrayal of the Andamanese – who were implicitly perceived as cognitively inferior – and the Neanderthals, the perception of whom was overtly biased, from the very first moment of their discovery (see Saniotis and Henneberg 2010-11). Such brutish cavemen – and who looked so different from us – could not be associated with superior cognitive expressions that we love to think are exclusive to us. 'Us,' in this case, must be the UP skeletal remains of people who would closely resemble those of 19th and 20th centuries European 'moderns.' Our search for such remains was thus highly biased and paleoanthropologists were eager to find such 'modern' remains and inclined to exaggerate their antiquity. Therefore, as Bednarik (2007, 2017) points out, Gravettian specimens were given Aurignacian antiquity and declared 'anatomically modern' Cro-Magnons. Conversely, archaic 'Neanderthaloids' were pushed back in time. Only that, because of the mistaken dating, there was no smooth osteological transition between Neanderthals and these anatomically modern humans (AMHs). The 'replacement hypothesis' was constructed in order to explain the fossil gap.

The sudden appearance and ratcheting of grandiose cave art was brought up as the unquestionable proof of the cognitive superiority of these exotic Cro-Magnons – again, because of no apparent transition between the presumed lack of symbolic thought with Neanderthals and the suddenly overwhelming evidence of it, at c. 40,000 years ago. A cognitive 'explosion' was thus attributed to these 'moderns.' Unfortunately, because of lack of evidence for such an 'explosion' in other parts of the world, the 'revolution' was limited to Europe. Accordingly, the cognitive gap was filled in with the Eurocentric 'revolution' model.

Political correctness, however, conjured up African Eve, and the 'replacement/out of Africa' theory was offered as an explanation for the discontinuity in the fossil and cognitive record (e.g. Mellars 1989). The hypothesis could also explain the presence of less 'brutish' archaic *H. sapiens* in Africa at a time when robust archaic hominins – specialized to the climatic extremes of the Ice Age – dominated West Eurasia.

Even after the discovery of the Châtelperronian and other 'transitional' industries clearly associated with Neanderthals (Bednarik 2007 and references therein), the linear paradigm was there to stay. Only the recent evidence for Neanderthal's modern cognitive abilities (Rodriguez-Vidal et al. 2014; d'Errico et al. 2017; Hoffman et al. 2018) have introduced a new approach to *Homo sapiens neanderthalensis* and have considered a revision of the linear perception of hominin evolution that was based on presumptions asking for the existence of a 'missing link.'

In the light of the latest discoveries, Neanderthals appear to have been our cognitive peers. However, it would be far-fetched to consider them anatomically-modern. As for their behavior, they were certainly more aggressive and hierarchical than today's more gracile and docile hominins (because of various biological and cultural considerations that will be addressed soon).

Apparently, 40 millennia ago, the Old World was inhabited exclusively by cognitively 'modern' archaic *Homo sapiens*, at various degrees of robustness. 'Modern behavior' would assume a rich diversity during the ensuing tens of millennia, with its origin in such a generalized 'last common cultural ancestor.' I would suggest that 'modernity' – contrary to the consensus view in paleoanthropology – did not arrive suddenly as an Anatomical–Behavioral–Cognitive package ('ABC' of modernity). While cognitive modernity, in my view, is a *biologically-developed species-specific trait*, I understand behavior – and, in specific cases, even anatomy – as *culturally-acquired traits*.

In this paper, I will focus on two regions, given that one of these (West Eurasia) was considered for long to be the cradle of cognitively modern humans (CMHs), while the other (southern Africa) is still perceived as the cradle of anatomically modern humans (AMHs).

I hypothesize that modern behavioral and anatomical traits have developed at different rates and in a different order. Anatomy appears to be a consequence of cultural behavior in West Eurasia (WE), but it seems to have been biologically-acquired – and before behavioral modernity – in southern Africa (SA), where behavior has assumed its modern form as a consequence of anatomy.

From such a perspective, the Eurasian Upper Paleolithic transition cannot be explained as the replacement of one species with another but rather as a culturally-determined behavioral 'sudden jump' (*sensu* Gould and Eldredge 1977; Steiner 2017) followed by a more gradual morphological transition (*sensu* Bednarik 2007) within the same – and cognitively already modern – species.

The species-specific ancestral cognitive abilities have also undergone changes during millennia of *biological-cultural coevolution* (SA) and, on the other side of the spectrum (WE), during tens of millennia of *cultural-biological coevolution*.

## 1. The 'Missing Link': Exograms

### 1.1 Biological Cognition vs. Cultural Behavior

The main shortcoming of the Upper Paleolithic 'revolution' and 'replacement' hypothesises is that they are mere theoretical constructs meant to save an exclusively biological concept of linear evolution. If the inevitable biases of such an approach are discarded and the cognitive expressions of pre-*sapiens* hominins placed within the frames of biological-cultural and cultural-biological coevolution (*sensu* Tomasello 1999; Henrich 2004), the suddenness of the Middle/Upper Paleolithic transition will become less enigmatic.

The table in SGM p. 6 (Bednarik 2013) compares hominin biological and technological stages with the relative durations of the use of major *paleoart* forms in the Pleistocene. For reasons that were already mentioned – but also because other regions of the Old World reflect the same chronological pattern – this paper restricts itself to anatomical and behavioral developments in southern Africa and West Eurasia, through a cognitive assessment of Stone Age art-like productions documented from these subcontinents.

SA and WE present very specific biological and cultural evolutionary trajectories which were determined by very different sets of variables and, consequently, resulted in disparate anatomical and behavioral manifestations. That is, *cultural behavior seems to have determined anatomical modernity* in WE and, conversely, *anatomical changes have determined behavioral modernity* in certain SA contexts. Therefore, there can be no linear continuity between the latter – a Late Pleistocene/Holocene development, 10-12 millennia ago – and the former – a Middle/Upper Paleolithic occurrence, 60-50 millennia ago. The 'missing link' between *biologically-developed cognitive modernity* and *culturally-acquired behavioral modernity* is provided by *exograms*.

*Consciousness* and emergent abilities for *external storage of information* cannot be separated: I consider pigment use/engravings and notches/beads and pendants as *indexes of biologically-developed consciousness and cognitive 'modernity.'* Abstract patterns in paleoart, which dominate at this early stage, are universal. As for figurative art-like productions (engraved and painted, but mostly the latter), I would suggest that they already betray culture-specific behavioral traits and, therefore, they can serve only as *indices of culturally-acquired behavioral 'modernity.'*

As all these products of conscious focusing are abundant in the archaeological record, commencing at approximately 1 million years ago (notches in WE and pigment hoarding in SA; ibid.), and because the type of consciousness – which is not mere 'theory of mind' or self-awareness – that can display such a convergent mental task is often taken as an index of cognitive modernity (e.g. Gabora 2003), we must conclude that archaic *Homo erectus/antecessor* (WE) and *ergaster/rhodesiensis* (SA) populations – even if only from a cognitive perspective – were 'modern.'

If the assumption of such an ancient cognitive modernity seems far-fetched, the undisputable widespread use of engraving and notching techniques at approximately 0.3 million years ago (not only in WE and SA but also in East Eurasia; Bednarik 2013) already implies the use of related faculties which, together with such exogrammatic abilities, are inseparable parts of cognitive modernity. Indeed, the possibility that such skills – mimetic, lexical, musical – were mastered by *Homo rhodesiensis* (SA) and *heidelbergensis* (WE) becomes accepted and accommodated in the paleoanthropological literature (ibid.; Benozzo and Otte 2017; d'Errico et al. 2003; Morley 2003).

In order to clarify the apparently paradoxical cultural configurations that I have outlined above, I will first attempt to expand the currently-accepted definition of *exograms* as 'memory traces stored outside the brain' (Bednarik 2014b) after which, their relevance to *consciousness-as-we-know-it*, *art* and *paleoart* will be discussed.

### *1.2 Memory, Engrams and Exograms*

Exograms (*sensu* Donald 1991; Bednarik 2014b) are functionally related to 'engrams,' which are theorized (not necessarily following Semon, who had coined the term in 1921) to be biophysically or biochemically combined *information units* stored in the brain – and other neural tissue – that become *consolidated in response to external stimuli*.

The consensus view in neuroscience (Schacter 2002) is that the sorts of memory involved in complex tasks are likely to be distributed among a variety of neural systems, yet certain types of knowledge may be processed and contained in specific regions of the brain. Such brain parts as the *cerebellum*, *striatum, cerebral cortex, hippocampus*, and *amygdala* are thought to play an important role in memory. For example, the hippocampus is believed to be involved in spatial and declarative learning, as well as *consolidating short-term into long-term memory*. Simplistically formulated, *short-term memory units* (i.e., *'memory traces'*) distributed in various cerebral areas become associated and consolidated in the hippocampus, where they become *long-term* (stabilized) *information packages* (i.e., *'engrams'*) that can be recalled, either as an environmentally determined reaction, or voluntarily, without environmental cueing.

The question is whether engrams become *re-consolidated* each time when specific external stimuli recur, or whether they exist as *permanently consolidated* information packages that can be retrieved in an unaltered form – voluntarily, or in response to such stimuli? I am restricting myself to a conservative approach: as engrams have not yet been physically detected or measured, I would suggest that they are *perpetually reconstructed, with slight variations between successive consolidations* (ibid., Thum et al. 2007; De Jaeger 2014). In this case, memory is not reliable, it plays tricks on us and it is dependent on emotional states that are present at the time of reconstruction, or on shifts in subjective values and attitudes that have developed during the time elapsed between the experience and its reconstruction. This becomes evident in the case of commonly shared experiences like, say, the first kiss. Given the subjective variables that play a role at the time of consolidation and recall, the event will be reconstructed and remembered differently by those who have shared it.

Our sense organs register the physical settings of an experience. Specific images, sounds, tastes, textures and smells that were associated with the experience can trigger out its recall. The sensory input associated with the event is anchored in space and time and stored as a short-term *causal* A-B-C-D *memory trace sequence* in the hippocampus. In order to free up neural storage and processing space, loosely linked memory traces – 'tagged' with a spatial, temporal and emotional extension – are broken up and distributed among various cerebral regions. Upon voluntary or environmentally-dictated recall, *re-consolidation may be corrupted* by subjective axiological shifts that have developed during the time elapsed between storage and retrieval. Likewise, stresses present at the time of retrieval may also influence the outcome of the re-consolidation process. Thus, the sequence in which memory traces are ordered is highly probabilistic and it may assume various configurations (e.g. B-D-A-C, see SGM p. 7) that are not necessarily consistent with each other over time.

A long-term consolidation of an engram cannot occur as long as memory traces are in such a state of *superposition* (Gabora 2003) and as long as each retrieval results in slightly different and thus, unreliable configurations (Schacter 2002). The only way to *add durability* to specific configurations is by embedding them *according to an objective causality*.

*Engrams* belong to what is known as (*subjective*) individual, i.e., *autobiographical memory* (SGM p. 8). Engrams are not created to last and their texture can vary from one re-consolidation to the next. Given the almost *unlimited probabilities in the re-sequencing of memory traces* stored in various parts of the brain, it is not surprising that biology and psychology – the disciplines that study autobiographical memory – have not succeeded capturing engrams in time and locating them in space. The only solution to add detectable durability to *specific configurations* that memory traces can assume is, as said above, by *adjusting them to* *an objective causality*. *Objectivity* implies an *external* and agreed-upon *rule of sequencing* which would render them *accessible* to others (*sensu* Block 1995). Such a 'rule' must be accessible itself – *learned* through copying or by resorting to communication. In other words, *consciously-constructed information packages that follow a communally agreed-upon objective causality can be fixed and passed on, from one individual to the other and from one generation to the next.* This is precisely the commonly-accepted definition of collective memory, which is adopted even by a popular online platform like Wikipedia.

*Collective memory* is already a cultural category and, therefore, *culturally-constructed, stabilized and transmitted information packages*, unlike engrams, *are stored externally, and they are devised to last*. While *subjective individual memory* relies on *short-lived engrams*, *objective collective memory* can be *passed on from one generation to the next* with the help of *exograms*.

Exograms can be defined as *memory traces stored outside the brain as consciously-sequenced long-term information packages meant to stabilize causal calibrations of reality*. They belong to the field of cultural and social sciences, with cognitive archaeology being the discipline dedicated to the study of their origin and meaning.

These clarifications were necessary in order to answer the question posed above, namely, ''whether engrams become *re-consolidated* each time when specific external stimuli recur, or whether they exist as *permanently consolidated* information packages that can be retrieved in an unaltered form – voluntarily, or in response to such stimuli?'' I would thus suggest that *engrams re-consolidate on spot*, as short-lived subjective responses to environmental stimuli, whereas *exograms are permanently consolidated information packages* that can be retrieved voluntarily, as learned responses to cultural signals. Moreover, the culturally agreed-upon (objective) causality of *exogrammatic representation* leaves its imprint on the *probable outcome of individual memory recall* and thus, an apparent *synchronicity between the two becomes the hallmark of cultural evolution*.

As an accolade, I would like to mention the intricate relationship between *collective memory* and 'collective consciousness,' with the hope that the explanations above will dispel some of the mystified perceptions of the latter, as propagated in popular culture. As I will illustrate further on, exograms play a crucial role in the understanding of these intertwined and often misinterpreted categories.

### *1.3 Material and Non-material Mnemonic Techniques*

*Memory* and *knowledge* are intimately interwoven categories. Externally stored memory traces are information units that can be combined through associations determined by 'exogrammatic' rules which, in their turn, follow a *communally agreed-upon causality*. Exograms are the final product of such a cognitive process. Causally sequenced and stored *knowledge* can be transmitted from one mind to the other. However, exogrammatic representation is not restricted to graphic illustrations. Memory traces are not strictly visual but, like those used in the consolidation of engrams, they are provided by all the senses. Graphically externalized memory traces serve only as *indexical references* to those who are in the possession of *exogrammatic skills* and are thus able to *re-iterate* and *express* a causal sequence meant to explain the essence of specific natural – or other – phenomena. The re-iteration, that is, *the conscious causal sequencing of memory traces* relies just as much on *vocalizations* and *mimetics* (*sensu* Bickerton 2009; Donald 1991). Moreover, exogrammatic skills must also be learned – although the ability for the external storage of information is a biological development, the transmission of exogrammatic meaning becomes culturally-conditioned.

Cultural manifestations in which *graphic*, *lexical*, *rhythmical* and *musical* abilities are *applied simultaneously as means of transmission* are known in anthropology as 'ritual.' Ritual is characterized by its rigid and conservative nature, which is important for a *high-fidelity transmission of knowledge* and, implicitly, for *reducing the risk of loss*, which is inevitable when transmission relies on mere copying. By the same token, *repetitiveness* is instrumental in *the embedding of the specific causal order* upon which ritual is constructed. Therefore, the first instances of 'fixing' such a causality in stone or wood – instead of simply 'illustrating' it in sand – should coincide with the emergence of hominin ritual behavior. The systematic use (which is not necessarily the origin) of the cognitive abilities that are the prerequisites of ritual behavior – external storage of information (Bednarik 2014b), proto-language (Bickerton 2009), mimetic skills (Donald 1991), rhythmic and proto-musical abilities (ibid.; Morley 2003) – can be confidently traced back to approximately 300 thousand years (ka) ago, to archaic *Homo sapiens.*

At 300 ka, Middle Paleolithic (Middle Stone Age) 'Mode 3' industries dominated the cultural landscape, world-wide (SGM p. 6). Unfortunately, the *stories*, *songs* and *dances* of our Mode 3 past are long-forgotten, and the paleoanthropologist must thus reconstruct a rich cognitive landscape by relying on a limited number of surviving scratches incised in durable material.

For reasons that will be touched on soon, Australian Aboriginal cultures have never abandoned Mode 3 industries. Therefore, turning to them in order to understand the origins and meaning of exogrammatic storage is highly rewarding. Likewise, with ritual taking such a central place in Aboriginal life, we may gain useful insights into its role in cultural transmission.

Like *Homo erectus* before them, the ancestors of the First Australians were explorers *par excellence* – that is, they had ventured to new shores, to environments that were utterly different from those they were used and adapted to.[1] Upon their arrival, the First Australians were equipped with all the cognitive abilities that paleoanthropologists define as 'modern.' Apparently, they had made full use of these capacities: the land was 'named,' and a causal order that was communally-devised in their minds was projected on the physical environment. Their cultural approach to the new environment was followed by a cognitive and behavioral adaptation to their own construct of reality. The specific causality of Dreamtime stories was augmented with songs and dances and, most importantly, with portable 'rock art,' meant to 'fix in stone' the very causal order (blueprint) of Creation.[2]

*Tjuringas*, also known as 'material mnemonic techniques,' are typical examples of external memory storage. They tell Dreamtime stories that can be easily 'read' by those initiated in *exogrammatic skills*. The 'readings' are communal affairs that are accompanied by 'non-material mnemonic techniques,' i.e., *music*, *dance* and *song*. Every such communal recapitulation of the causal order upon which the environment was mentally constructed re-consolidates the *prescribed sequencing* of collective Dreamtime memory traces and transmits the information to those who participate in a *coroboree*, or – through meticulous initiation rites – to the next generation. Ritual rigidity and 'The Law' *inhibit improvisation* and the slightest change in the sequencing of memory traces is punishable. Reality is kept 'alive' thanks to ritual behavior – that is, ritual *re-constructs* and *re-consolidates* the specific sequencing that makes Reality and the information it pertains accessible to those whose minds are tuned to the same causal 'wavelength.'

Environmental changes that took place after the first 'calibration' of Reality – from meteorite impacts to desertification and rise in sea level – became added to the initial stories and accommodated to their specific causality as 'geomythical sequels' (Hamacher and Norris 2014). Thus, the body of information that had to be transmitted increased *additively* (not to be confused with *'cumulatively'*) and, in order to pass on such a vast amount of knowledge, ritual behavior became the central component of Australian culture, unlike in other parts of the world, where *cumulative* (not *'additive'*) technological innovation became the cultural preference adopted to address environmental instability (Steiner 2016). Thus, the retention of Mode 3 industries – with every single tool and technique also embedded in ritual – is rather an index of spiritual sophistication than of technological backwardness.

In such a context, Cameron's (2015) question whether Australian 'rock art' should be perceived as 'art or knowledge,' becomes pertinent. Moreover, with the starting point of this discussion being *abstract* (Mode 3) Lower and Middle Paleolithic material – and non-material – mnemonic techniques and, with the emphasis on ritual transmission, the Australian example might prove instrumental in understanding the role played by exograms in cultural contexts that can be reconstructed only by relying on *archaeologically-preserved transmission techniques*, namely: rock 'art.'

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[1] This, in contrast to certain ancient African populations that did not experience such a 'rift' and to whom I will return later.

[2] However, this scenario cannot be generalized and applied to the First Americans who, upon their entering the New World, were at an already Mode 4 technological level and with a long history of cultural specialization behind them.

## 2. A Conscious Calibration of Reality

### *2.1 Contextual Focus Hypothesis*

The perception of the immediate environment – as provided by our senses – together with memory traces that may be associated with such a phenomenal 'knowledge,' become accessible to other minds only when they are systematically organized, according to communally-devised rules for a causal sequencing. Einstein's definition of science, as an "attempt to make the chaotic diversity of our sense-experience correspond to a logically uniform [unified] system of thought" describes precisely the mechanism by which phenomenal information becomes converted to accessible knowledge. Exograms play a major role in this process and, therefore, the first instances of exogrammatic representation must be correlated with the emergence of 'scientific thought.'

Liane Gabora's (2003) 'contextual focus hypothesis,' namely, "the [mental] capacity to shift between *associative* – conducive to forging new and random concept combinations – and *analytic* thought, which is conducive to manifesting them in an *ordered, reciprocally understandable* fashion" (emphasis mine) formulates in a succinct manner such a cognitive process. According to Gabora, at the divergent end of the continuum there is a defocused, intuitive and associative *mode* that finds remote or subtle connections between 'concepts' that are *correlated but not necessarily causally related*. At the other – convergent – end of the operational range of the contextual focus is a *rule-based*, *analytic mode* of thought that analyzes relationships of *cause and effect*. Insights and new ideas germinate in a defocused state in which one is receptive to the possible relevance of many dimensions of a situation. They are refined in a focused state, in which irrelevant dimensions are filtered out and only the relevant ones are condensed.

In the case of the human brain – for reasons that will be soon mentioned – the indiscriminate associative combination of concepts may lead to a *combinatorial explosion of possibilities*; in other words, to a state of *undecided superposition*. However, such a complex state is likely to be very difficult to maintain and a potential downfall of processing in an associative mode may occur. When – in the associative mental state – concepts appear in the context of each other, their meanings change in ways that are non-compositional, i.e., they behave in ways that violate the rules of classical logic (Gabora and Kitto 2013). Despite its potential impact, this challenge is not as insurmountable as it might at first seem, as there is one mathematical formalism which was invented precisely to describe such contextuality: quantum theory (ibid.).

Substituting Gabora's *'concepts'* with *'memory traces,'* I would suggest that their *rule-based causal associations* can be depicted in the abstract motifs of early rock art, which illustrate a collapsed state of superposed memory traces. *External memory storage* (*sensu* Donald 1991) becomes the technique that overcomes the risk of a potential downfall of processing which would be the inevitable outcome of trying to compute the ever-increasing amount of memory traces that were stored in the neural recesses of our big-brained robust ancestors. *Exogrammatic rules* lead to a specific and adaptively advantageous *stabilization* of the indiscriminate associative possibilities in the combination of memory traces and convert them to *causal* and, therefore, reciprocally-understandable information packages.

Miyagawa et al. (2018) hypothesize a similar cognitive process according to which, "symbolic thinking led to a fundamentally different way to compute data, one that extracts only the essence required for abstract representation instead of computing the entire set of incoming raw information." Such a 'collapsed state' is *maintained* with the help of ritual behavior, which lends to *a causal calibration of reality* the *durability* that is necessary for its perception, representation and transmission.

### *2.2 The Art and Science of Tracking*

Without knowing it, 1998 Rolex Award laureate Louis Liebenberg (2013a, 2013b) supplied an impressive amount of empirical evidence that seems to strengthen and illustrate Gabora's (2003) contextual focus hypothesis. Liebenberg suggests that there is a link between the development of the '*art* of tracking' and the origin of cognitive modernity. Moreover, scientific reasoning also appears to have its etiology rooted in 'the *science* of tracking,' i.e., in mental processes without which elaborate forms of tracking would be inconceivable. Liebenberg differentiates between two 'scientific' types of tracking: (a) *systematic tracking* is restricted to a step-by-step following of signs, which can be complemented with (b) *speculative tracking* which, in its turn, relies on the *meticulous* gathering of information from signs, until it provides a causally-correct indication of what the animal was doing and where it was going.

Speculative tracking involves the *creation* of a *working hypothesis* based on *a causal association of memory traces* related to animal behavior, topography and other tangential phenomena. The emphasis is primarily on *identifying*, *mentally-sequencing* and *verbally-debating* empirical evidence in the form of tracks and other signs. In other words, with a knowledge of animal behavior in mind, trackers *zoom-in* to look for signs where they *expect* to find them. They can decide to follow them systematically, or to interpret the signs, construct a mental model and let the hypothesis guide them to the animal. The ability to predict animal behavior based on minimal indexical referencing is achieved in a convergent (analytical) mental state. Conversely, and complementing 'scientific tracking,' following the identification of signs, the hunters do not waste time to follow the tracks one-by-one, or to debate their meaning at length. They process the minimal information in a divergent (associative) mental state, in which causal order is not necessarily observed and proceed immediately running the prey down, based on their 'intuition.' During the run, they maintain such a defocused mental state and enter a *trance-like condition* in which *they become the chased animal and assume its behavior*.

For example, in the last episode of David Attenborough's BBC documentary *The Life of Mammals* (2002) such a 'persistence hunt' is followed, at the beginning of which the hunters focus on finding tracks and signs necessary for a causal prediction of the prey's movement. During the run, and likely because of the physical strain involved, the hunters become defocused and continue to run in a trance-like state in which they access the mind of their quarry and intuitively follow the route taken by the fleeing animal. This is not a sign of supernatural abilities achieved in an altered state of consciousness, but the result of the simultaneous, non-analytical processing of memory traces related to animal behavior, which allows the hunter to 'become' the animal – that is, assume its feelings, instincts and behavior. On the other hand, a hypothesis built on empirical experience and causal reasoning can be verbally debated, and to predict the animal's 'thoughts' and movements does not necessitate a trance-like condition, but only simple causal reasoning based on an intimate knowledge of animal behavior.

Liebenberg uses interchangeably the terms 'science' and 'art' of tracking. This is not incidental: systematic, i.e., *convergent tracking* may be designated as a *scientific endeavour*, while tracking in a trance-like – that is, in a *divergent* – mental state is what Liebenberg calls '*creative* science.' The *specific causal outcome* ('collapse') of a *defocused concept* (memory trace) *combination achieved in a trance-like condition* during the hunt can become a part of a *reciprocally understandable repertoire* which, in its turn, can be externally stored ('stabilized') and transmitted as 'knowledge.' The experience of the trance is recalled in the *ritual dance* that recapitulates the hunt and the insights acquired in a divergent mental state are *shared* (like meat) with the community. The *mimetic illustration* may be accompanied by *graphic illustration* (not necessarily painted on rock, despite the ability to do so[3]) which, in this case, could be a *figurative depiction* of the *hunt*, of a *therianthrope*, etc.

### *2.3 The First Artist/Scientist*

This takes us back to the question posed by Cameron (2015), namely, whether 'exograms' are 'art or knowledge'? *Are abstract engravings on stone/wooden tjuringas* or *figurative illustrations* of hunted animals

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[3] As long as there is demographic strength or cultural stability, transmission may rely only on mimetic/musical transmission. Children could have drawn hunting scenes in sand during the dances, but the practice of painting them on rock denotes change: environmental, population bottlenecks, contact with menacing cultures, cognitive losses, etc. I will return to this point toward the end of the paper.

and therianthropes *witnesses to convergent and, respectively, divergent mental processes?* Does abstract rock art sketch causal constructs of reality and do figurative art-like productions illustrate subjective phenomenal experiences? Meanwhile, let us suffice with the observation that both exogrammatic modalities are meant to transmit/share knowledge acquired in antithetical mental states. *The ability for both abstract and figurative representation must have evolved in parallel with the capacity to shift the contextual focus between associative and analytical perceptions of reality* (*sensu* Gabora) *and with the emergence of the practice to shift between systematic and trance tracking* (*sensu* Liebenberg).

However, the preference for abstract or figurative exogrammatic representation depends on the importance of the specific type of knowledge that must be transmitted: a conscious formatting of reality became a necessity when, due to encephalization, an indiscriminate associative combination of memory traces would have resulted in a combinatorial explosion of possibilities which, in its turn, could have had maladaptive consequences. *When and why did human neural storage capacity become large and complex enough to accommodate an amount of memory traces that could have resulted in a breakdown of associative processing?* Answering this question will implicitly determine the date at which convergent thought and thus an analytical/causal perception of reality became, out of necessity, the most important cognitive signature of our ancestors.

I have tentatively compared the functionality of Australian Aboriginal material mnemonic techniques to that of archaeologically preserved Mode 3 rock engravings. My comparison was justified by the similarity between the motifs depicted and the technological setting within which they were produced. I have also theorized that the ancestors of Australian Aborigines, very much like *Homo erectus* before them, had ventured to new environments at a developmental stage when all the cognitive abilities that paleoanthropologists define as ‘modern’ were in place. Likewise, the biological flexibility of *H. erectus* – a hominin evolutionary characteristic that will be introduced and discussed soon – was augmented with their cognitive aptitude for convergent thought. I argue that *biological flexibility* enabled *Homo erectus* to venture out of Africa and that *cognitive flexibility* guaranteed their survival and success in novel environments. Very much like the First Australians, they have presumably ‘created’ a causally-ordered landscape to which they became adapted and in which they thrived.

According to Liebenberg, the ability to shift at will between the mental states that are employed in persistence hunt can be attributed to *Homo erectus.* Indeed, the paleoanthropological record seems to support Liebenberg’s suggestion (Carrier 1984; McCall 2014).

Following Donald (1991), let us consider his suggestion according to which, with the enlarged cranial capacity of *Homo erectus*, the human mind became radically different from its ancestral, pre-human condition. This change is also characterized by a shift from an episodic to a mimetic mode of cognitive functioning, made possible by the onset of the capacity for voluntary retrieval of stored memories, independent of environmental cues. If not *environmental*, then the cues are, supposedly, *cultural*. Therefore, the memory storage should also be cultural, i.e., *external and reciprocally understandable.* Cultural transmission with *H. erectus* must have been beyond simple copying, which would already imply (proto)linguistic abilities. As I have already suggested, linguistic and musical faculties must be understood as complementary parts of a much bigger cognitive landscape that also includes *mimetic*, rhythmical and *graphic* representational aptitudes.

Ian Morley, in his seminal work on the archaeology of music (2003), states confidently that by approximately 600,000 years ago, with *Homo erectus*, the vocal and neurological apparatus for *voluntary control* over the structure and complexity of vocal utterances was already fully-developed. This enabled *extended* and *planned sequences* of such utterances. Morley attributes a *communicative* dimension to *consciously controlled* pitch, contour and intensity. As control increased, the length and complexity of sequences would also increase. Subsequently, ‘‘the *order* in which the expressive vocalizations occurred could assume *meaning.*’’ Here, Morley describes a typical convergent cognitive process and, because his focus is on music – which we immediately identify as an ‘artistic’ expression – the thin red line that separates art and knowledge becomes blurred.

The *origin* of the cognitive abilities that are the prerequisites of ritual behavior – external storage of information (Bednarik 2014b), proto-language (Bickerton 2009), mimetic skills (Donald 1991), rhythmic and proto-musical abilities (ibid.; Morley 2003) – can be thus be traced back to approximately 600 ka ago, to *Homo erectus*. Archaic *Homo sapiens* (including *H. heidelbergensis*/*rhodesiensis*) must have already been in full possession of these faculties and their *systematic application* can be confidently associated with them.

Based on isolated finds, like the grooves incised on a bovid bone from the Kozarnika Cave in Bulgaria (the age of which was estimated by Bednarik [2014a] to be >1 million years old), I would suggest that the antiquity of *ritual behavior* may be pushed back in time to an even earlier age. (Let us not forget that the Kozarnika bone [SGM p. 13; *Fig. 1*] is likely only the *visual aspect* of a behavior that, as seen above, cannot be separated from its *vocal, mimetic, rhythmic and musical extensions*.)

I reserve the right to remain open-minded to an earlier possible origin of ritual behavior: as mentioned in the introduction, patterns and images drawn, say, in sand or on tree bark have a limited life span. Spirals, parallel lines or zig-zags traced on such media would have not survived to our days, due to taphonomic and various weathering processes. Isolated finds may however hint to behaviors that were practiced in contexts in which stone, bone or wood became the *preferred* material used for exogrammatic representation. I would theorize that *the practice* – and the causal understanding of reality that lies behind it – *did not appear suddenly, but it gained in importance and assumed increased meaning* at around 300 ka ago, which would also explain the number of finds dated to that period. This might also point to the possibility that it was approximately at this time when *the first individual cognitive trials of a causal understanding of reality became a well-established collective and trans-generational cultural practice*.

Donald (1991) identifies three uniquely human systems of memory representation, namely: (i) *mimetic* (starting with *H. erectus*, at c. 1.5 million years ago); (ii) *lexical* (archaic *H. sapiens*, 300,000 years ago) and (iii) *external* (attributed exclusively to 'anatomically modern' humans, at 40,000 years ago). Contrary to the three-tiered model, I would suggest that the cognitive abilities listed above have developed in synchronicity, as complementary parts of a complex ritual behavior. Therefore, a single transition is more likely than three hierarchically distributed cognitive punctuations. Especially so, because the cognitive expressions of the first and second stages – as theorized by Donald - already include the abilities attributed to the third stage. *Mimetic, lexical* and [graphic] *external memory representations* are not only complementary to each other but, because they are the products of the same cognitive process, they do not make any sense when hierarchically ordered.

In conclusion, symbolling abilities seem to have been present in a latent/emergent form already with *Homo erectus*. As Morley argues, *H. erectus* was in the full possession of the necessary physiological and neurological apparatus for mimetic, lexical and external memory representation. However, the ability – or its random use – does not imply its immediate and wide-scale application. The documented systematic application of these ancestral abilities – the entire set of what I have labeled 'ritual behavior,' of which the external storage of causally-sequenced memory traces in the form of abstract representations is an integral component – may be attributed to archaic *Homo sapiens* (*rhodesiensis, heidelbergensis, neanderthalensis*) who, presumably, were also in the possession of latent iconographic abilities that would become fully mobilized only when acquiring meaning and importance in a strictly cultural (i.e., 'artificial') environment.

### 2.4 'Consciousness-as-we-know-it'

So far, I have repeatedly referred to a '*consciously*-sequenced' perception of reality. Moreover, I have also floated the idea that Lower and Middle Paleolithic abstract representations should be perceived as tangible signs of an emergent species-specific *consciousness.* At this point, I must address the elusive concept of 'consciousness.' Given the various perceptions and explanations of the concept – which range from the spiritual to the neuropsychological and quantum-mechanical – there is no clear-cut consensus definition of consciousness. From the perspective of what was said up to this point, the best fitting approach to consciousness would be that offered by Ned Block (1995). Block differentiates between *phenomenal* (P-) and *access* (A-) types of conscious perception.

*P-consciousness* is raw experience of movement, colors, forms, sounds, sensations, emotions and feelings, with *our bodies and responses at the center*. This is, practically, Einstein's ‘‘chaotic diversity of our sense organs,’’ as described in a previous section. It can also be likened to Gabora's (2003) divergent, unfocused mental state, the *phenomenal awareness* of *superposed and non-causally related memory traces*.

*A-consciousness*, on the other hand, is information stored in our minds which is made accessible for *verbal report*, *reasoning*, and the *control of behavior*. Einstein's ‘‘logically unified system of thought’’ and Gabora's convergent mental state – in which loosely related memory traces assume a ‘‘causally-ordered and reciprocally understandable form’’ – would be the best parallels.

I argue that the ability to shift between Block's P- and A- aspects of consciousness and between the divergent and convergent ends of the operational range of Gabora's contextual focus are closely related cognitive aptitudes.

The abstract paleoart corpus that has survived from the very period when such abilities emerged are the material remains of a cultural behavior that must have included additional, non-material cognitive mechanisms of converting individual phenomenal perception to collectively accessible information. As Block stresses, A-consciousness implies *verbal report* (i.e., [proto-]linguistic skills), *reasoning* (that is, a causal interpretation and perception of not necessarily causally-ordered information and the ability to predict in the future, based on analytically-devised rules) and *controlled behavior* (which is determined by and adapted to the causally-ordered construct of an already predominantly cultural environment).

Miyagawa et al. (2018) approximate a similar process in their ‘cross-modality information transfer hypothesis’ in which, [the extraction of] ‘‘only the essence required for abstract representation instead of computing the entire set of incoming raw [phenomenal] information’’ is the main characteristic of *symbolic thought*. *Abstract representation* and *symbolling* become thus indispensable in the *conversion of phenomenal conscious perception to accessible information*.

Francesco d'Errico and colleagues (2017) propose a comparable cognitive transition in a recent paper suggestively titled *From Number Sense to Number Symbol*. In the article, they suggest that a 44 ka old incised baboon fibula from Border Cave (South Africa) and a similarly notched 72 ka old hyena femur from Les Pradelles Cave (France) may be interpreted as *‘exosomatic devices' meant to store numerical information* (SGM p. 13; *Fig. 1*). Judging by the dates of the artifacts and by similar finds in other parts of the world, the authors conclude that such exosomatic devices were in use with archaic humans – including Neanderthals – during the African Middle Stone Age and the European Middle Paleolithic. They interpret the cognitive background of these devices as ‘cultural exaptations' which, simplistically formulated, means the application of a biologically developed cognitive potential in a cultural environment, where the biological ability – or *pre-adaptation*, as the term *exaptation* was previously known – becomes adaptively useful and thus, perpetuated in a novel form. However, the ages of these artifacts are much later than those attributed to the already mentioned and similarly notched/engraved finds from Kozarnika, Wonderwerk or Bilzingsleben and dated by Bednarik (2014a) to > 1 my, 300 ka and > 325 ka (*Fig. 1*). Apparently, we can identify two distinct periods in which abstract notches and engravings had special meaning and importance: (i) the exogrammatic representations of archaic hominins from the first period (up to c. 300 ka) may be perceived as the *indices of an emergent consciousness and ritual behavior*, while (ii) notches and engravings dated to c. 70 ka and continuing well into the Upper Paleolithic may, indeed, be perceived as *expressions of cultural exaptations rooted in earlier symbolling abilities*.

The title of Derek Bickerton's (2009) book *How Man Made Language and How Language Made Man* is just as suggestive as that of the abovementioned paper authored by d'Errico et al. (2017). Block's A-consciousness implies *verbal report* and *reasoning* and, as I have already theorized, proto-linguistic skills must have been part of ritual behavior together with, or closely related to controlled vocalizations, *sensu* Morley (2003). While musical and mimetic abilities would have had a role in the *reiteration* and *trained perception* of causally-sequenced constructs of reality, the descriptive character of language would have been instrumental in the *consolidation* and *transmission* of such a conceptually-constructed cultural environment. Not incidentally, Bickerton stresses on the close relationship between *niche construction* and the development of language. I will return to niche construction theory very soon. Meanwhile, I would like to note that the '*how man made language*' part of the title refers to the process of *constructing* the *cultural niche*, while the '*how language made man*' is a good description of how man *adapted* to his/her own cultural construct.

*Language* and *time* are closely related categories. Bernie Taylor (2017) offers an excellent model for the origin of our linear perception of cyclical time. Without being aware of it, his approach is complementary to Bickerton's proposal regarding the origins of language. Taylor introduces the concept of 'biological time,' that is, the meticulous observation of animal behavior, the specifics of which – calving, rutting, mating, gestation periods – are correlated with seasons, floods, lunar phases and other repetitive (cyclical) natural phenomena. Lunations become thus indexical references for, say, the availability of food resources. Animal behavior may vary from season to season and tracking the animal may ask for different strategies during different lunar phases. Similarly, the meat of certain animals may be rich in fat and nutritious, depending on the heliacal or nocturnal rising/setting of specific constellations, with the hunt being planned accordingly. Observing and recording biological time results in an impressive amount of knowledge the transmission of which, according to Taylor, relies not only on language – *sensu* Bickerton – but also on rock art. For example, the famous stag from the Axial Gallery of Lacaux was painted above a row of abstract dots and a rectangle. The stag is placed above the latter which, in Taylor's interpretation, points to a specific time of the year – e.g. the fourteenth (left to right) or second (right to left) lunation (SGM p. 12) – when the stag's antlers are at their fully developed stage and, therefore, it possesses the maximum amount of 'potency' during its biological time (see Lewis-Williams 1988; Steiner 2017 regarding the importance of 'tapping' power-animal potency).

Of special interest here is that although the Axial Gallery was painted during the Upper Paleolithic, the iconic depiction of the stag is accompanied by abstract representations. Therefore, the functionality of the latter cannot be directly related to the conversion of phenomenal perception to accessible information but rather interpreted as a later phase of cultural adaptation to an already established construct of reality, an adaptation of subsistence, social and ritual activities to the biological time of the stag depicted in this specific mural. Therefore, Taylor's 'biological time' may just as well be called 'cultural time,' for reasons which will become evident in the following sections.

In the paragraphs above, I have illustrated the simultaneous emergence of *consciousness* and the first instances of *exogrammatic expression* by drawing parallels between Ned Block's theory and cognitive phenomena that seem to support the view that the abstract patterns of Lower and Middle Paleolithic rock art reflect our ancestors' preoccupation with adapting reality to a culturally-devised conscious format. One of the main points in the argument is Gabora's contextual focus hypothesis, which was expanded by Gabora and Kitto (2013) in order to accommodate a quantum approach to consciousness. When – in the associative mental state – concepts appear in the context of each other, their meanings change in ways that are non-compositional, i.e., they behave in ways that violate the rules of classical logic. Gabora and Kitto adopt the classical Copenhagen interpretation according to which, *conscious observation results in quantum state reduction*. That is, memory traces in an undecided state of superposition become manifested in an ordered and reciprocally understandable format, according to a communally devised 'causal stencil.' The *quantum collapse* is *the result of convergent thought* that extracts only the essence required for abstract representation instead of processing the entire set of memory traces that are open to infinite associative possibilities in a defocused mental state. The *causal stencil* is a cultural product which, as I argue, is the general motif of the oldest, i.e., > 300 ka abstract representations.

Contrary to the popular Copenhagen tradition, Penrose and Hameroff (2011) argue that quantum state reduction is not the result of conscious observation but, quite the opposite, *consciousness is the result of quantum state reduction*. In other words, a specific outcome of the combinatorial probabilities of superposed memory traces occurs in synchronicity with – and as a function of – an objective quantum state reduction (OR).

I am inclined toward considering the classical model, because of its compatibility with my understanding of the role played by the oldest (> 300 ka) abstract representations, as detailed above. However, the Penrose-Hameroff hypothesis has the potential to explain the cognitive background of abstract notches and engravings that I have tentatively ascribed to a later (< 70 ka – 12 ka) period that precedes and then overlaps with the Upper Paleolithic iconic explosion. I would therefore suggest that the objective causal order to which our conscious perception of reality adjusts itself – like in the Penrose-Hameroff model – is the very construct of reality devised by our Lower/Middle Paleolithic ancestors and stabilized during tens of millennia of ritual behavior. While their abstract notches and geometrical patterns reflect a conscious modelling and calibration of reality, abstract representations from the second period may be explained as indices of the conscious conditioning of our behavior, as an adaptation and adjustment to an already externalized – and therefore objective – cultural construct of reality. Hence, the abstract representations of this period should be approached from a cultural/*behavioral* perspective, unlike the first manifestations of exogrammatic abilities, which reflect a strictly biological/*cognitive* development.

Simplistically formulated, Lower/Middle Paleolithic *exograms* illustrate our *taming of reality* (by its conversion to a conscious format), while Middle/Upper Paleolithic *paleoart* mirrors the process of *taming ourselves* (by conditioning our behavior to the dictates of our own construct of reality). *Art*-as-we-know-it would emerge as a next step, as a *technique* (*sensu* Ellul 1964) devised to *buffer between biologically-developed cognition and culturally-acquired behavior.*

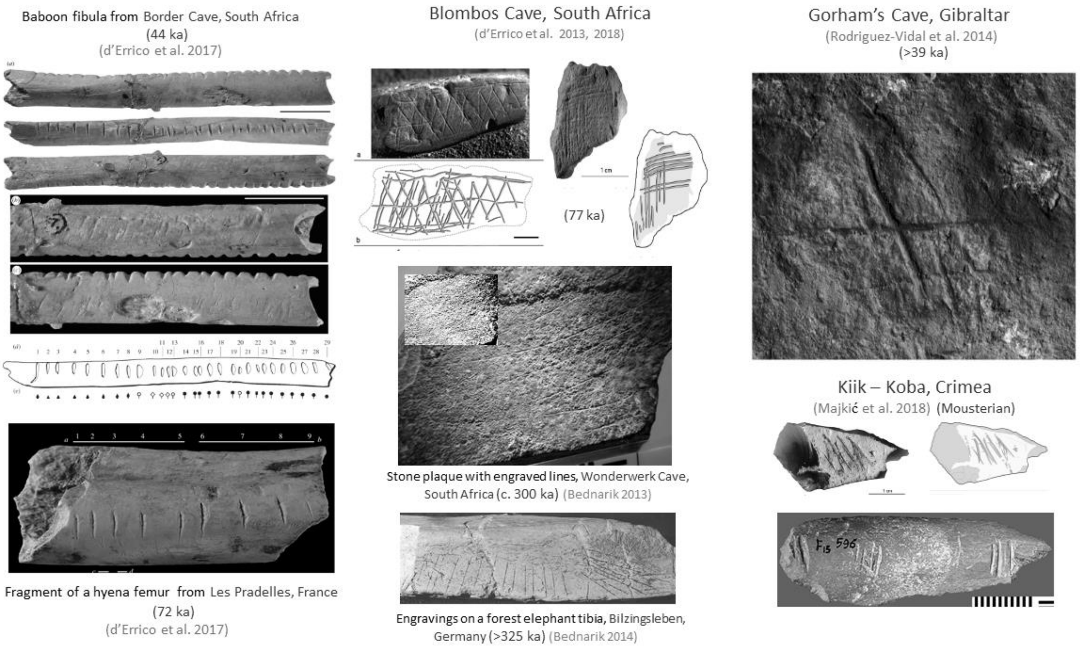

*Fig. 1 - The illustrations above are offered as exemplifications of the suggestion that the biological emergence of a species-specific type of consciousness could be associated with the first abstract representations of the Lower and Middle Paleolithic (the Wonderwerk, Bilzingsleben and Kozarnika grooves and engravings). The ability for exogrammatic representation was apparently an exaptation for the already culturally-conditioned type of consciousness (i.e., 'consciousness-as-we-know-it') that would emerge during the later phases of the Middle Paleolithic (the Border Cave, Les Pradelles, Blombos, Gorham's Cave and Kiik-Koba incisions and hashtags) and which would reach its full expression in the iconographic explosion of the Middle/Upper Paleolithic transition.*

*Symbol*, *number*, *language*, *time* and *art*, according to anarcho-primitivist philosopher John Zerzan (1999), are the very cultural constructs that alienate the 'noble savage' from his natural environment and which restrict the full realization of his biological potentials. However, Zerzan's *reification*, i.e., the tendency to take the conceptual as the perceived and to treat concepts as tangible realities, is a *cognitive exaptation of* *both 'savage' and 'civilized.'* The only difference between the two is in how their *commonly shared cognitive aptitudes* were applied and how the inherent risks of cultural evolution were managed.

## 3. A New Approach to Evolution – Neoteny and Its Consequences

### *3.1 The Blaga Coordinates*

What was the evolutionary background that had enabled the development of hominin-type consciousness and, implicitly, the necessity for external storage of information? Given that the latter is the main characteristic of human cognition, such an inquiry must explain the unique case of hominin brain development, with a focus on our increased neural storage capacity.

In a recent (2018) study, Fiddes et al. have identified a set of three nearly identical genes found only in humans and which appear to play a critical role in the development of our large brains. The genes – known as NOTCH2NL – appeared between 3 and 4 million years ago, just before the period when fossils show a dramatic increase in the brain sizes of human ancestors. The new human-specific Notch genes were derived from NOTCH2, one of four previously known mammalian Notch genes, through a duplication event that inserted an extra partial copy of NOTCH2 into the genome. This happened in an ancient ape species that was a common ancestor of humans, chimpanzees, and gorillas. The partial duplicate was a nonfunctional 'pseudogene,' versions of which are still found in chimp and gorilla genomes. In the human lineage, however, this pseudogene was 'revived' when additional NOTCH2 DNA was copied into its place, creating a functional gene. This new gene was then, according to Fiddes and colleagues, duplicated several more times, resulting in four related genes, called NOTCH2NL, found only in humans. Other genes involved in human brain development seem to have arisen through a similar duplication process. A notable example is the gene SRGAP2C, which is thought to increase the number of connections between neurons. In modern humans, these genes are also involved in genetic defects associated with neurological disorders like autism and schizophrenia, to which I will return in the final sections of this paper.

The NOTCH2NL genes are especially active in the pool of neural stem cells thought to generate most of the cortical neurons. By delaying their maturation, the genes allow a larger pool of these stem cells to build up in the developing brain, ultimately leading to a larger number of mature neurons in the neocortex (the outer layer of the brain in mammals; in humans, it hosts higher cognitive functions such as language and reasoning). This delayed development of cortical neurons fits a pattern of delayed maturation characteristic of human development. In next section, I will return to the importance of this pattern of *delayed maturation* and to the implications of neoteny in our peculiar physiological and psychological evolution.

The Romanian philosopher and writer Lucian Blaga (nominated for the Nobel Prize on the proposal of his compatriot and admirer, Mircea Eliade) dedicated a whole book to the subject of evolution, part of a trilogy that promoted historical and cultural theories. In *Anthropological Aspects* (1976 [1943]) he proposed a 'new approach' to evolution. His insights were only actualized a few decades later, when Steven Jay Gould and Niels Eldredge (1977) started to consider, independently, questions posed, but only partly answered by Blaga. I will present below the framework suggested by Blaga and adopt it as a loose frame of reference (not as a rule, but as a 'ruler') that will guide my discussion.

Blaga was looking for a model in which certain particularities, like the problem of what he perceived as human 'primitivisms' could be explained, without recurring to the then widely accepted gradualist and linear concepts. His 'new approach' placed evolution in a field defined by two coordinates within which *life* became subjected to evolutionary tendencies that took distinct orientations, namely: (i) toward specialized and optimized organisms, or (ii) toward generalized and autonomous life forms.

The field is defined by a *vertical* and a *horizontal* axis:
(1) a tendency toward *specialization,* through *the cumulative acquisition of adaptive features* was ascribed to the horizontal, and (2) a tendency toward *generalization*, through *the retention of primitive features* and the *reduction of specialized traits,* to the vertical.

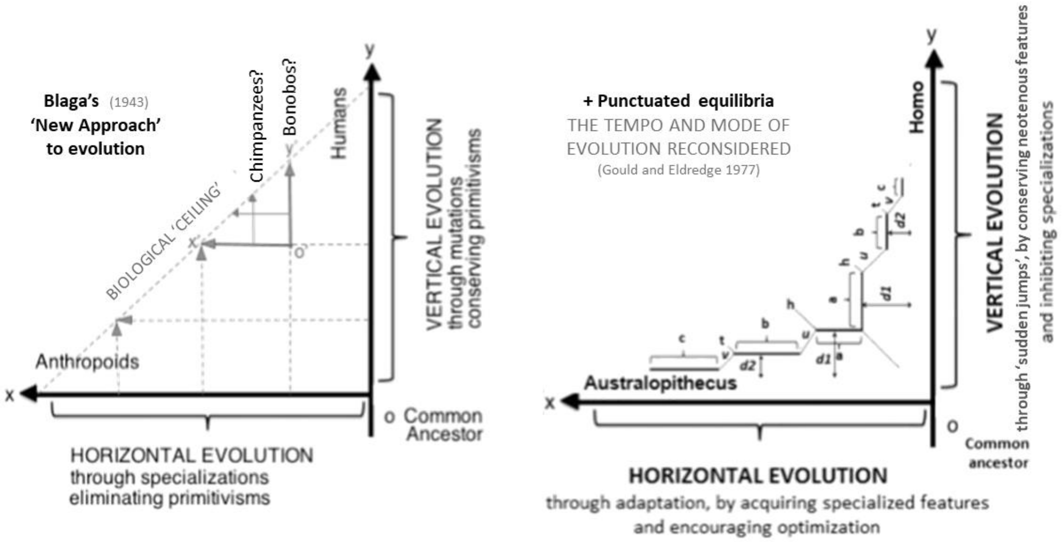

*Fig. 2 - The Blaga coordinates (left) augmented with the postulates of the punctuated equilibria hypothesis (right).*

**HORIZONTAL EVOLUTION** (o-x)

The alternation of horizontally-positive stable phases (a, b, c) with vertically-negative short-lived phases (*u, v*).

- The horizontal phases are the temporal distribution (*stasis*, duration) of a species, while the vertical ones represent transitional forms.
- The vertically-negative stages are characterized by the permanent adoption of specializations, which result in increased adaptive rigidity and environmental dependence.
- The closer a species is to the horizontal, the higher the chance of it being 'captured' and that no further vertical tendencies would occur (*d2 < d1*).
- The vertically-negative phases (*u, v*) represent '*sudden jumps*' that become decreasingly shorter in time, the stronger the attraction of the horizontal (*v < u*).
- The horizontally-positive phases (a, b, c) become increasingly longer in time (a < b < c).
- The closer a species is to the horizontal coordinate, the weaker the influence of the vertical axis.
- Minimal vertically-positive tendencies may also occur - the closer to the vertical coordinate, the higher the possibility of their transformation from *tendencies* to *phases*. Thus, new lateral evolutionary lines may speciate (h, t).

**VERTICAL EVOLUTION** (o-y)

The alternation of vertically-positive stable phases (a, b, c) with horizontally-negative short-lived transitional phases (*u, v*).

- The vertical phases are the temporal distribution (*stasis*, duration) of a species, while the horizontal ones represent transitional forms.
- The horizontally-negative stages are characterized by the permanent adoption of reductions, which result in increased adaptive flexibility and environmental autonomy.
- The closer a species is to the vertical, the higher the chance of it being 'captured' and that no further horizontal tendencies would occur (*d2 < d1*).
- The horizontally-negative phases (*u, v*) represent '*sudden jumps*' that become decreasingly shorter in time, the stronger the attraction of the vertical (*v < u*).
- The vertically-positive phases (a, b, c) become, likewise, decreasingly shorter in time (a > b > c) – apparently, evolution works faster on the vertical than on the horizontal coordinate.
- The closer a species is to the vertical coordinate, the weaker the influence of the horizontal axis.
- Minimal horizontally-positive tendencies may also occur – the closer to the horizontal coordinate, the higher the possibility of their transformation from tendencies to phases. Thus, new lateral evolutionary lines may speciate (h, t).

BOX 1 – THE BIOLOGICAL FIELD

(1) The horizontal evolutionary process, i.e., *the strategy of specialization to the environment*, occurs mostly through natural and sexual selection: evolution may be perceived as a success, and a condition that facilitates survival in a given environment is reached. In other words, from a state of 'sufficient harmony' with the environment, evolution leads to a state of 'perfect harmony.' The only problem is that organisms following this strategy are at peril when the environment they are so highly optimized to changes. The higher the degree

of specialization, the lower the ability to cope with changes. In cases of extreme specialization, the slightest fluctuation in the environment can wipe out a species. Another backlash of such an evolutionary mode is that once a state of 'perfect harmony' is reached and, provided that the environment remains stable, further evolution becomes characterized by the development of *hypertrophies*.

(2) The vertical mode of evolution is the answer to the dangers inherent in the strategy of specialization: at the price of conserving some primitive features, a degree of autonomy is also preserved, i.e., a higher flexibility in the face of environmental changes – instead of the smooth specialization through selection, a rougher evolutionary strategy is adopted, which is transformation through mutations or punctuations. At first glimpse, this strategy does not seem to be so successful: the organism is not so finely tuned to its environment. But, when the environment undergoes changes, the flexibility granted by the vertical evolutionary mode proves its advantage: the higher the degree of autonomy, the lower the danger of being affected by environmental instability. In cases of very pronounced autonomy, the organism is capable to survive in almost any type of natural environment – changes are taken as opportunities, the opening of 'new horizons.' In the case of vertical evolution, the tendency is to preserve an already acquired state of 'sufficient harmony' without falling in the trap of 'perfect harmony' and the dangers entailed in it.

According to Blaga, vertical evolution preserves adaptive flexibility by falling back on a generalized morphology, whereas horizontal evolution results in a specialized morphology that limits adaptive flexibility and may culminate in the acquisition of maladaptive features.

Blaga approximated a mechanism that in the following decades would become known as the theory of *punctuated equilibria* (Gould and Eldredge 1977). The punctuated equilibria model can be applied to both coordinates and, by doing so, it becomes evident that there is no slowly balanced linear evolution, but only short, punctuated periods of evolutionary activity – *sudden jumps* – separated by much longer intervals of stability – *stasis* – in which biological changes are practically negligible. Blending Blaga's 'new approach' with the punctuated equilibria model that he has predicted – but fell short of elaborating it – the 'new approach' becomes meaningful even for more recent inquiries regarding the peculiarities of hominin evolution. In *Fig. 2* (right) I have inserted a graphic approximation in which vertical and, respectively, horizontal periods of stability are interrupted by short-lived transitional phases which, in their turn, are followed again by stable periods (as detailed in BOX 1).

However, Blaga has drawn a hypothetical 'biological ceiling' between the coordinates of his model and thus he has set a limit to the *countless evolutionary possibilities* that tend to become realized (*Fig. 2*, left). As a function of its proximity to the horizontal, a species' vertical evolutionary tendencies become narrowed down, i.e., there is an upper limit of biological flexibility. For example, chimpanzees (x') – as a more specialized species – display less biological flexibility than bonobos (y') – who have derived from a common ancestor (o') that was closer to the vertical coordinate at the time of speciation. In other words, a bonobo will never evolve into a human, and chimpanzees will never become bonobos: the 'biological ceiling' limits the evolutionary flexibility of both.

Enlarged with the postulates of punctuated equilibria, the graphic model also highlights that the temporal continuity (*stasis*) of a species *specialized on the horizontal* will be increasingly longer, the more optimized to its environment it is. *Over-specialization* makes them so rigid that they cannot respond to novel environmental challenges, thus the danger of extinction becomes imminent. On the other hand, the stable phases of species that stay *generalized on the vertical* will decrease in time, and their high degree of autonomy would increase their flexibility in dealing with environmental fluctuations or voluntary changes of habitat, which could result in a wider geographical distribution.

### *3.2 Physiological and Psychological Neoteny in Hominin Evolution*

Coming back to Fiddes and colleagues' (2018) identification of a set of three nearly identical genes found only in humans – which, as mentioned, appear to have played a critical role in the development of our large brains – I am stressing again on their observation that the delayed development of cortical neurons and the ensuing increase in neural storage capacities fits a pattern of *delayed maturation* characteristic of human development. The pattern ascribes well to a phenomenon known as *neoteny*. In Blaga's days, neoteny was understood only in a rudimentary and recapitulative way, *sensu* Haeckel (1883). What Blaga perceived as 'primitivisms' must have been the fetal characteristics of juvenile apes that became stabilized features in humans.

Steven Jay Gould, in his *Ontogeny and Phylogeny* (1982), offers a list of these *primitive*-juvenile – that is, neotenous – features: our 'flat-faced' orthognathy/reduction or lack of body hair/loss of pigmentation in skin, eyes and hair/the shape of the external ear/the epicanthic fold/high relative brain weight /the central position of the *foramen magnum*/persistence of the cranial sutures to an advanced age/the structure of the hand and foot/the form of the pelvis/the *labia majora* of women/the ventrally-directed position of the sexual canal in women/certain variations of the tooth row and cranial sutures/absence of brow ridges and cranial crests/thinness of skull bones/position of orbits under cranial cavity/brachycephaly/small teeth and late eruption of teeth/no rotation of the big toe/prolonged period of infantile dependency and of growth/long life span. According to Gould, evolution occurs when ontogeny is altered in one of two ways: 1) when new features are introduced at any stage of development with varying effects upon subsequent stages, or 2) when features already present undergo *changes in developmental timing*. Together, these two processes exhaust the formal content of phyletic change; the second process is *heterochrony*.

Neoteny is only one of the six possibilities of *heterochrony* (change in developmental timing): (i-ii) *acceleration* (faster) vs. *neoteny* (slower); (iii-iv) *hypermorphosis* (further) vs. *progenesis* (not as far); (v-vi) *predisplacement* (begins earlier) vs. *postdisplacement* (begins later) (Bogin 1999).

Ashley-Montagu (1989) theorized that part of the differences seen in the morphology of modern types of man can be attributed to different rates of 'neotenous mutations' in their early populations. Thus, the Mongoloid skull is the most neotenized human skull. The European skull is less neotenized than the Mongoloid and African, with the Australian Aboriginal skull still less neotenized than the European, with the Neanderthal skull even less neotenized than that of the Australian Aboriginal. Observing the San, he described the following neotenous traits relative to Europeans: large brain/light skin pigment/less hairy/round-headed/bulging forehead/small cranial sinuses/flat roof of the nose/small face/small mastoid processes/wide eye separation/median eye fold/short stature. In addition, McKinney and McNamara (1991) attracted attention to the fact that African Pygmy and Asian Negrito populations also display highly neotenous features. However, as Hulse (1962) noticed, neoteny is not the only dimension of heterochrony that plays a role in human evolution. He brings up the example of Australian Aboriginals, who have retained similar skeletal characteristics to those which most people possessed in earlier times (*gerontomorphic* characteristics, as opposed to the *pedomorphic* traits that the Kalahari Bushmen display).

Understanding neoteny in this larger context, Thiessen (1997) argues that *Homo sapiens* is more neotenized than *Homo erectus*, and *Homo erectus* more than *Australopithecus*. By the same token, bonobos display more neotenous features than chimpanzees (ibid.; de Waal and Lanting 1997). Moreover, Ashley-Montagu (1989) suggests that juvenile pithecanthropine and australopithecine skulls would have had a closer resemblance to those of modern humans than to those of the adult forms of their own species. Humans, in their turn, have more neotenous skulls than *Homo erectus* and archaic *H. sapiens*.

The persistence of 'primitive' features, *sensu* Blaga, may thus be explained with the phenomenon of neoteny. Therefore, his generalized (vertical) mode of evolution stresses the role played by neotenous processes in human development, in which it assumes a crucial function in inhibiting tendencies toward specialization.

Neoteny, however, must not be understood as a process that manifests itself exclusively in morphology. The cognitive implications resulting from the retention of a juvenile shaped cranium and brain volume ratio to the body are equally far-reaching and of central importance to my inquiry. On one hand – within the Blaga coordinates – *life* escapes the attraction of the horizontal, which would restrict its potentials, but the price of this autonomy is high. The pedomorphic ape that is the result of such an evolutionary mode is extremely vulnerable. But, on the other hand, the means to compensate for such an unspecialized morphology is 'offered' by neoteny itself. As Bruce Charlton argues (2006), what looks like *immaturity* – or, in his terms, *the retention of youthful attitudes and behaviors into later adulthood* – is, actually, a valuable developmental characteristic, which he calls *psychological neoteny*. Highly educated people and eminent scientists demonstrate more neotenous psychological traits. The same applies to 'natural people' and children. In fact, *the ability of an adult human to learn is considered a neotenous trait.* Biological neoteny in humans had as a side-effect psychologically neotenous traits: curiosity, playfulness, affection, sociability, and an innate desire to cooperate (ibid.).

Psychologist David Bjorklund (1997) writes that "in many cases, important evolutionary changes are brought about by retardation of development, not by acceleration. This is reflected by the concept of neoteny, which means literally 'holding youth,' or the retention of embryonic or juvenile characteristics by a retardation of development." Gould (1982) also highlights "the undeniable role of retardation in human evolution" and he considers human neoteny as an "evolution by retardation".

Such juvenile traits were insightfully understood by psychoanalyst Donald Winnicott (1971) in revealing how playing, for instance, assumes a decisive role in the mental growth of children and, no less, *in human coping with reality and in developing our culture, sciences, philosophy, and arts.*

Following Gould, Jules Bemporad (1991) writes that "we may be considered slowly developing apes whose prolonged infancy allows us to internalize and develop a much more complex behavioral and cognitive repertoire and who persist in displaying juvenile features well into adult life." Playfulness is striking among these juvenile features, and although playing is ascribable to all mammalian brains, as neuroscientist Jaac Panksepp (1998) mentions, "humankind is still an especially playful species possibly because we are neotenous creatures who benefit from a much longer childhood than other species." Furthermore, he writes that "play is an index of youthful health. The period of childhood has been greatly extended in humans and other great apes compared with other mammals, perhaps through genetic regulatory influences that have promoted 'playful' neoteny." By the same token, discussing neoteny, Bjorklund (1997) remarks that there is no other species that demonstrates curiosity and play into adulthood to the extent that *Homo sapiens* do. Novelty and the unknown are typically avoided in adult animals, with the notable exception of humans.

However, and as it will be discussed soon, certain phenomena that closely resemble genuine biological and psychological neoteny would mutate to new dimensions in strictly cultural contexts, as *pseudo-neotenous* maladaptive processes.

I would like to conclude this section with the observation that unlike Blaga's horizontal coordinate – which is an evolutionary blind alley leading to inevitable extinction – *the vertical mode of evolution does not imply that, upon reaching a high position on the o-y coordinate, tendencies toward specialization would cease to exert their attraction.* At around the time of the Middle/Upper Paleolithic transition, another 'sudden jump' seems to have occurred, catapulting our ancestors into a new evolutionary dimension which, in its turn, became defined by similar tendencies toward specialization or autonomy.

### *3.3 The Upper Paleolithic Singularity*

Within the Blaga coordinates, pre-historic industries (stones) and hominin species (bones) may be followed in parallel and correlated with the basic postulates of the punctuated equilibria theory (Gould and Eldredge 1977). Thus, technocomplexes are more stable – last longer in time – the closer a hominin species is to the horizontal. Conversely, hominins placed 'higher' on the vertical coordinate develop technologies at a faster rate, and the duration of the industries becomes markedly shorter.

The Oldowan of the Lower Paleolithic, 2 to approximately 1 million years ago (mya), was a stable industry that lasted for approximately 1 million years (my). The Acheulian, with its Lower and Upper stages, still of the Lower Paleolithic, spanned over a period of approximately 800 thousand years (ka), between 1 to 0.2 mya. The Mousterian lasted for some 70 ka, it was the technocomplex of the Middle Paleolithic, and it spanned roughly the period between 200 to 40–30 ka ago. Taken together, all the Upper Paleolithic traditions lasted for a brief 25 ka. The European Mesolithic, again undifferentiated, did not take longer than a few thousands of years. The Neolithic was very short when compared to the preceding stages – it commenced approximately 10 ka ago in the Levant, slightly later in other areas, and it lasted for some 6 ka, followed by the Chalcolithic – 1 ka, which was itself followed by the Early, Middle and Late Bronze Age (1 ka together) and the Iron Age, which lasted for only 600 years. However, the Neolithic and the cultures following it do not belong to the biological field, and they are only mentioned here to illustrate the amazing rate assumed by cultural change. From 1 million to 800 thousand, to 70 thousand, to 25 thousand – at the dawn of history the life span of cultures is expressed in thousands, later on in hundreds and, in modern and contemporary times, in only decades, or years.

From this brief inventory, it becomes evident that the life-span of industries and cultures decreases in time - they are stable for progressively shorter periods and they accompany specific evolutionary stages (stases) together with the transitions (sudden jumps) to another. Only subsequent evolutionary stages (species) develop novel technocomplexes.

By comparing 'stones and bones,' one can notice that in the biological field defined by the o-x/o-y coordinates, *the rate of cultural change lags behind that of biological speciation.* Or, to put it simplistically, *old bones use old stones* (*H. erectus* paired with the Acheulian); *transitional bones keep the old stones* (*H. heidelbergensis* still associated with the Acheulian); *new bones use new stones* (*H. neanderthalensis* paired with the Mousterian). The emergence of novel technologies could be explained with the inventiveness that, as seen, is a psychological side-effect of neoteny – new bones display neotenous traits when compared to old bones.

The 'rule' is observed up to a point, at which *culture takes the lead*, and biology starts lagging behind it. Such a switch was common to all human populations (cf. Zerzan 1999) with the difference that in West Eurasia it had occurred in a quite precipitated fashion, due to environmental stress. In southern Africa, on the other hand, it was more gradual and its impact less severe. In both areas, however, culture would be a step ahead of biology until the Mesolithic, when technological development had reached a 'sufficient' state of elaboration. (In Australia, for reasons that were already mentioned, Mode 3 industries persisted, and the switch was not of a technological nature but, nonetheless, the ancestors of Aboriginal Australians had also effectuated it.)

In West Eurasia, the date at which the rate of biological evolution was overtaken by that of cultural change can be confidently placed within the Middle/Upper Paleolithic transition. Undoubtedly, the period witnesses a 'new beginning,' the onset of strictly cultural rules that would determine the nature of further (anatomical and behavioral) evolution. The 'suddenness' of the Upper Paleolithic transition and the empirical evidence that for the last 40 millennia – or more – culture evolves at a speed that biology cannot catch up with, led to the assumption that in Europe, where the transition was studied in depth, the aboriginal population was displaced by newcomers who brought with them – or improvised on spot – a 'superior' culture. The Mousterian tradition of the Neanderthals, according to the 'rule,' should have also been the culture of transitional forms leading to anatomically modern humans (AMHs); when finally, *Homo sapiens sapiens* appeared in the fossil record, he – and he alone – was supposed to develop the Aurignacian.

However, as already mentioned in the introduction, there were no transitional fossils to be unearthed, except the so-called 'Neanderthaloids' who were not confined to a clear-cut period and, because of their archaic features, their ages were grossly exaggerated. Moreover, some finds that had clearly developed from the region's final Mousterian, but also showed Aurignacian characteristics were discovered all over Europe (Malez 1959; Svoboda 1993; Kuhn and Stiner 2001). But, given the misconception that the Neanderthals were brutish cavemen, the 'big bang' in our cognitive evolution could not be attributed to such a backward species.

Robert Bednarik (2007) has followed the changes seen in human skeletal characteristics and has correlated them with the complex mosaic of the European tool traditions from 45 to 30 ka ago. He has attracted attention to the fact that the fossil record does not yield unanimously 'anatomically-modern' remains, and that archaic-looking – and likely archaically-behaving – 'Neanderthaloids' dominate the European theater of evolution until relatively recent times, without any trace of a sudden 'anatomically-modern' intrusion. The changes in human skeletal characteristics, according to Bednarik, were gradual. However, the cultural changes were remarkable, and they seem to have developed at a rate that was markedly faster than that of biological changes. ‘Neanderthaloids’ gave gradually way to AMHs – and were not suddenly displaced by them – long after the Aurignacian.

Bednarik (ibid.) also emphasizes that the accelerated rate of cultural change – *unlike in previous periods, when ‘the rule’ was still observed* – occurred in a period when only archaic hominins were present in Europe. He thus suggests that not only the Aurignacian-proper, but also the Bohunician, the Szeletian, the Olschewian, the Jankovichian, the Bachokirian, the Uluzzian, the Uluzzo-Aurignacian, the Proto-Aurignacian and the Altmühlian might all relate to humans other than the so-called ‘moderns.’ Moreover, he concludes that the ethnicity of the makers of any stone tool tradition and exogrammatic representation of the entire first half of the Upper Paleolithic – including the entire Aurignacian – appears to be that of *robust*, Neanderthal-like humans, or of their direct descendants. Bednarik concurs here with Tobias (1995), according to whom, the search for physical modernity is itself misguided, as modernity is indicated by cognition, behavior and culture, and not by cranial architecture or other minor physical differences.

At approximately 50 to 40 thousand years ago, a cognitively modern indigenous population, perfectly capable to accomplish the Upper Paleolithic ‘revolution’ by itself was already present in Europe. Therefore, and as I have already postulated, the Neanderthal to AMH transition should not be interpreted as the replacement of one species with another, but as a culturally-determined behavioral ‘sudden jump’ followed by a gradual morphological transition within the same – and cognitively already ‘modern’ – species.

Additional, but already *culture-specific cognitive changes* have followed the behavioral punctuation and have accompanied the morphological transition. Their emergence can be attributed to the period in which the rate of cultural change accelerated to such an extent that biological evolution was left lagging behind it (SGM p. 15).

I would define this crucial moment in our cultural evolution ‘the Upper Paleolithic singularity.’ At around the time of the Middle/Upper Paleolithic transition, the above-mentioned behavioral punctuation had catapulted our ancestors into a new evolutionary dimension which, in its turn, became defined by tendencies toward specialization or autonomy, very much like Blaga’s biological theater of evolution.

### *3.4 The Complementary Blaga Coordinates*

Having in mind the Upper Paleolithic singularity, a complementary set of coordinates that define evolutionary processes within the new cultural field must be introduced (*Fig. 4*). A ninety-degree rotation of the biological field to the right illustrates the same tendencies within the cultural field, with an o’-x’ coordinate that follows cultural accumulations that would eventually result in *rigidity and specialization*, and an o’-y coordinate that follows cultural *flexibility and autonomy*, through reductions. Our conditioned understanding would prefer to ‘correct’ the illustration in the slide and mirror it instead of rotating Blaga’s original, with ‘civilized’ contexts marked on the vertical, and ‘savage’ contexts on the horizontal. Like that, a linearly combined *biological and cultural* evolutionary vector would present a teleological continuum.

However, *Fig. 3* illustrates *how* the cultural dimension was entered – the ancestors of both ‘savage’ and ‘civilized’ undertook the ‘sudden jump’ that had propelled them deep within the cultural coordinates. Once in the cultural field, vertical and horizontal re-orientations took place, according to parameters that will be touched on later.

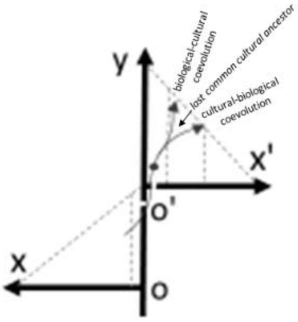

*Fig. 3 – Entering the cultural field. Vertical orientations within the complementary Blaga coordinates must not be understood as a continuation of the biological vertical, but as a re-orientation from an already incipient stage of cultural specialization, as detailed in the text.*

The coordinates of the cultural field (*Fig. 4*, below) start from a hypothetical point (o’) that represents an *idealized* stage that was – *theoretically* – supposed to have been reached on the vertical coordinate of the biological field, at the time of the Eurasian Middle/Upper Paleolithic transition. A perpendicular line that illustrates tendencies toward *cultural specialization* splits off to the right (o’-x’), and a vertical coordinate (o’-y) – which is a continuation of the biological vertical – follows cultural tendencies toward *flexibility and generalization*.

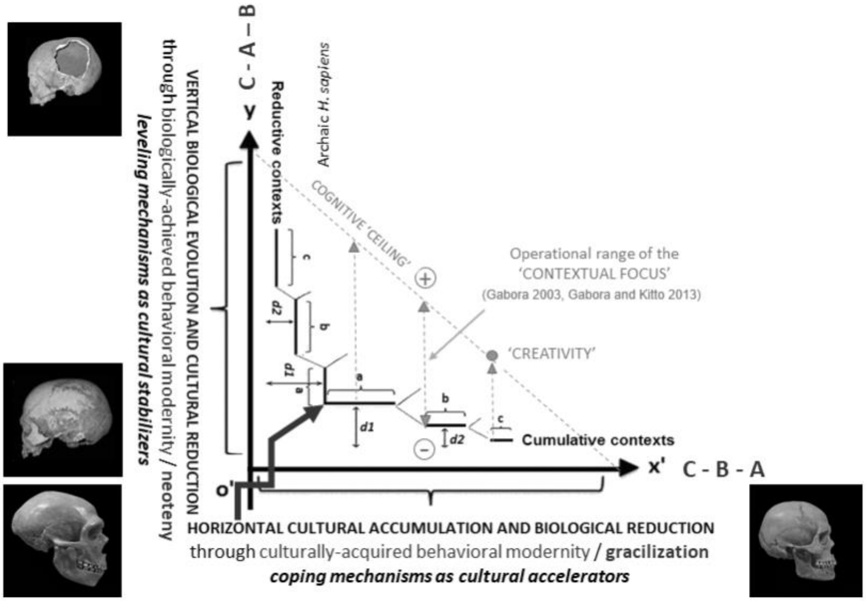

*Fig. 4 – The complementary Blaga coordinates*

**CULTURAL ( – BIOLOGICAL) EVOLUTION** (o’-x’)

*Adapting biology to culture.*

- Characterized by specialization to culturally-defined and selected-for objectives and a loss of cultural flexibility. Biological evolution starts lagging behind the progressively faster rates assumed by cultural change and adapting by ‘shortcuts’ to the accelerated cultural accumulation, which results in a *pseudo-neotenous phenomenon* (= gracilization, domestication syndrome).
- Cultural manifestations last less and less in time (a > b > c) and there is a marked compensatory tendency to elaborate and accumulate technology that does not serve immediate needs. Therefore, the gap between biology and culture is progressively widening.
- Cultural change becomes accelerated and, therefore, a *false sense of ‘flexibility’* is perceived and attributed to the horizontal *cultural process.*

**BIOLOGICAL ( + CULTURAL) EVOLUTION** (o’- y)

*Adapting culture to biology.*

- Characterized by technological reductions and the presence of a *biological-cultural continuum*, including ongoing *genuine neotenous processes.* Thus, both biological and cultural flexibility are successfully retained.
- Cultural manifestations become stabilized in time (a < b < c) and there is a tendency to reduce unnecessary elaboration, in order to let biology catch up with culture.
- Therefore, a *false sense of ‘rigidity’* is perceived and attributed to vertical *cultural evolution.*

BOX 2 – THE CULTURAL FIELD

The *idealized* coordinates run from the *tentative* date mentioned above (o’) to the present (x’/y). At this stage, *the chronological frame is arbitrary*, but it will gradually become evident why the Middle/Upper Paleolithic transition is *not the factual starting point of the divergence between cumulative* and *reductive* cultural orientations, but only the beginning of horizontal cultural tendencies. The meanings behind the specifications marked along and inside the coordinates – cumulative vs. reductive cultural orientations/biological neoteny vs. cultural gracilization/culturally- vs. biologically-acquired behavioral modernity/ratcheting- vs.

leveling mechanisms/biological-cultural vs. cultural-biological evolution/increased- vs. reduced 'cognitive ceiling' – will be explained, one-by-one, in the following sections. The explanation will continue to focus on the peculiarities of the West Eurasian (WE, o'-x') and southern African (SA, o'-y) cultural trajectories and on the comparison between their antithetical cultural strategies. As for now, let us simply enumerate the general 'rules' followed by cultural evolution within the complementary Blaga coordinates, as highlighted in BOX 2, above.

## 4. Cultural Sufficiency/Efficiency

### *4.1 Niche Construction*

I have forwarded the suggestion that Lower/Middle Paleolithic *exograms* illustrate the conversion of reality to a conscious format, while Middle/Upper Paleolithic *paleoart* mirrors the conditioning of behavior to the dictates of our own construct of reality.

Niche construction theory (NCT, Odling-Smee et al. 1997) offers a plausible explanation of *why, how* and *when* our *cultural niche* was constructed, while dual inheritance (or gene-culture coevolution) theory (*sensu* Tomasello 1999; Henrich 2004) describes the adaptive strategies followed in our adaptation to the cultural realities of such a conceptual environment. Moreover, the *behavioral, morphological* and *cognitive* consequences of such a *self-adjustment* are also highlighted in the theory. However, dual inheritance theory (DIT) addresses only the processes that take place on the horizontal (o'-x') coordinate of the hypothetical cultural field presented in the previous section. Fortunately, in the anthropological literature (e.g. Woodburn 1982), the abovementioned shortcoming of DIT is corrected with the documentation and interpretation of the mechanisms that enable the development of cultural flexibility, which is the main characteristic of the vertical coordinate.

In biology, *niche construction* is the process in which an organism alters its own – or other species' – environment, often but not always, in a manner that increases its chances of survival. Changes that organisms bring about in their worlds that are of no evolutionary or ecological consequence are not examples of niche construction (Odling-Smee et al. 1997).

Several biologists have argued that niche construction is as important in evolution as natural selection (for a detailed discussion, see Yeoman 2011). Not only does an environment cause changes in species through selection, but species also cause changes in their environment through niche construction This back-and-forth creates a feedback relationship between natural selection and niche construction: *when organisms affect their environment, that change can then cause a shift in what traits are being naturally selected for*. NCT has far-reaching implications for the human behavioral ecology. Standard evolutionary theory only allows for cultural processes to affect genetic evolution by influencing the individual and depends on the ability of that individual to survive and pass on its genes to the next generation. Cultural processes are viewed merely as an aspect of the human phenotype and are not believed to be consequential to human evolution. Cultural diversity is believed to reflect variation in the environments that different populations of humans evolved in, and nothing else. This theory overlooks the fact that *humans can modify their selective environments through cultural activity*, thus feeding back to affect selection (Odling-Smee 2003).

Certain cultural environments have completely eliminated the natural component and, in such an *artificial* context, *selecting for maladaptive traits that only benefit survival in the specific cultural environment – but affect negatively biological fitness – becomes the driving force of 'cultural evolution.'* According to Odling-Smee (ibid.), cultural processes add a second knowledge inheritance system to the evolutionary process through which *socially-learned information is accrued, stored, and transmitted between individuals both within and between generations.* With the addition of language to human culture came an increased mental capacity. Or, following an increased mental capacity, language was added to human culture – I have already mentioned this problematic sequence in one of the preceding sections. This allowed for human adaptation to the cultural niche to be a learned process, unlike for non-human species, whose adaptive process to the natural environment is instinctual. The result was a marked *acceleration* of environmental, behavioral and genetic modifications. As niche construction advocate Derek Bickerton (2009) argues, ‘‘humans could construct their niches without having to wait on interminable rounds of feedback between genes and behavior.’’ The speed at which humans are able to construct niches modifies the selection pressures and either genetic evolution or further niche construction can result (Odling-Smee 2003).

### *4.2 Gene-Culture Coevolution*

DIT, also known as gene–culture coevolution or *biocultural evolution* (although I prefer the term *‘cultural-biological,’* as opposed to *‘biological-cultural’ evolution*, a term that I reserve for the designation of the antithetical cultural process that characterizes the vertical coordinate) explains how human behavior is a product of two different but interacting evolutionary processes: genetic evolution and cultural evolution.

In DIT, culture is defined as *behavior acquired through social learning*. One of the theory’s central claims is that culture evolves partly through a Darwinian selection process, which dual inheritance theoreticians often describe by analogy to genetic evolution (Richerson and Boyd 2005). A theory on gene-culture coevolution also calls for a more integrated relationship between genetic evolution and cultural processes than standard evolutionary theory does. In such a model, cultural activities are believed to affect the evolutionary process by modifying selection pressures. In other words, *cultural change has the capacity to co-direct its population’s genetic evolution.*

‘Culture,’ in this context, is defined as ‘socially-learned behavior,’ and ‘social learning’ is, in its turn, defined as copying behaviors observed in others or, acquiring behaviors through being taught by others. Thus, culture is presented as socially-learned information stored in individuals’ brains that is capable of *affecting behavior* (ibid.). Most of the modeling in the theory relies on the first dynamic (*copying*) though it can be extended to *teaching*.

Teaching/social learning implies *social complexity and elaborate transmission mechanisms*, which themselves are cultural products. Thus, mimetic, lexical *and* exogrammatic transmission should acquire a central role in the theory. Understanding social learning is a system of pattern replication and ‘‘understanding that there are different rates of survival for different socially-learned cultural variants sets up, by definition, an evolutionary structure: cultural evolution’’ (Campbell 1965).

In DIT, the evolution of culture is perceived as being dependent on the evolution of the *techniques* that facilitate tendencies toward social complexity which, once achieved, allows for *efficient* social learning. Analytic models show that *social learning becomes evolutionarily beneficial when the cultural environment changes with enough frequency for the genetic inheritance not to be able to track the changes, but not fast enough for individual learning to be more efficient* (Richerson and Boyd 2000). Richerson and Boyd argue that *the evolution of cumulative culture* depends on observational learning and is uncommon in other species because it is ineffective when it is rare in a population. They go on arguing that *the climatic changes occurring in the Pleistocene may have provided the right environmental conditions for the onset of the cumulative dimension of culture*.

Michael Tomasello (1999) suggests that cumulative cultural evolution is the result of a ‘ratchet effect’ that began when humans developed the cognitive architecture to understand others as mental agents. Conversely, Henrich’s (2004) ‘treadmill model’ *connects cultural complexity to group size*, because of a need to constantly outrun a treadmill of cultural loss, the backward motion of which is caused by errors in copying and in cultural transmission.

### *4.3 Not by the Treadmill Alone*

The model proposed by DIT and NCT does not seem to apply to certain isolated hunter and gatherer societies which – due to demographic decline or geographical isolation – are viewed as not being characterized by cumulative cultural evolution, but rather by what is mistakenly perceived as ‘cultural loss.’ Imperfect copying may result in the already mentioned ‘treadmill effect.’ The treadmill model attempts to link social evolution to population size, based on the presumption that the cultural transmission of skills requires imitation that is usually imperfect when only a limited number of a population masters the skills. It proposes that a minimum population size and a basic level of social complexity and interaction with other similar groups is needed to ensure sufficient innovation to compensate for a constant drain due to errors in transmitting knowledge and skills. When group size becomes too small, the rate of loss will outstrip replication and innovation. The result is flawed transmission and failure to outrun the treadmill. This can lead to maladaptive losses and depletion of technologies, compromising a society's evolutionary prospects.

Joe Henrich (2004) attempts to explain a major 'puzzle' in anthropology with the help of his treadmill model, namely: the apparent social 'devolution' of Tasmanian Aboriginals during the Holocene. On the face of it, the Tasmanian case study appears to be ideal for testing Henrich's model, because (i) the size of the potential group of imitators likely dropped substantially when Tasmania became isolated from mainland Australia, whereas (ii) their tool assemblage appears to have decreased in complexity. This was believed to be indicated by the disappearance of the bone points used to make clothing before the rise in sea level around 8,000 years before present – when the ancestors of Tasmanians became isolated – and, that at the time of contact with Europeans, the Tasmanians were not wearing clothing, despite experiencing a cold and wet climate (a number of convincing counterarguments to Henrich's use of the Tasmanian 'case' for the illustration of his 'treadmill model' were listed by Andersson and Read [2006])

However, there is a wider conceptual and empirical problem hiding here. The strong focus on technology in cultural evolution research clearly stems from the fact that technological skills can be tracked archaeologically. But what if groups with low technological complexity invest their inventiveness in *developing complex non-technological skills*?

Taylor (2010) makes the case that cultures can be expected to pursue either of two trajectories with respect to investment in material technology. The first is the one that we tend to expect, where *the functioning of the body is augmented by complex material technology*. Reliance on material technology, however, also has the effect of *entangling individuals in various requirements*, such as obtaining and transporting raw material, maintaining and repairing artifacts, and dealing with the risk of technology failing (Hodder 2012). This indicates that, *under certain circumstances, it might be more beneficial to go in a direction that minimizes the dependence on material technology, replacing it with non-material skills instead.* Taylor argues that the Tasmanians, with their simple tools, show clear evidence of having pursued such a trajectory in their development of cultural strategies for dealing with their environments. This would mean that their low technological complexity says little about the complexity of the skills they maintained in general.

Apparently, the cultural evolution of the Tasmanians was based not on *accumulation* and *ratcheting* of innovations for innovations' sake, but on *reduction* and *flexibility*. Moreover, although there is no culture that does not build its own niche, the cultural niche of the Tasmanians and of other small and isolated societies that can be described as 'reductionist' (*sensu* Woodburn 1982; Taylor 2010; Steiner 2017), was probably not too elaborate. Despite isolation, at the arrival of the Europeans the Tasmanians were healthy, well-fed and thriving, albeit in small numbers. Unfortunately, by the time that modern anthropology took an interest in describing such a peculiar mode of cultural evolution, the Tasmanians were already acculturated and on the brink of extinction. Therefore, no model of 'reductive' cultural evolution can be hypothesized in the Tasmanian case, but neither one of cultural loss, in lack of reliable ethnographic data.

The Andamanese are also brought up by Henrich (2004) as another example of an isolated group prone to cultural loss. His equations suggest that the indexes that quantify loss in the treadmill model are lower in the case of the Andamanese than those observed with the Tasmanians. Henrich explains this result by assuming that – unlike the Tasmanians – the Andamanese were contacted and, therefore, not utterly isolated. He enrolls genetic evidence in support of this suggestion. Firstly, the genetics that he cites are not more convincing than that referred to by those who strive to prove the opposite, i.e., an extended – and in excess of a 'mere' 8,000 years – period of isolation of the Andamanese (Thangaraj and Hagelberg 2003). Secondly, only because the Andamanese were 'known' to the outside world does not automatically imply that there was contact.

The Jarawa and Sentinelese of the Andaman Islands were never studied in a scientific manner, but one may risk theorizing – by inferring data collected about the related Onge of Little Andaman and the Batek Negritos of Malaysia – that they could be hunters and gatherers of the egalitarian *immediate-return* type.

### 4.3 Exceptions to the Rule?

The Batek are of special interest here, not only because they are phenotypically related to the Andamanese and live in an identical ecosystem, but also because they are one of the six isolated hunter and gatherer populations known to anthropologists for their *immediate-return subsistence strategies* (Endicott 1974) and *egalitarian social organization* (Woodburn 1982). Moreover, they also seem to conform to Taylor's (2010) suggestion that under certain circumstances, it might be more beneficial to go in a direction that minimizes the dependence on material technology by replacing it with non-material skills.

Other – already well-documented – hunter and gatherer societies that would fit Taylor's description are the Mbuti Pygmies of the Congo (Turnbull 1965), the !Kung (Ju/'hoansi) Bushmen of Botswana and Namibia (Marshall 1976; Lee and DeVore 1976; Wiessner 1977; Lee 1979), the Pandaram and the Paliyan of southern India (Morris 1975; Gardner 1980), and the Hadza of Tanzania (Woodburn 1968, 1970, 1972).

Most anthropologists recognize a broad distinction between hunter-gatherers with elaborate social and economic systems and those mentioned above, who appear technologically less sophisticated, but socially more egalitarian. They were also described as *generalized* and *specialized* (Price and Brown 1985), *egalitarian* and *non-egalitarian* (Kelly 1995), or *immediate-return* and *delayed-return* hunter-gatherers (Woodburn 1982). Following Woodburn, I will refer to hunter-gatherer societies with *more elaborate social and economic systems* as delayed-return (DR) and to those *with more egalitarian social systems, but less complex technology* as immediate-return (IR) hunters and gatherers (HGs). I will also occasionally refer to them – following Kelly and Price and Brown, and in contexts that are independent of economic considerations – as 'generalized' or 'egalitarian' HGs, mostly because of the negative implications of the term *'immediate-return,'* which may be associated with *'primitive,'* or *'inferior.'*

The category of IR HGs comprises the populations listed above who, besides common economic strategies (IR) and ideological similarities (egalitarianism) are also characterized by *a shared physical appearance*, namely: short stature/globular braincase/reduced body hair/peppercorn hair.

The physiological characteristics common to Bushmen, Pygmies and Negritos led to an erroneous perception according to which these populations were believed to have had a common descent from a region-wide substrate of humanity in southern and East Africa (Tobias 1978) or, in the case of Pygmies and Negritos, in Central Africa and Southeast Asia. Moreover, countless theories regarding a Pygmy origin of the Southeast Asian Negritos were also forwarded (for a discussion see *The Negrito Hypothesis Revisited*, a collection edited by Phillip Endicott [2013]). However, the IR HGs of southern India – albeit also characterized by short stature and globular braincases – are basically not different from their Dravidian agro-pastoralist relatives and neighbors and, therefore, they do not fit this simplistic picture. I will return to the relationship between phenotype and immediate-return strategies in a following section in which I will also discuss this peculiarity at large. As for now, let us enumerate the main characteristics that set delayed- and immediate-return hunters-gatherers apart:

– *DR hunter-gatherers*: large, less-mobile groups/ownership, incipient social stratification/social systems oriented to past, present, future/delays in return for labor invested/hoarding, storage and delayed consumption/technological investment and elaboration/resource specialization/ownership rights over valued assets/planned strategies/conformist/specialized ritual/aggressive, warlike.
– *IR hunter-gatherers*: small, mobile groups/egalitarian principles/social systems oriented to present/immediate consumption/low levels of technological investment and elaboration/generalized resource exploitation/flexible strategies/minimal ownership rights/individualist/communal ritual/peaceful.

Moreover, *intentional avoidance of formal long-term binding commitments*, *relational autonomy in personal affairs*, and *reverse dominance hierarchy* are integral parts of an IR context (Dale et al. 2004). That is, commitments, debts, and assertiveness are discouraged. *Distributed decision-making* and *communal ritual* are both part of the egalitarian character of these societies.

*Cultural flexibility* was also researched, with the surprising conclusion that religious manifestations are far from being rigid and orthodox, but very fluid and accommodating in character (Dowson 1994; Chidester et al. 1997; Low 2004).

A *benign view of nature* is dominant, hence the trust in its providing capacities. Paradoxically, IR societies are isolated in harsh peripheries like deserts, draught-prone savannas, and impenetrable rainforests. However, they are all characterized by their infinite trust in the providing capacities of such inhospitable environments and have a philosophy of under-exploiting resources (Sahlins 1972). Conversely, DR groups live in more generous environments, but doubt nature's providing capacities and tend to overexploit resources and supplement them by recurring to storage (Dale et al. 2004 and references therein).

Apparently, IR hunters and gatherers may be described as pursuing a *reductive cultural evolution*, which is in sharp contrast with the standards of *cumulative cultural evolution* modeled by DIT theoreticians.

Another caveat in DIT and NCT is that the takeoff of both cumulative cultural evolution and the construction of the cultural niche within which the *'evolution of cultural evolution'* (Henrich and McElreath 2003) takes place is forcibly dated to the alleged Upper Paleolithic 'big bang' in cognitive modernity (e.g. Mithen 1998). Hence, perceiving IR economy as a *primordial state* – which, to an extent, it is – and the egalitarian societies that pursue it as living fossils – which, they are definitely not – would practically deny their being cognitively and behaviorally modern humans. In the following sections I will argue that, although IR subsistence strategies are cultural 'primitivisms,' their adoption denotes a high degree of evolutionary flexibility and that the egalitarian societies developed by those who have returned to IR economies are cultural 'achievements' which, unfortunately, are utterly ignored in the analytical models of DIT.

## 5. Cultural Heterochrony

### 5.1 Neoteny in Culture

As already observed, the human capacity to create, store and transmit culture arose from genetically-evolved psychological mechanisms related to neoteny. In other words, the means to compensate for an unspecialized morphology – which is the main signature of vertical biological evolution – is 'offered' by neoteny itself. The cognitive implications of neoteny may thus confidently be defined as *exaptations* without which, human culture as we know it, would be very difficult to imagine.

On one hand, DIT strives to project the mechanisms of biological evolution on culture but, on the other hand, it ignores the decisive role that neoteny seems to have played in our biological evolution. Therefore, any theory of cultural evolution that does not include neoteny as a component is incomplete. In this paper, I would like to correct this shortcoming by suggesting that neoteny has a cultural extension that should be acknowledged and added to the variables upon which the equations of DIT are constructed. This becomes an imperative for any theory of cultural evolution that perceives recent anatomical developments as a function of culture. Such a correlation is strongly emphasized in gene-culture coevolution theory (e.g. Cochran and Harpending 2009).

Let us not forget that neoteny is only one of the six possibilities of *heterochrony*, or the change in the timing of biological developmental events (Bogin 1999). *Acceleration* (faster) is the opposite of *neoteny* (slower), *hypermorphosis* (further) is the converse side of *progenesis* (not as far), and *predisplacement* (begins earlier) is the complementary aspect of *postdisplacement* (begins later). The pace of developmental change in culture may assume all these possibilities and, as it will soon become evident, *acceleration, predisplacement and hypermorphosis* define cumulative (horizontal) cultural evolution, while *neoteny (slowing down), progenesis and postdisplacement* are the main characteristics of reductive (vertical) cultural evolution.

However, these terms assume a relativistic meaning in culture, the inevitable consequence of which is our biased perception of what is 'primitive,' when compared to our understanding of what it means to be 'civilized.' In order to understand the intricacies of *cultural heterochrony*, I will follow cultural *ratcheting* *techniques* described by DIT theoreticians (e.g. Tomasello 1999) in parallel with – and contrasted to – *leveling mechanisms*, as observed by anthropologists (e.g. Woodburn 1982). The importance of demographic strength in cultural transmission will also be questioned and alternative strategies meant to cope with the threat of the 'treadmill effect' (Henrich 2004) will be forwarded.

### *5.2 The Antiquity of Cumulative Cultural Evolution*

According to Jürgen Richter's (2000) article *Social Memory Units Among Late Neanderthals*, between the first and the second glacial maximum (i.e., between 60,000 and 28,000 years ago) a patchwork of different 'social memory units' occurred all over Europe. The exchange of information becomes evident within well-defined but flexible boundaries. Artifacts began to represent their makers, thus indicating entities of social memory and lines of tradition. Hence, Neanderthal behavior in this period seems to prepare the emergence of the European Upper Paleolithic. 'Social memory' is understood by Richter as *the ability of a group of humans to maintain a specific set of information by means of tradition over many generations*. Social memory contains a pool of ideas and concepts which are shared by a group of humans. The more individuals contribute to such a pool – and participate in it – the higher the chance for a successful tradition and for the long-term maintenance of the pool's contents. By contrast, a small population which is isolated from others may develop specific ideas and concepts which get lost as soon as the population is extinct by inbreeding, starvation, or other factors. In an area that is inhabited by many small and isolated groups one may expect occasional, short-term occurrences of ideas and concepts. Innovations, under such circumstances, tend to disappear very quickly. Inventions are thus made repeatedly – and they are forgotten again, and again.

Here, Richter echoes the tenets of DIT, especially those that describe Henrich's 'treadmill' and Tomasello's 'ratchet' effects, which place stress on the importance of *demographic strength* and *social complexity* as techniques meant to counter cultural loss.

If the ephemeral occurrence of concepts is accepted as a rule for Middle Paleolithic industries, the rule, according to Richter, is no longer valid starting from 60,000 years ago: between 60,000 and 28,000 years before present (BP), all of the earlier innovations – which had been re-invented and re-lost several times during the Middle Paleolithic – become firmly entrenched parts of the technological knowledge. Moreover, an increasing amount of 'new' innovations was added to the knowledge-pool and 'ratcheted' against loss with the help of social techniques. Richter labels the groups that have managed to entrench these concepts and ideas – the components of a group's information pool – *social memory units* (SMUs). SMUs must not be perceived as strictly ethnical or geographical developments, but rather as chronological sequences that witness the development of *social networking* techniques devised by *small and isolated populations* under climatic stress and on the brink of extinction.

To support his observations, Richter compares three major cultural sequences of the period, namely: Mousterian of Acheulian tradition, Mousterian, and Micoquian – as documented from the Combe-Grenal, Sesselfelsgrotte and Kulna Caves. The comparison helps him to identify five SMU exchange networks that spanned from Western to Eastern Europe, and to ascribe them to specific stages of the time range discussed. Richter reconstructs the environmental and social landscapes that stimulated the intensification of social memory after 60,000 BP. European population history in the discussed period must be understood, according to Richter, in terms of *retreat and expansion*: retreat to the west during the volcanic winter that was the aftermath of the Toba eruption at around 71 ka BP (Ambrose 1998), and repeated expansion to and retreat from Western and Central Europe during the first glacial maximum with its highly unstable climate. Times of retreat were characterized by *dense exchange networks*, which intensified and standardized the information-pools. Times of expansion caused *extended exchange networks*, which were probably maintained by specific social strategies under mobile conditions. These were followed by times of consolidation that saw the emergence of regional sub-systems (short episodes during the first glacial maximum). The marked population decrease around 71,000 BP, a virtual Neanderthal 'bottleneck' in Western Europe, and the subsequent expansion must have stimulated the development of specific *strategies of network maintenance*. These helped to establish regional SMUs, which became then maintained for several thousand years.

The article raises a number of hypothetical possibilities that are quite contradictory to the orthodox perception of the turbulent Middle to Upper Paleolithic transition. The existence of 'social memory units' and their characteristics, as suggested by Richter, already set European cultural developments that occurred 60 millennia ago within a theoretical framework that is very much like that approached in dual inheritance theory. In this thought-provoking paper, Richter places late Neanderthals in a cultural context that was supposed to have commenced only with 'anatomically modern humans': cumulative cultural evolution.

### *5.3 Ratcheting Cultural-Biological Coevolution*

According to the postulates of gene-culture coevolution, cultural activities are believed to affect the evolutionary process by modifying selection pressures. In other words, cultural change has the capacity to co-direct a population's genetic evolution. Sexual selection with a *culturally-transmitted mating preference* plays an important role in this theory. Transmission entails *biases* that occur when some cultural variants are favored over others during the process of cultural transmission.

Boyd and Richerson (1985) defined and modeled a number of possible transmission biases. The list has been refined over the years, especially by Henrich and McElreath (2003):

– *Content bias* results from situations where some aspect of a cultural variant's content makes them more likely to be adopted (McElreath and Henrich 2007). Content biases can result from genetic preferences, preferences determined by existing cultural traits, or a combination of the two.
– *Context bias* results from individuals using clues about the social structure of their population to determine what cultural variants to adopt. The determination is made without reference to the content of the variant. There are two major categories of context biases: (i) *model-based* biases, and (ii) *frequency-dependent biases* (ibid.).

(i) *Model-based biases* result when an individual is biased to choose a particular 'cultural model' to imitate. There are four major categories of model-based biases:
(1) *prestige* bias,
(2) *skill* bias,
(3) *success* bias,
(4) *similarity* bias

(1) A '*prestige* bias' results when individuals are more likely to imitate cultural models that are seen as having more prestige. A measure of prestige could be the amount of deference shown to a potential cultural model by other individuals. (2) A '*skill* bias' results when individuals can directly observe different cultural models performing a learned skill and are more likely to imitate cultural models that perform better at the specific skill. (3) A '*success* bias' results from individuals preferentially imitating cultural models that they determine are most generally successful (as opposed to successful at a specific skill as in the skill bias). (4) A '*similarity* bias' results when individuals are more likely to imitate cultural models that are perceived as being similar to the individual based on specific traits.

(ii) *Frequency-dependent biases* result when an individual is biased to choose particular cultural variants based on their perceived frequency in the population. The most explored frequency-dependent bias is the (1) '*conformity bias*.' This results when individuals attempt to copy the *mean* or *accepted* cultural variant in the population. Another possible frequency dependent bias is the (2) '*rarity bias*.' This bias results when individuals preferentially choose cultural variants that are less common in the population. The rarity bias is also called a '*non-conformist*' or 'anti-conformist' bias (Henrich and McElreath 2003).

– *Social learning* is the other cornerstone of cultural transmission which, at its simplest, involves blind copying of behaviors from a model (someone observed behaving). Although learning is a more advanced form of social transmission, the same potential biases apply to both:
(1) *success bias* (copying or learning more effectively from those who are perceived to be better off),

(2) *status bias* (copying or preferentially learning from those with higher status),
(3) *homophily* (copying/learning from those most like ourselves),
(4) *conformist bias* (disproportionately picking up behaviors that more people are performing) (ibid.).

Although *group selection* is commonly thought to be nonexistent or unimportant in *genetic evolution* (Maynard-Smith 1964), DIT predicts that – due to the nature of cultural inheritance – it may be an important force in *cultural evolution*, because the *conformist biases* that determine *social learning.*

– *Social networking* (even in its incipient phase, as described by Richter [2000]) must have reflected the biases listed above – *prestige, skill* and *status* can be increased through the talent for technological innovation and, in a scenario in which 'technology for the sake of technology' is pursued (see Taylor 2010), technological *acquisition* becomes an important driving force. Exchange, in this case – and beside its role in developing social networks – becomes another modality in the consolidation of prestige. Barter and/or trade were likely the by-products of status-related biases and must have played a role in the ratcheting of technological innovation by taking it to a 'more than sufficient' level.

### *5.4 Leveling Biological-Cultural Coevolution*

Surprisingly, the biases upon which cultural transmission relies in *cumulative* contexts (o'-x') seem to be absent with reductive contexts (o'-y). Quite the opposite seems to be the case: *socially-learned preference biases* rely on the *inhibition* and *leveling* of model-based biases (*prestige*, *skill*, *success, status, similarity*) instead of their ratcheting.

*Leveling mechanisms* (which *slow down* and stabilize the pace of cultural evolution) are the counterpart of *ratcheting techniques* (which *accelerate* the pace of cumulative cultural evolution). Therefore, in the cultural field (see BOX 2), *leveling mechanisms assume the role played by neoteny in the biological field* (BOX 1) and they can thus be understood as an expression of *cultural neoteny*. Moreover, *group selection* – a function of the strength of *conformist biases* in cumulative cultural evolution – does not seem to play a role in reductive contexts, because of the stress on *non-conformist biases*. As it will soon become self-evident, *hypermorphosis/progenesis* and *predisplacement/postdisplacement* – the other aspects of *heterochrony* beside *accelerated/slowed down* – do also have cultural extensions.

But first, let us take a closer look at *how* do leveling mechanisms act and – in the next section – at *when* did they commence to define the trajectory of vertical cultural orientations?[4]

As James Woodburn explains (1982), ''societies, which have economies based on immediate- rather than delayed-return, are assertively egalitarian. Equality is achieved through *direct, individual access to resources*; through *direct, individual access to means of coercion and means of mobility which limit the imposition of control*; through *procedures which prevent saving and accumulation and impose sharing*; through *mechanisms which allow goods to circulate without making people dependent upon one another*. People are systematically disengaged from property and therefore from the potentiality in property for creating dependency.''

The characteristics of these immediate-return systems were already mentioned in some detail, and therefore ere I will only present the essence of Woodburn's observations on *how these societies promote equality*. The social organization of all the studied immediate-return hunter and gatherer societies has the following basic characteristics: (1) *Social groupings are flexible and constantly changing in composition*; (2) *Individuals have a choice of whom they associate with in residence, in the food quest, in trade and exchange, in ritual contexts*; (3) *People are not dependent on specific other people for access to basic requirements*; (4)

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[4] Having in mind *cultural heterochrony*, I can already say – without being a spoiler – that cultural evolution did not assume a vertical tendency 60 ka BP – the date to which Richter pushes back the onset of cumulative cultural evolution. The cultural strategies elaborated by *H. sapiens neanderthalensis* were a *predisplacement*, a cultural punctuation effectuated at a behaviorally still aggressive and markedly hierarchical stage that had paved the way to cultural *hypermorphosis*.

*Relationships between people - whether relationships of kinship or other - stress sharing and mutuality but do not involve long-term binding commitments and dependencies of the sort that are so familiar in delayed-return systems*. What is perhaps the most remarkable characteristic is that *these societies systematically eliminate distinctions of wealth, of power and of status.*

Woodburn recognizes the need to explore the expression of egalitarianism in religious belief and practice, and he apologizes for not doing so. However, Lewis-Williams (1988) and Dowson (1994) did just that – their conclusions will be presented and discussed in the next sections.

As for now, there is more than sufficient anthropological evidence upon which the suggestion that with immediate-return hunters and gatherers rigorous and systematically-applied techniques – i.e., *leveling mechanisms* – which *inhibit* a cumulative development based on the material, social, and even spiritual components of culture apply. Moreover, any tendency toward *hierarchy* is also discouraged, given the immediate effect of these stabilizing mechanisms, namely: *the ability of individuals to attach and to detach themselves at will from groupings and from relationships, to resist the imposition of authority by force, to use resources freely without reference to other people, to share as equals in meat brought into camp, to obtain personal possessions without entering into dependent relationships.*

What these cultural 'values' achieve, is to *disengage people from property, and from the potentiality in property-rights for creating dependency*. Therefore, the social component of culture is also displaying a high degree of flexibility, without being elaborated at the expense of other cultural components. As for the mental and spiritual dimensions of culture, I will soon touch on the former and elaborate on the latter and conclude that a similar degree of flexibility is in place.

Woodburn thinks that such a cultural *achievement* can only be realized – without impoverishment – in societies with a simple hunting and gathering economy because, under different circumstances, such a degree of disengagement from property would inevitably damage the operation of the economy. In the specific immediate-return context, the fluidity of local grouping and spatial mobility, combined with and reinforced by a set of distinctive egalitarian practices that discourage people from accumulation, *inhibit not only political change but also any form of economical intensification*. Therefore, 'immediate-return,' albeit a cultural 'primitivism,' should rather be perceived as a flexible – and thus unspecialized – cultural base that allows for the development of the aforementioned egalitarian principles, which are a cultural accomplishment.

The question that arises is, whether such a basic economy is an 'inheritance' from the past, or a 'reduction' from a more elaborate 'delayed-return' stage? While 'immediate-return' subsistence strategies are, indeed, cultural 'primitivism,' egalitarian societies are cultural successes. The evidence presented in the next part of the paper will not only conclusively answer this important question, but it will also tangibly illustrate the concept of 'cultural neoteny.' Dual inheritance theory models perfectly the cumulative aspect of cultural evolution with *non-egalitarian societies* and it omits – or dismisses – the achievements of immediate-return hunters and gatherers. In contexts in which the development of social complexity is consciously inhibited and is not of central importance in cultural transmission, terms like 'treadmill effect' and 'ratcheting effect' also lose their meaning.

## 6. The Gentle Bushman and the Tame Neanderthal

### *6.1 Neoteny and the Domestication Syndrome*

Some (Mithen 1998; Richerson and Boyd 2000) have noted that it would make things easier if the Upper Paleolithic – because of the cognitive 'big bang' associated with it – also coincided with an increase in brain size. But, paradoxically, the terminal Pleistocene is marked by the sudden reversal of several million years of continuous encephalization, when the cranial volume of humans abruptly began to plummet (Henneberg 1988; Bednarik 2012). The Upper Paleolithic arguably witnesses the cessation of biological evolution and the onset of an evolutionary mode centered exclusively on culture. Therefore, the problem of the marked decrease in brain size – the beginning of which coincides with the take-off of cumulative cultural evolution – cannot be approached from a strictly biological perspective.

Gene-culture coevolution (DIT) predicts that, under certain situations, cultural evolution may select for traits that are genetically maladaptive (Boyd and Richerson 1985). When the cultural environment changes with an increased frequency – as it does for the last 60 millennia – biological adaptations cannot catch up, except by shortcuts that may result in biologically maladaptive, but culturally fit characteristics.

From a strictly biological point of view, neoteny should have continued to dictate further cranial growth, the lack of which is striking, given that apparently neotenous features became accentuated during the last tens of millennia of cultural evolution. However, in a cumulative cultural environment, neoteny may assume maladaptive characteristics and become manifested in distorted and freakish physical expressions, as a result of self-imposed breeding preferences. Neotenous traits may become cultural ideals and selected for. Thus, the rate at which such traits are developed adapts itself to the pace dictated by cultural change, which is much faster than that of genuine neoteny in a natural setting.

The *pseudo-neotenous* features displayed by domesticates illustrate this process at its best: during the span of only a few generations, *a priori* decided-upon traits pursued in breeding (like docility, milk or wool output, meat quality) result in an apparently neotenous appearance that does not serve the biological fitness of the domesticated animal. This is the ‘domestication syndrome’ or, in our case, *self-induced*, or *pseudo-neoteny*. Therefore, *genuine* and *maladaptive* neoteny – however similar in morphological expression – must be understood as the biological and, respectively, the cultural aspect of the same process.

I keep on stressing that *biological neoteny does not necessarily lead to domestication*, but *domestication results inevitably in the accelerated acquisition of apparently neotenous features*. Wild boars did not become pigs because of neoteny, but pigs display neotenous features because of the domestication of wild boars (Frantz et al. 2015). By the same token – however shocking this statement may appear – Neanderthals did not become ‘anatomically modern’ humans because of neoteny, but AMHs display neotenous features because of the self-domestication of Neanderthals. Pigs are not wild boars, and AMHs are not Neanderthals. Genetic changes induced by domestication may lead to speciation (ibid., Tchernov and Horwitz 1991).

Selecting for traits that are considered advantageous in a constructed cultural niche – like *docility and sociability*, which are *the cultural repression of aggressiveness* – is like being bred by selecting for specific behavioral traits, very much like Byelayev (1969, 1979) did with his foxes. In other words, the cultural niche was not elaborated by domesticates, but the realities and breeding preferences within the cultural niche domesticated humans.

Helmuth Nyborg’s suggestion (1994) that ‘feminized,’ *slower maturing* ‘neotenous androtypes’ will differ from ‘masculinized,’ *faster maturing* ‘androtypes’ by having more rounded and fragile skulls, wider hips, narrower shoulders, less physical strength, live in cities – as opposed to living in the countryside – and by receiving higher performance scores on ability tests, must also be understood as a *post-biological* pseudo-neotenous manifestation. Nyborg theorizes that certain ecological situations would favor the survival and reproduction of the ‘masculinized androtypes’ due to their sheer ‘brutal force,’ while other ecological situations would favor the survival and reproduction of the ‘feminized androtypes’ due to their ‘subtle tactics.’ Let us – following Bednarik (2008) – call such culturally-fabricated ‘androtypes’ *gracilized* phenotypes. Gracilization does not occur in a natural environment, but it takes place in an artificial, culturally-constructed niche.[5]

Here, Sapolsky’s (1996) thoughts on the relationship between *hierarchy, aggressiveness* and *chronic stress* are very well illustrated: the environment in which Nyborg’s ‘feminized androtypes’ thrive is the hierarchically-organized and socially-complex cultural niche. *Domestication* and *hierarchy* are complementary to each other, for obvious reasons. According to Sapolsky, the chronic stress that characterizes social complexity, besides shrinking our brains, also fattens our bellies, which is precisely what happens to Nyborg’s gracilized ‘androtypes’ in a strictly cultural environment.

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[5] Nyborg’s ‘feminized androtypes’ could be called with confidence ‘Nyborgs’ because, to an extent, they are reminiscent of ‘Cyborgs.’ Transhumanist fantasies (Bostrom 2005) should have accorded more attention to the phenomena that I discuss in this section; apparently, for the last 40 millennia, human evolution is already prescribed by humans, and technology seems to play an important role in creating a culturally-engineered human phenotype that displays all the characteristics listed by Nyborg (1994). Self-domesticated Nyborgs are very much like consciously planned Cyborgs.

The ‘smartness’ of such ‘androtypes’ is, therefore, relative. The reduction of the neural storage capacity, as Bednarik (2014b) suggests, is paralleled by our absolute reliance on the external storage of information. The brain specializes in the *causal reading of exograms* and cognitive functions become *reduced* to the ability to access, but not to store or process information. *Social learning becomes thus centered on the transmission of the know-how to access knowledge, but not knowledge itself.*

### *6.2 Natural Inhibition vs. Cultural Repression*

In this context, I would still like to mention a significant behavioral consequence entailed in Woodburn’s *leveling mechanisms*; namely, that regarding *sociability* and *aggressiveness*. As I have already suggested, *genuine neoteny* goes on with vertical cultural orientations of which, the case of immediate-return hunters and gatherers is the best example. Leveling mechanisms are expressions of *cultural neoteny* because they are conducive to behavioral manifestations which are similar to those acquired through the psychological side-effects of biological neoteny: *hierarchy is inhibited*, *aggressiveness is discouraged*, and *sociability increased*.

Let us consider the case of chimpanzees and bonobos, as an example for the behavioral manifestations of genuine neoteny. With the markedly hierarchical chimpanzees, males display a high degree of aggressiveness: not only that they are hostile to each other, but they are also extremely aggressive toward males from neighboring communities, whom they often ambush and kill. ‘Warfare’ between neighboring groups is also documented (Van Lawick-Goodall 1968). In comparison, *neotenous* bonobos (Shea 1983), also known as *‘pygmy’* or *‘gracile’* chimpanzees (de Waal and Lanting 1997), have developed a high degree of sociability and have also inhibited aggressiveness. Apparently, the peaceful bonobos are capable of altruism, compassion, empathy, kindness, patience and sensitivity (ibid.; de Waal 2002). The development of these traits took approximately one million years of neotenization (Fischer et al. 2004). Grooming and sexual activity generally play a major role in bonobo societies, and they are important in forming social bonds and in *reducing aggressiveness* through conflict resolution and post-conflict reconciliation (Manson et al. 1997).

Compared to the *natural inhibition* of hierarchical and aggressive traits observed with bonobos, an example of rapid *cultural repression* of these traits is offered by Sapolsky’s (1997) research on baboons. Sapolsky observed an emerging ‘baboon culture’ with a group in which all the alpha males and high-ranking individuals died due to food poisoning. As food is not shared in hierarchical baboon societies, only the females, the young and the low-ranking males survived the poisoning. Curiously, in a very short time – not in a million years, but in a generation – hierarchical group organization and aggressive behavior were reduced. A ‘friendlier’ group emerged in which, more grooming and hugging, sharing, and even caring were the immediate behavioral manifestations. Moreover, males from other baboon groups that joined the ‘peaceful’ ones, *learned socially* their ‘cultural norms’ and *adapted to them* by *repressing their natural predisposition* toward hierarchy and aggressiveness.

To stay with Sapolsky (1996), let us consider the implications of his hypothesis according to which, hierarchy entails and institutionalizes *stress* which, in its turn, produces hormonal activities that damage the hippocampus.

Neoteny and stress seem to be incompatible: chronic stress impairs psychological neoteny by affecting neural storage and the ability for *non-social* learning. And, as I have already attracted the attention to, the shrinking of brain size contradicts neotenous tendencies which manifest themselves in the increase of the cranium. As chronic stress and its consequences define hierarchical societies, reducing stress becomes an imperative in achieving egalitarianism. In immediate-return hunter and gatherer societies hierarchy is inhibited, and the consequences of psychological neoteny are encountered on every level. The absence of stress also facilitates increased sociability: sharing, caring and compassion.

Sapolsky’s study also mentions the fraying of chromosomes as an immediate side-effect of chronic stress. Interestingly, in therapy groups meant to cope with stress, the emphasis on compassion resulted in hormonal activity that mended pathological chromosome fraying.

The often-mentioned *gentleness* and peacefulness that characterize immediate-return societies (Marshall 1989 [1959]) can thus be related to the leveling mechanisms that inhibit any expression of hierarchy. There is even an anthropological example of a society that overtly exhibits all the behavioral characteristics that were observed with bonobos. I have in mind the Onge of Little Andaman Island, a markedly neotenous Negrito population that is closely related to the repeatedly mentioned Jarawa. The first Europeans who have encountered them were shocked by the Onge's public display of affection, their need for permanent physical contact, their peacefulness and egalitarian principles (Portman 1899). Unfortunately, today the Onge are on the brink of extinction, but I am confident that before being contacted by outsiders, they would have qualified for being added to the list of immediate-return and egalitarian hunter and gatherer societies which, sadly, is restricted to the six populations already mentioned.

### *6.3 Stabilizing and Accelerating Techniques*

In stark contrast with the egalitarian hunters and gatherers mentioned above, Hayden's (2003) 'trans-egalitarian' societies *promote precisely what leveling mechanisms inhibit* in the case of the former: *social complexity, hierarchy, stress and aggressiveness*. Such traits were possibly parts of an 'archaic nature,' from which they were *reduced* through *leveling mechanisms* on the vertical coordinate of the cultural field and, conversely, *institutionalized* through *coping mechanisms* on the horizontal axis.

Both leveling and coping mechanisms are *cultural techniques*. Following Jacques Ellul, I understand *techniques* as he defined them in his introduction to *The Technological Society* (1964), namely: ''[the] totality of methods rationally arrived at and having absolute efficiency (for a given stage of development) in every field of human activity.'' Ellul has also specified that in this context the term does not solely refer to machines, technology, or procedures used to attain an end. He defines a number of cultural concepts that make 'efficiency' a necessity. From these, I would like to single out *rationality* and *artificiality*, as these describe very well niche construction.

However, cultural niches vary from culture to culture and they range from lose and flexible – as observed with that of immediate-return hunters-gatherers – to the rigid and elaborate, which subscribe to Ellul's 'technological society.' Therefore, and in order to avoid confusion, I refer to 'leveling techniques' in the case of the former and to 'coping techniques' – which reflect Ellul's perception of techniques as *buffers* between the biological and the technological – in the case of the latter. In elaborate cultural niches, the rationality of technique enforces logical and technological organization through division of labor and the setting of biased standards that promote such an organization (here, Ellul comes close to approximating the *transmission biases* that influence cumulative cultural evolution in DIT).

*Coping mechanisms* also create an artificial system ''[which] eliminates or subordinates the natural world'' (ibid.). Culturally-constructed artificial systems, instead of their being subservient to humanity, demand *techniques* that help human beings *adapt to them*, and accept their 'tyranny' (in this case, Ellul comes close to NCT, which also predicts that certain cultural environments have completely eliminated the natural component and, in such an *artificial* context, selecting for maladaptive traits that only benefit survival in the specific cultural environment – but affect negatively biological fitness – becomes the driving force of 'cultural evolution').

– *Leveling mechanisms* are *stabilizing techniques* (i.e., cultural neoteny slows down the pace at which culture evolves) which manage cultural elaboration and do not let it go beyond a level of *sufficiency* (*cultural progenesis*). Thus, biological evolution keeps up with the stabilized rate at which culture evolves and there is no need for an artificial buffering between the two. The absence of cultural specialization allows neoteny to continue its role in biological evolution and its psychological side-effects manifest themselves in the texture of immediate-return hunter-gatherer societies. Hierarchy and aggressiveness become inhibited, stress is reduced, and egalitarianism and peacefulness become encouraged.
– Conversely, *coping*/buffering *mechanisms* are *accelerating techniques* (i.e., they inflate the pace at which culture evolves) which encourage cultural elaboration to go beyond a level of sufficiency, to one of *efficiency*

(*cultural hypermorphosis*). Thus, biological evolution starts lagging behind the accelerated rate at which culture evolves and there is a need for an artificial *buffering* between the two. Cultural specialization prevents neoteny to continue its role in biological evolution and the shortcuts taken for keeping up with the ever-increasing rate at which culture evolves leads to rapid gracilization. Like genuine neoteny, its maladaptive cultural dimension (gracilization, domestication syndrome) is also accompanied by psychological side-effects.[6] *Aggressiveness becomes culturally repressed and becomes socially-learned docility, chronic stress becomes a permanent feature of the cultural landscape and hierarchical structures remain the main social signature of trans-egalitarian societies* (*sensu* Hayden 2003).

### 6.4 Cultural Hypermorphosis and Progenesis

Following Richter (2000), we have already determined the time at which cumulative orientations in cultural evolution became crystalized. However, the Middle/Upper Paleolithic transition must not be understood as the divergence between cumulative and reductive cultural trajectories: while on the o'-x' coordinate of the cultural field the stress is on cultural *acceleration* and *hypermorphosis*, cultural evolution on the vertical seems to be determined by cultural *neoteny* and *progenesis*. By the same token, if cumulative tendencies have originated *earlier* (as an expression of cultural *predisplacement*), the origin of reductive cultural strategies must be attributed to a later date and understood as an example of cultural *postdisplacement.* Cultural evolution may thus be placed within frames determined by the six dimensions of *heterochrony*.

Ongoing *biological neoteny* (on the vertical) and *cultural gracilization* (on the horizontal) are only the morphological expressions and consequences of *cultural heterochrony*, the manifestations of which would also acquire behavioral and cognitive dimensions.

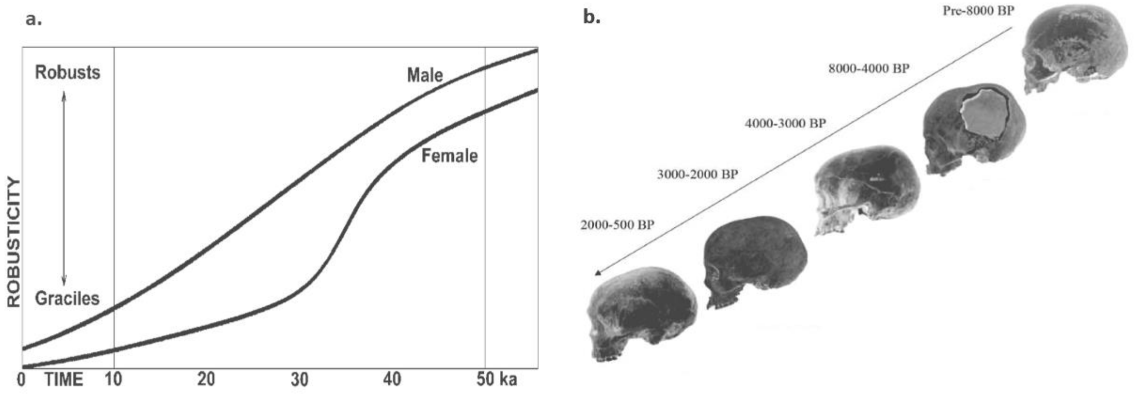

*Fig. 5 –* a. *Depiction of male/female relative cranial gracility in Europe through time: the decline in robusticity is gradual in males, but accelerated in females between 40 and 30 ka (Bednarik 2008, 2017) /* b. *Osteological evidence (Stynder 2006) supports Morris' (2002) hypothesis of a relatively recent (Late Pleistocene/Early Holocene) origin of recognisably KhoeSan pedomorphic cranial morphology. But: large body size/robust bone structure until c. 8,000 BP (Bräuer and Rösing 1989).*

European cognitively modern Aurignacians were – according to Bednarik's (2007) convincing and already discussed evidence – very likely archaic Neanderthaloids or their still markedly robust descendants. Phenotypes that can be undoubtedly defined as 'anatomically modern humans' (AMHs) do not appear in the European archaeological record before the Gravettian (ibid.) that is, at c. 30 ka ago.

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[6] Schizophrenia and autistic disorders are hypothesized to be consequences of self-domestication (Benítez-Burraco and Boeckx 2015; Benítez-Burraco et al. 2016) and believed to have emerged after 'anatomically modern' (i.e., self-domesticated and thus gracilized) humans diverged from Neanderthals (Srinivasan et al. 2015). Moreover, schizophrenia and autistic traits are also believed to have played a role in Upper Paleolithic cave art (Spikins 2018). The etiology of the said disorders was directly associated with genetic defects in which large segments of DNA are either duplicated or deleted and which result in a neurological syndrome known as 1q21.1 deletion/duplication (Fiddes et al. 2018). I will return to these observations in my discussion of Solutréan/Magdalenian cave art.

Conversely, African cognitively modern humans (CMHs) at around 30 to 20 ka ago were also markedly robust, far from the popular image of the 'Bushmanoid' AMH (Stynder 2006).

For example, the reassessment of the whole Klasies fossil assemblage shows that although some specimens fall within the range of variation typical of modern humans (Rightmire and Deacon 1991), the majority are surprisingly robust, suggesting a mosaic evolutionary pattern in which cranial and postcranial elements evolved at different rates. The fossils are dated to approximately 90,000 BP (ibid.). On the other hand, excavations at Die Kelders and investigations of a very important site at Blombos have produced several teeth, which share most of their attributes with modern African populations, but still of a very 'generalized' type, far from what we associate with 'Bushmanoid' morphology. The ages for these specimens were suggested to be of 60-80,000 years BP (Mitchell 2002).

As I have discussed elsewhere and, as also suggested by Ashley-Montagu (1989), the Bushman populations of southern Africa display highly neotenized features when compared to Caucasians or the 'generalized' African phenotypes. A globular braincase and a bigger brain (in brain-to-body *ratio*) are the differences which are relevant here, because of the psychological implications of neoteny (Charlton 2006) which, in their turn, affect behavior. As seen in the comparison between chimpanzees and bonobos (de Waal 2002), neoteny reduces aggressiveness and hierarchical tendencies. Therefore, it is not far-fetched to think that the archaic inhabitants of Upper Paleolithic Eurasia and the still markedly robust Africans around 60 ka ago were behaviorally more aggressive and socially more hierarchical than contemporary (neotenous) Bushmen or (gracilized) Europeans. Whereas the 'gentle' and 'harmless' character of the 'savage' Bushman (Marshall 1989) is a consequence of genuine biological neoteny, the 'docility' of the 'civilized' descendants of Upper Paleolithic Europeans is very likely a behavioral outcome of maladaptive cultural gracilization (SGM p. 18; *Fig. 5*).

Although aggressive traits are culturally-suppressed on an individual level, they are still present in the fundamental values that determine the development of 'civilized' culture and society. Conversely, in vertical cultural orientations, aggressiveness and hierarchy must have been *biologically reduced before the emergence of 'egalitarian societies' and culturally inhibited in already egalitarian settings* (in which *leveling mechanisms* manage the risk of their possible re-emergence – which should not be perceived as *repression*, because there is no contradiction between biological and cultural 'inclinations.').

Aggressiveness and hierarchical group organization are pre-modern and universal behavioral traits, the presence of which, with archaic populations that otherwise display all the signs of cognitive modernity, should not come as a surprise.

The use of ocher, incisions on lumps of ocher and geometrical etchings on ostrich eggshells point toward such a cognitive modernity in the case of the anatomically still robust Stillbay and Howieson Poort people (Stynder 2006). Lumps of differently colored ocher were also found in Tanzania, and dated to the same period, i.e., 70 to 60 ka ago (Schepartz 1988). But, as emphasized above, cognitive modernity is far from being an index of behavioral modernity, and the 'archaic' anatomy of these African CMHs raises a few questions about their behavioral and social characteristics, which must have been very different from those of their peaceful and egalitarian descendants.

During the Late Pleistocene, a genetically Khoe(san)-like population already dominates the ethnographical landscape of southern and East Africa (Tobias 1978; Nurse et al. 1985; Schuster et al. 2014). Interestingly, the KhoeSan people of *southern* Africa have long been viewed as the direct ancestors of the earliest anatomically modern *Homo sapiens*. According to Tobias (ibid.), the geographical range of early Khoe(san) groups extended over much of southern, eastern and north-eastern Africa. Genetic research carried out over the last 20 to 30 years appears to reinforce the longstanding hypothesis that the Khoe(san) were the aboriginal population of these regions (ibid.; Nurse et al. 1985; Schuster et al. 2014). More genetic research continued in this vein and, interpreting the results, Soodyall and Jenkins (1992) placed the divergence between the three major genetic groupings of sub-Saharan people – Khoe(san), Pygmy and Negroid – to approximately 150,000 years BP. Veeramah et al. (2012) concur with this early date, and Singer and Wymer (1982) went as far as to suggest that there might have been a biological continuity between the Klasies River people mentioned above and the ancestors of modern KhoeSan. However, an almost complete human cranium that was discovered in 1954 in the Hofmeyr district of the Eastern Cape Province contradicts such an interpretation. Grine et al. (2007) report a date of around 36,000 years for this specimen. Its morphology has been described as being a mosaic of archaic and modern traits (Morris and Grine 1999). Grine et al. (ibid.) report that the Hofmeyr cranium falls outside the range of variation displayed by modern KhoeSan crania in most aspects of craniofacial morphology. Instead, their measurements of facial dimensions and vault curvature surprisingly reveal a *markedly robust individual*, which situates the Hofmeyr cranium *within the range of variation of European Upper Paleolithic crania*.

Morris (2002, 2003) has hypothesized that the San (Bushman) phenotype arose relatively late in South Africa. According to Morris' hypothesis, the still robust common ancestors of modern southern African Khoe and San populations underwent a bottleneck situation associated with the Late Glacial and the Last Glacial Maximum (LGM) at c. 24,000 to 17,000 BP. At this time the cool, dry glacial climate would have resulted in the desertification of much of southern Africa, particularly the inland regions. A scarcity of inland archaeological occurrences suggests significant depopulation of these areas (Mitchell 1990; Wadley 1993). At the same time, a large area of land would have been exposed along South Africa's southern coast, with an extended coastal plain of over 100 kilometers at some places (van Andel 1989). Unlike the interior, the better watered southern coastal region displayed comparatively denser human occupation at this time (Parkington 1990). These evolutionary processes would eventually have resulted in the differentiation of this coastal population from other African populations and thus to the emergence of ancestral KhoeSan (Morris 2002, 2003).

At the end of the glacial period, there would have been a population expansion that would have resulted in the introduction of KhoeSan morphological traits into the rest of southern Africa (ibid.). Osteological evidence (Bräuer and Rösing 1989; Morris 2002; Stynder 2006; Stynder et al. 2007) appears to support Morris' hypothesis of a relatively recent southern African origin of recognizably KhoeSan *cranial morphology*. In accordance with his model, terminal Pleistocene/Early Holocene human crania do indeed display a general KhoeSan craniofacial pattern, particularly with regards to *upper facial form* (Bräuer and Rösing 1989). According to them, fossils such as the 10,000 years old Albany Man and various similarly aged fossils from sites such as Matjes River Rock Shelter, Wilton Large Rock Shelter and Oakhurst, possess the *small, broad upper faces typical of recent KhoeSan populations*.

However, one notable aspect of these Early Holocene people is their *large size and robust bone structure*, which was for a long time thought to be rare amongst recent KhoeSan people (ibid.). Such changes in cranial morphology may be taken as *a sign for an incipient or ongoing neotenization* process that would reach its full expression following the isolation of certain groups of this robust, but undoubtedly KhoeSan phenotype. The psychological side-effects of neoteny are entailed in cranial morphology and not necessarily in body size. However, neotenization seems to have continued and, indeed, small body size would appear, but only starting with the mid-Holocene (*Fig. 5*).

At approximately 8,000 BP, a dramatic reduction in stature and robustness seems to have occurred (Pfeiffer and Sealy 2006; Stynder 2006; Stynder et al. 2007). A slight increase occurs at around 4,000 BP which, I would suggest, was the aftermath of the arrival of Khoe pastoralists from East Africa, as hypothesized by Blench (2008) and Smith (2005).

### *6.5 The Origin of Egalitarian Societies*

Given the variety of environments in which these people were dispersed, it is safe to assume that they developed various cultural approaches, from 'moderate' delayed-return (DR) strategies (Dale et al. 2004) to fully-fledged DR economies (Mitchell 2002).

Although Woodburn (1988) considers 'encapsulation' to be the underlying factor in the development of immediate-return (IR) economies, encapsulation is a phenomenon that could not have occurred before the Khoe pastoralist presence or the Bantu agro-pastoralist expansion.

Beside encapsulation, another social theory regarding the emergence of IR societies is 'competition,' as suggested by Hayden (1990). However, given Hayden's (2003) preoccupation with 'trans-egalitarian' societies – in which competition, indeed, becomes important – ascribing competitive characteristics to an economy that strives to reduce every aspect of competitiveness does not make much sense.

'Risk reduction' (Hegmon 1991; Kelly 1991) is another social theory that tries to explain the emergence of egalitarian societies and immediate-return strategies, and this would make sense, given its compatibility with an ecological theory (Binford 1980; Oyuela-Caycedo 1996) which proposes that IR strategies develop where resources are patchy, in contrast to DR economies, which emerge in lush environments. Therefore, disruption and isolation would explain better the original impulses toward IR strategies. *Hxaro*, as already discussed, is also considered to be rooted in such risk-reduction techniques (cf. Wiessner 1977).

Although the ancestors of Pygmies and Khoe(san) separated approximately 150 to 110 ka ago (Soodyall and Jenkins 1992; Veeramah et al. 2012), both genetic lines, as argued above, were phenotypically *robust*. Typical 'Bushmanoid' characteristics of cranial anatomy would become noticeable only during the terminal Pleistocene but these ancestral KhoeSan were, likewise, still remarkably robust (Stynder 2006). Present (pedomorphic) phenotypes appear in the osteological record only starting with the Holocene and are associated with the Lockshoek – Interior Wilton – Smithfield B Later Stone Age (LSA) sequence (Bousman 2005). Therefore, Tobias (1978) and Schuster et al. (2014), in their mention of a Khoe(san) element that dominated East and southern Africa approximately 80,000 years BP, refer likely to the genetic line that would, during the Holocene, result in KhoeSan phenotypes as we know them today.[7]

Interestingly – but not surprisingly – these populations were characterized by DR strategies (see Mitchell 2002 and references therein; Bousman 2005): storage pits were unearthed and identified even in the Kalahari!

Similar population fragmentations occur in Southeast Asia where, like in Africa, a phenotypically modern population continuity was once proposed. The 'Negrito hypothesis' speculated that a shared phenotype among various contemporary groups of hunters and gatherers (dark skin, short stature, peppercorn hair) was due to common descent from a region-wide, pre-Neolithic substrate of humanity (see Endicott 2013). Populations answering this description are found in and around the forests of Peninsular and Island Southeast Asia, the most widely reported being those of the Andaman Islands, Malaysia, and the Philippines. 'Negritos' were presumed to derive from an early ancestral population whose former distribution may have also included parts of New Guinea and Australia, but who were either absorbed or replaced by later migrants (Barnard-Davis 1867; de Quatrefages 1895; Radcliffe-Brown 1922).

For the Out-of-Africa scenario to accommodate the Negrito hypothesis, it would be reasonable to anticipate evidence for short stature in the fossil record. Possible evidence for a hominin of short stature in the early paleoanthropological record of the northern Philippines is limited to a single metatarsal, whereas later human remains indicate predominantly robust phenotypes (Dizon et al. 2002; Détroit et al. 2013). A second expectation of placing the Negrito hypothesis within the Out-of-Africa hypothesis is that there should be some degree of shared retention of phenotype among other populations, in particular the African Pygmy groups (for a genetic history of Pygmies, see Batini et al. 2011).

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[7] The degree of biological relatedness between eastern and southern African Stone Age hunter-gatherers has long been a subject of interest and still wrongly interpreted in recent research. For example, Willoughby et al. (2018) describe Stone Age teeth from Magubike rock shelter in Tanzania as ''closely resembling those of the San of southern Africa.'' Theoretically, the description is correct but very misleading. Schepartz (1988) critiques the presumption that EA/SA Late Pleistocene people were 'unreduced' robust 'Bushmanoids.' Rightly so: as Morris (2002) attracts the attention to, San (Bushmen) are a relatively late South African development. It was an ancestral proto-*Khoe(san)* stock that inhabited EA and SA in the Late Pleistocene, which itself would split into southern (*KhoeSan*) and eastern (*Khoe*) branches at 35 ka (Tishkoff et al. 2007). The LGM leads to isolation and the ancestors of San split at around 27 ka (Pickrell et al. 2012) in southern Africa and those of the *KhoeHadza* and of the *Sandawe* become separated at around the same time (Veeramah et al. 2012). The *Hadza* would become isolated from the ancestors of *East African Khoe* at c. 18 ka (Pickrell et al. 2012; Tishkoff et al. 2007). Therefore, and in order to avoid confusion, *Khoe(san)* in the text is the designation that I adopt for the (pre 35 ka) common genetic ancestors of East African Khoe, Sandawe and Hadza, and of the southern African Khoe and San. By the same token, the designation *KhoeSan* is used to denote the southern (post 35 ka) branch of the Khoe(san), i.e., the ancestors of modern Khoe and San.

Comparing postcranial measurements of Aeta (Philippines) and Andamanese with African, Asian, and Australian hunter-gatherers suggests that *the phenotypic variation does not support the existence of a generic Pygmy or Negrito phenotype, past or present* (Stock 2013). These findings do not rule out an ancestral connection between these populations, but any account of the Negrito hypothesis has to explain this amount of physical variation.

An alternative explanation for the Negrito phenotype is that of *convergent evolution*, whereby similar physical traits developed independently among multiple populations. An explanation for the existence of short stature is that it evolved as a 'life-history trade-off' favoring *early reproduction and cessation of adult growth* (neoteny), in order to enable *flexibility* for novel biological adaptations in the remote rainforest environments in which certain groups became isolated (Migliano et al. 2007; Endicott 2013).

In other words, the southern African scenario seems to repeat itself in Southeast Asia and the dark, short-statured and peppercorn-haired Negritos, however reminiscent of African Pygmies, apparently evolved locally, from robust populations that underwent a *neotenal leap* during the Holocene.

To sum up, I would hypothesize that during the Last Glacial, and especially the LGM, certain human populations in a bottleneck situation that became isolated in the deserts of interior southern Africa and the drought-stricken savannas of East Africa, but also in the Central African and Southeast Asian rainforests, *reversed* to immediate-return strategies (DR proved to be practiced in more lush areas, see the Albany industry of the Oakhurst complex in South Africa [Mitchell 2002; Bousman 2005]). IR strategies would have granted more flexibility, a generalized 'new start' from which novel cultural steps could have been taken. Indeed, the interior Lockshoek industry – belonging to the same Oakhurst complex of which the coastal Albany industry or the savanna Pomongwe tradition are DR examples – was an *arguable reversal to immediate-return subsistence*. Moreover – and as the osteological record indicates – a neotenal leap seems to have taken place at the beginning of the Holocene: short stature and pedomorphic characteristics evolved, in a similar fashion like that proposed for Southeast Asia, which was interpreted as a 'life-history trade-off' favoring early reproduction and cessation of adult growth (Migliano et al.2007; Endicott 2013). This would also be compatible with the 'risk management' hypothesis for the origins of immediate-return hunters and gatherers, as proposed by Hegmon (1991) and Kelly (1991).

Apparently, the economical *reduction* to a more generalized, but more flexible IR base *was followed* by a *biological reaction*, expressed in further neotenization which, in its turn, resulted in a more generalized and, therefore, more flexible behavioral and social base. I would like to emphasize – again – that immediate-return subsistence is not synonymous with egalitarian behavior and social organization. *IR is a reduction from DR to a non-specialized economy that 'freed' the isolated groups of the interior from cultural entanglement* (*sensu* Taylor 2010), *and in which biological processes could act without interference.*

The Holocene neotenal 'sudden jump' – beside the obvious physiological flexibility that it pertained – must have also leveled hierarchical/aggressive tendencies and granted a *higher level of sociability*, which would, inevitably, lead to egalitarianism. *Therefore, higher levels of sociability based on reduced levels of hierarchy enabled a novel type of social complexity.*

*Hxaro* – in the southern African case – is the key to such a non-committed complexity based on maximum flexibility. It *did not emerge as a coping technique* meant to counter the dangers of the 'treadmill effect,' but as the result of a biologically-granted potential. By the incipient Interior Wilton (formerly Smithfield A, 8 ka ago) *leveling mechanisms* start being elaborated as the stabilizing techniques that would eventually entrench egalitarianism during the classic (7 to 4 ka ago) and developed (4 to 2 ka ago) stages of the same Interior Wilton tradition (see the evidence cited by Stynder [2006] regarding the increasing occurrence of *hxaro* exchange goods at around 10 ka ago).

IR strategies are a 'primitivism' carried into the new cultural dimension, which is an *egalitarian* (*sensu* Woodburn 1982) and *affluent* (*sensu* Sahlins 1972) society. The ability to retain such a primitivism – or to reverse to such a less specialized primitive stage – is the expression of the flexibility that characterizes vertical evolution in biology (Blaga 1976 [1943]) and, as it seems, in culture (Steiner 2016, 2017). The cultural 'achievement' in this case is not the IR economy, but the egalitarian character of the societies that have emerged immediately after employing such a generalized tactic. Therefore, the comparison between the European Mesolithic and the southern African Wilton industry (and the subsequent Smithfield B tradition) may be valid on the technological (material) plane, but it cannot be extended to the behavioral (social) and – as it will soon become evident – cognitive (mental) levels.

During the Last Glacial, isolated Neanderthal groups in West Eurasia did not revert to a 'primitive' economy but, instead, they 'developed' SMUs, as documented by Richter (2000). The strategy was compensatory in character and was meant to *entrench technological achievements and safeguard them against cultural loss.*

Hierarchical and aggressive *robusts* living in an already well-consolidated and ratcheted cultural niche – which was likely modeled on the very values entailed in such behavioral traits – were not flexible enough to *react biologically* to the hardships of the LGM, which affected them incomparably harder than the environmental conditions experienced by their African cousins. After *tens of millennia of cumulative cultural evolution*, they have *reacted culturally*, with an emphasis on *technological innovation* and *social complexity*.

The adoption of a cumulative type of cultural evolution 60,000 years ago by cognitively modern but anatomically archaic *H. sapiens neanderthalensis* in western Eurasia had paved the way to the emergence of behaviorally (*hierarchical*, *docile*) and anatomically (*gracilized*) modern populations.

Conversely, the adoption of a reductive type of cultural evolution during the final Pleistocene by cognitively modern but anatomically still robust *Homo sapiens* in southern Africa had paved the way to the emergence of anatomically (*neotenous*) and behaviorally (*egalitarian*, *peaceful*) modern populations.

## 7. Cultural Speciation

### *7.1 Holocene Size Reduction and the Domestication Syndrome*

I have aired the suggestion that the ultimate 'cultural speciation' between vertical and horizontal orientations is a relatively recent – terminal Pleistocene/Early Holocene – development. Similarly, based on osteological evidence, I have theorized that the emergence of anatomically modern phenotypes may be correlated with various biological/cultural strategies that were adopted as a response to the environmental changes of the Last Stadial and Glacial Maximum (LGM) (c. 27,000 to 17,000 BP). These, in their turn, would determine the nature of the biological responses and/or cultural orientations adopted during the Younger Dryas (YD, c. 11,000 BP).

Indeed, a general mammalian size reduction seems to have occurred during the Early Holocene. In parallel, an accelerated loss of robustness – accompanied by speciation – took place in the case of domesticates (for a discussion see Tcharnov and Horwitz 1991 and references therein).

One could argue that both Eurasian and African robusts became *'naturally' gracilized* during the Early Holocene and that modern phenotypes are the result of such a *universal* decrease in body size. However, Holocene mammalian size reduction was documented with *isolated* populations in *natural environments*, while the size reduction observed with *domesticates* took place in crowded cultural environments.

In southern, Central and East Africa, very much like in parts of South East Asia, the isolation that was brought about by the climatic upheavals of the LGM was answered by making use of the degree of flexibility that characterizes cultural orientations that are still not vertically or horizontally committed. Such a *reductive cultural step* had apparently enabled the perpetuation of biological tendencies, i.e., of neotenous developments.

Paleoanthropological evidence – as discussed before – supports such a possibility: the biological consequences of the LGM cultural reduction become manifested by the Early Holocene, when human morphology in the above-mentioned remote regions already starts displaying markedly neotenous features.

Small body size would appear in isolation, as a 'life-history trade-off' favoring early reproduction and cessation of adult growth (Migliano et al.2007). In southern Africa, at approximately 8,000 BP, a dramatic reduction in stature and robustness seems to have occurred (Pfeiffer and Sealy 2006; Stynder 2006; Stynder et al. 2007). The date corresponds not only with the Holocene mammalian size reduction, but also with the incipient phases of the Interior Wilton industry and the appearance of *hxaro* exchange artifacts in the archaeological record. The similarities between the Interior Wilton and modern San technological traditions and the evidence for *hxaro* which, in its turn, may be related to the leveling mechanisms that stabilize social and technological developments in egalitarian societies point to a relatively recent origin of the latter.

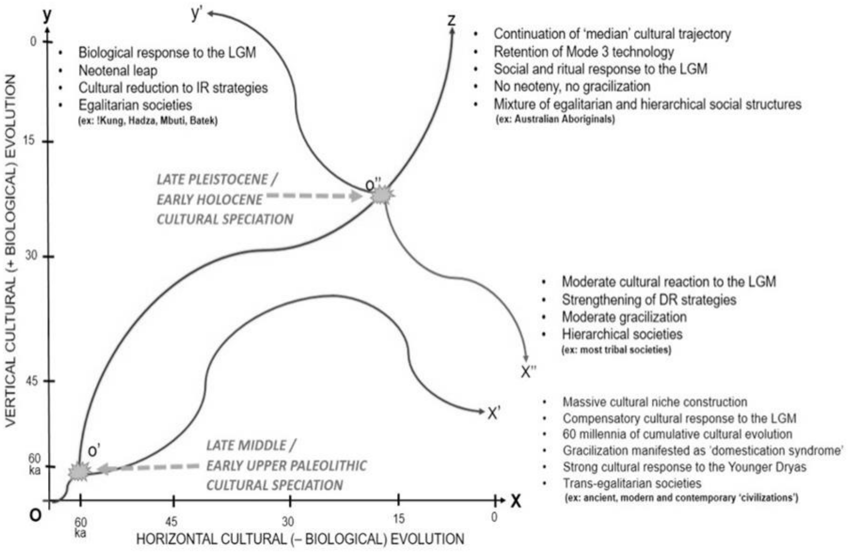

*Fig. 6 – Pleistocene and Holocene cultural speciations*

In this context, the development of the cultural flexibility entailed in the leveling mechanisms documented by Woodburn (1982) is the tangible side-effect of ongoing neoteny in vertical cultural orientations. Therefore, the o'-y axis of the cultural field is the *natural extension of the vertical coordinate of the biological field*. Hence, vertical evolution in the cultural field can be confidently defined as *biological-cultural coevolution*, in stark contrast with horizontal cultural trajectories which, for reasons discussed below, will be defined as *cultural–biological coevolution*.

The climatic deterioration of the LGM was felt more severely in Eurasia, where populations with a 40,000 years history of cumulative cultural evolution (Richter 2000) had lost much of their cultural flexibility because of their specialization to the demands of already well-established and elaborate cultural niches. In the harsh Eurasian paleoclimate – which had also determined the horizontal turn taken in cultural evolution during the Middle/Upper Paleolithic transition – 'regressions' became unimaginable, not only because of the environmental realities that would not have allowed for an immediate-return subsistence, but also because of an already advanced stage of gracilization – the morphological consequence of ongoing self-domestication which, according to Bednarik (2007), had reached an archaeologically detectable stage at around this time (c. 30-27 ka).

The price of cultural 'fitness' came at the expense of biological flexibility and, therefore, the response to the climatic challenge of the LGM was strictly cultural: instead of reduction, further elaboration seems to have occurred. However, at least at this stage, the cultural compensation does not seem to have taken place exclusively at the technological level: having in mind the grandiose and obsessive display of 'creativity' during and following the LGM, I would suggest that the compensation was mostly of a cognitive nature. As I will soon explain, by *'cognitive compensation'* I mean *adjusting cultural behavior to the restricted cognitive potentials that were the consequence of tens of millennia of niche construction and self-domestication.*

The narrowing of the 'cognitive ceiling' is graphically illustrated in *Fig. 4* (SGM pp. 14, 24): the ability to shift the 'contextual focus' to its associative end (*sensu* Gabora 2003) *decreases in direct proportionality* *with the degree of cultural elaboration*.

Of course, the reduction to IR strategies was not adopted by all southern African populations during the LGM and cognitive responses to the environmental changes of the period were not restricted to Eurasia. The 27,000 years old iconographic images from the Apollo 11 Cave in Namibia hint to the possibility that cultural over-reactions did also occur in southern Africa. However, the display of the 'talent' for iconographic representation is on a more modest scale and it was apparently *discontinued* when the environmental conditions returned to normal. Since the ability was not 'ratcheted' (*sensu* Tomasello 1999), I would suggest that the culture responsible for the Apollo 11 Cave 'art' was not of the cumulative type and the cognitive 'innovation' was lost to the 'treadmill' (*sensu* Henrich 2004). On the other hand, the Apollo 11 Cave figurative depiction may also denote a common – 'childish'? – practice. The ability was, in this case – incidentally or willingly – applied on rock, instead of, say, sketched in sand, or painted on tree bark (which would have become a rare commodity during the desertification that characterized the period). The *re-emergence* of pictorial rock art, i.e., *the systematic application of an arguably earlier developed ability* in southern Africa a few millennia later will be discussed in the next section.

### *7.2 Slowing Down to Sufficiency and Accelerating toward Efficiency*

The cultural ancestors of modern egalitarian hunters-gatherers and of contemporary technological societies had both achieved a technologically 'sufficient' material stage at the onset of the Holocene, but at already variously specialized/flexible cognitive levels.

Eurasian hunters and gatherers, due to their long history of cumulative cultural evolution were, at this stage, already cognitively entangled in the realities of their constructs of reality. The technological divergence would occur only starting with the Holocene, as an *accelerated* development with an eye on *efficiency* in cumulative contexts and as a *slowed-down* process with the retention of *sufficiency* as its main objective in vertical cultural orientations.

In the Levant, following the plenty that had allowed for sedentary life and the ratcheting of delayed-return strategies during the Natufian (Bar-Yosef 1998), the disrupting effect of the Younger Dryas endangered the retention of such a specialized sedentary culture, which could only be carried on by recurring to a 'cultural sudden jump,' i.e., the Neolithic 'revolution.'

The *cultural niche* that was elaborated by incipient agriculturalists created a new *biological niche* which, in its turn, became exploited by the wild ancestors of would-be domesticates and commensals (Tcharnov and Horwitz 1991). I include the late Natufians in the category of such 'domesticates': together with wolves and wild boars, they have adapted and specialized to the niche that they have created and thus, they have experienced an additional loss in body size, which is a typical characteristic of domesticates, known as the 'domestication syndrome' (ibid.; Byelayev 1979).

While isolated hunters-gatherers in southern Africa recurred to a *cultural reduction* in their coping with environmental change, their Levantine relatives living in a crowded cultural environment opted for additional cultural elaboration.

According to a slowly emerging new paradigm, agriculture is far from being an exclusively material/technological 'innovation.' Contrary to what was previously thought, the etiology of the Neolithic *cultural leap* may also be understood as a *cognitive reaction* to the environmental changes of the Younger Dryas.

In a manner that is reminiscent of the cognitive response of Solutréan and Magdalenian Europeans to the climatic havoc of the LGM 8 millennia before them, Anatolian Early Holocene delayed-return hunters and gatherers have suddenly started to display an obsessive preoccupation with symbolic constructs, which led to collective grand-scale projects. Göbekli Tepe, a cultic site *par excellence*, is maybe the best example (Schmidt 2003). Agriculture is believed to have commenced as a modality to support such 'obsessions' (ibid.; Cauvin 2007).

By the same token and at the same time, the Natufians of the southern Levant developed strong symbolic attachments to their settled way of life. The cultural rigidity that was the result of this cognitive specialization inhibited the possibility of a 'regression' to nomadic life when the climate turned unfavorable. Instead, a cultural step was taken, which was meant to support the said symbolic attachments and ratchet the settled cultural environment in which they have developed.

Hayden (2003) theorizes that 'trans-egalitarian societies' have developed as a result of such symbolic obsessions and that the grandiose Solutréan and Magdalenian cave art of Upper Paleolithic Europe points to their emergence. Moreover, he forwards the hypothesis that feasting meant to display *status* and *prestige* was an integral part of the ritual activities pursued in the painted caves. Despite that his evidence is not convincing, feasting and orgies did indeed take place at Göbekli Tepe (Schmidt 2003) and, because of the similarities between the Upper Paleolithic cognitive reactions to the LGM and the Neolithic Anatolian/Levantine cultural responses to the Younger Dryas, I am inclined to take Hayden's hypothesis in consideration. Furthermore, given that the consolidation of *prestige, power* and *status* is also pursued in cumulative cultural evolution, 'trans-egalitarian' societies may be directly contrasted with 'egalitarian' societies in which, *the development of prestige, power and status is actively discouraged.*

Only at this moment was the 'sufficient' Mesolithic toolkit expanded, i.e., adapted to novel agricultural needs, and the obsession with technological 'advance' and *domestication* became irreversibly institutionalized (for a discussion, especially regarding 'the domestication of metals,' see Steiner 2010).

Levantine and Anatolian agriculturalists expanded to Europe (Haak et al. 2010; but see also Diamond's [1997] 'geographical axis' argument, which also explains the horizontal orientations that were imposed on most delayed-return cultures), where they encountered a culturally-gracilized population with a similarly rich history of compensatory cultural niche construction. Their values were compatible with those imported by the Neolithic newcomers and they were, apparently, easily adopted.

Undoubtedly, immediate-return hunters and gatherers display a higher degree of neoteny than the self-domesticated descendants of the Natufians. *Genuine neoteny* occurred in the first case (Holocene mammalian body size reduction), and *pseudo-neoteny* in the second example (Neolithic domesticate body size reduction).

In conclusion, the increased biological flexibility granted by the cultural reduction of the terminal Pleistocene enabled neoteny to continue its natural course not only with the San of southern Africa, but also with populations that found themselves isolated in Central/East Africa and in South East Asia. The still robust ancestors of Hadza and Sandawe became separated *during the/as a result of* the environmental changes of the LGM, very much like the ancestors of Pygmies or Negritos. Short stature and other (mostly cranial) pedomorphic characteristics – and, as a behavioral side-effect of such neotenous developments, *egalitarian societies* – emerged in all these locations, during the mid-Holocene. Therefore, and as already stressed, the perception of immediate-return subsistence strategies as a primitive and ancestral stage that would evolve toward more elaborate delayed-return economies is, basically, wrong.

By the same token, egalitarian societies are not ancestral to more complex and hierarchical social structures, but a relatively recent behavioral *achievement*.

The linear perception that plagues our understanding of 'cultural evolution' takes us back to the implicit linearity presumed in the 'emergent' to 'mobilized' progression of symbolling abilities, which was the starting point of this paper. In the following, I will focus on the cognitive implications of *cultural heterochrony* and on the *accelerated* or, conversely, the *delayed* application of symbolling abilities that were, arguably, already in the possession of our Middle Paleolithic ancestors.

## 8. Coping with Cultural Change and Cognitive Loss

### *8.1 The Rock Art of Egalitarian Societies*

According to the consensus, *southern, eastern and Central African* rock art emerges in parallel and/or immediately after the reversal to immediate-return subsistence and the emergence of egalitarian societies. The abstract Batwa tradition was tentatively dated to c. 14 ka (Namono 2012); San figurative rock art is estimated to have a 12 ka antiquity; the East African rock art ascribed to the ancestors of the Sandawe/Hadza hunters and gatherers is considered to be c. 9 ka old. If these dates reflected the real age of African rock art, one could argue for a relationship between the novel economical/social organization and the parietal art which would, presumably, enshrine the ‘values’ of egalitarianism. Such an interpretation would, however, imply the *delayed emergence of cognitive abilities* that were already at a ‘mature’ stage in West Eurasia, millennia before their systematical application in Africa. But, as already emphasized in the previous section, well-developed iconographic abilities in southern Africa were present long before the emergence of egalitarianism, at approximately the same time when they started to be systematically applied in Eurasia. San rock art draws on figurative traditions inherited from non-egalitarian robust ancestors who had demonstrated their ability during the Last Stadial (27 ka ago) in the Apollo 11 Cave (SGM p. 21).

The date at which the stone slabs were painted was determined using the accelerated mass spectrometry (AMS) $C^{14}$ method (Rifkin et al. 2015), which is more reliable than tentative dates based on archaeological context or stylistic considerations.

We must consider the possibility that the iconographic ability was latently present and *sporadically practiced* long before its application on a massive scale during the Holocene. The ‘artistic’ skills displayed in the execution of the ‘first’ rock paintings illustrate clearly that the ability did not appear all of a sudden but, when its application became *meaningful*, dormant traditions were revitalized and used on a large scale. Therefore, reliable dates for the emergence of the systematic use of such latent abilities become imperative. The problem with the above-mentioned tentative – but widely accepted – dates is that, as said, they are based on stylistic considerations and on not too reliable archaeological contexts. In the case of immediate-return hunters and gatherers – because of *the stable character of their culture* – the dates theorized by such approaches are questionable. Moreover, IR economies *reduce* cultural elaboration and do not produce unnecessary cultural artifacts (e.g. rock art).

However convenient an explanation of rock art as the illustration of novel economical/social realities would be, only the reliance on direct dating techniques and archaeometry can offer an accurate understanding of the relationship between rock art and the cultural contexts in which it became systematically applied. An AMS carbon dating of San rock art from three locations was undertaken by Bonneau et al. (2017). Surprisingly, the oldest dates were shown to be slightly in excess of 5 ka in SE Botswana and their age decreases to c. 4 ka in Lesotho and the Drakensberg. These measurements confirm earlier AMS $C^{14}$ results according to which, the earliest directly dated South African parietal art – depicting human figures painted on exfoliated slabs at Steenbokfontein – was estimated to be not older than c. 3650 BP (Rifkin et al. 2015 and references therein).

Similarly, Batwa rock art is generally believed to be much younger than the > 14 ka attributed to it by Namono (2012), namely, in the order of 3 ka. Hence, the earliest occurrences of Batwa and San rock art do not necessarily reflect the emergence of egalitarian societies and, implicitly, they do not illustrate incipient, but already well-established cultural norms of immediate-return hunters and gatherers.

Direct dating techniques place the emergence of San rock art traditions in a historical period that made the application of already extant iconographic abilities meaningful – apparently, the ages attributed to the oldest Bushman rock art coincide with the arrival of Khoe[8] pastoralists in southern Africa (Smith 2005; Blench 2008; but see contra, Sadr 2008).

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[8] The genetic similarities between modern Ethiopians and ancestral East African Khoe are highlighted in a study by Semino et al. (2002) and confirmed by Schuster et al. (2014). I have already mentioned the dates at which the split between ancestral eastern/southern African proto-Khoi(san) populations took place. An East African presence of this genetically Khoe(san) element is beyond doubt. In isolation – both in southern and eastern Africa – some of these groups would return to IR strategies. The East African Khoe on the other hand, did likely continue their DR subsistence strategies and, eventually, would adopt pastoralism from their Cushitic neighbors. In EA they have impacted their close relatives, the Hadza, but also their more distant cousins, the Sandawe. Their expansion to the south (Blench 2008) impacted various distantly related South African DR HG Khoe groups, but also IR and egalitarian San. Likely, some of the newcomers adopted Bushman lifestyles and, opposite, some Bushmen may have adopted pastoralism. Genetic exchange must have also been common at the end of isolation.

In such a context, the advent of the Bushman figurative rock art style could be understood as an expression of the need to *re-affirm* and *illustrate* egalitarian social/spiritual practices (depictions of communal ritual dances), or to *share* experiences acquired in the trance-like condition that accompanies persistence hunt (animal and therianthrope paintings, as discussed in another section). The accent lies on what differentiates the San hunters-gatherers from the pastoralist Khoe.

A sense of *threatened values* and the *exposure to an alien cultural environment* must have triggered out arguably *extant but latent symbolling abilities* which became meaningful as a modality to *illustrate* cultural identity. Although abstract representation has also a long history in southern Africa (pre-Bushman cupules/petroglyphs engraved on quartzite outcrops in the Kalahari were dated, based on paleoclimatic constraints and micro-erosion analysis, to 400 ka BP [Beaumont and Bednarik 2010]), figurative abilities were opted for. I would suggest that *abstract* representation is preferred when the *environment is conceptualized* (like in the Lower/Middle Paleolithic 'calibration of reality'), while *figurative* depictions are more suitable for the *illustration of behavior* in a conceptualized environment.[9] The application of *abstract* or *iconographic* expression is solely a matter of *perspective* and not of *hierarchy* or *ability*.

For example, Batwa rock art favors abstract expression (which does not exclude the ability for the figurative, see the example of the Jarawa boy Emmy, as discussed in the introduction). The origin of the Batwa style (SGM p. 20) also coincides with the emergence of an *external threat to cultural identity*, namely: the Bantu contact. Pygmy beliefs exalt environmental *harmony* and the prosperity of people depends on it. *Harmony itself became threatened* at contact and, rock art, very much like the *molimo* ceremony, was meant to *re-establish it* (for a discussion, see Namono 2012).

The realities of contact (early Bantu contact at c. 3500 BP in the case of the Batwa; Khoe contact in southern Africa at around 4,000 BP; Khoe interaction with the Sandawe and Hadza in East Africa at earlier dates, as testified by the Kondoa rock art corpus [Bwasiri and Smith 2015]), could have resulted in *encapsulation*, which Woodburn (1988) sees as one of the possible origins of egalitarianism. Indeed, encapsulation might have resulted in the re-affirmation of egalitarian behavior and/or in the re-confirmation of environmental harmony, as described above. Novel and more elaborate leveling mechanisms meant to inhibit the accumulation of prestige must have also been devised during this turbulent period.

### *8.2 Cultural Change and Ritual Innovation in Southern Africa*

In southern Africa, the ritual 'innovations' meant to cope with the threat posed to egalitarianism may have spread via *hxaro* beyond the area where contact did initially take place. Indeed, Bonneau's (2017) direct dating of rock paintings suggests that the oldest rock art is where Khoe contact occurred (SE Botswana, see also Blench 2008) and that in the mountainous parts of southern Africa (Lesotho and the Drakensberg) the paintings are much younger.

Woodburn (1982) has recognized the need to explore the expression of egalitarianism in the religious beliefs and practices of immediate-return societies, but he has stopped short from pursuing the subject. However, he was correct in his presumption that the spiritual dimension of immediate-return cultures must also confirm to patterns that support egalitarianism and thus inhibit developments toward social stratification. However, following contact, cognitive and behavioral changes must also have occurred, i.e., a loss in the ability to shift the contextual focus to its associative end (*sensu* Gabora 2003) and a re-orientation of ritual meant to counter the loss, which had likely resulted in only a segment of the population being able to enter trance at will. Egalitarianism in the religious beliefs and practices of immediate-return societies can be imagined only in a scenario in which the natural talent to shift the contextual focus is available to a large segment of the community, because in such a case the need for a ritual specialist would not arise. However, many Bushman paintings are far from being depictions of communal ritual or egalitarian behavior.

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[9] Figurative rock art can, to an extent, also describe the nature of reality: consciously executed super(im)positions may reflect intentional meaningful relationships between the two layers, i.e., the manifestation of *contradictory but potentially equal causal probabilities* (Lewis-Williams 1981).

The rock art of southern Africa is usually associated with the hallucinations of San medicine people, or 'shamans' (for accounts of San shamanism see Lee 1968; Marshall 1969). It is mistakenly believed that – like in the classical example of Siberian shamanism – the Bushman medicine man performs the typical solitary dance of the lone shaman (Witzel 2011). Bushman trance is communal, and because *about half the men and a third of the women in any camp are shamans and medicine men* (Lewis-Williams 1988; Dowson 1994), 'shamanism' is very different from what this erroneous term invokes. The same interesting occurrence was mentioned by Deacon and Dowson (1996), namely: among the /Xam Bushmen most individuals were once able to enter a trance-like condition and experience directly what, in later times and once this faculty eroded, would become the prerogative of the lone shaman. In Bushman medicine dances, *the majority of people enter a state of trance and, in that condition, they activate supernatural potency that they share it with those less fortunate, in the form of communal healing.*

Thomas A. Dowson (1994) has observed, researched, and documented such ritual contexts. He has recognized the illustration of the phenomenon in the rock art of the now extinct Bushmen of Lesotho and the Orange Free State, in which communal groups with *a big number of 'shamans'* are depicted in dancing postures. The shamans are identifiable by nasal bleeding, therianthhropic features and a number of other distinctive gestures and postures indicative of Bushman shamanic practices (Lewis Williams 1981). Dowson attracts attention to the fact that *they are uniformly painted:* the figures are all more or less of the same size, and there is no depiction of any person who is more elaborately decorated or dressed than any of the others, shamans or non-shamans. Dowson suggests that such paintings point to social circumstances in which a large number of people in a community were in the possession of the faculties that would later be the prerogatives of the lone ritual specialist, and thus no one could become pre-eminent; even though shamans could contact the spirit world, heal and make rain, ''they were not better than anyone else.'' Service to their community was a natural choice, not a *power base*.

This situation is similar to that described by Marshall (1969), Lee (1968, 1979), Biesele (1978) and Katz (1982) for parts of the Kalahari in the 1950s and 1960s when, as said, about half of the men and one third of the women in any camp were in the possession of the ability to shift the contextual focus at will. This does not necessarily imply that the ability was once universal and its documentation in the 1950s mirrors a cognitive loss. I would suggest that the faculty was a development entailed in vertical cultural evolution, i.e., a heightening of the 'cognitive ceiling,' as opposed to its narrowing in cumulative (horizotal) cultural contexts (*Figs. 4*, *7*). The psychological side-effects of neoteny must have been directly responsible for the acquisition of such cognitive abilities.

Although some shamans gained reputation for being especially gifted healers, they did not accumulate prestige or assume positions of leadership or more influence. They continued to take part in hunting and gathering, made arrowheads and were treated like anyone else. Hence, the cognitive ability cannot be imagined as preceding the emergence of egalitarianism which, as already discussed, may also be associated with the psychological dimensions of neoteny. This kind of 'ritual communality' was also observed in the *simbó* trance dance of the Sandawe of East Africa (Dempwolff 1916).

But –as Dowson notices in the same article – at a certain stage, the lone ritual specialist would take the central place on the stage. This means that *either too much prestige was accumulated by some gifted shamans* and they monopolized the ritual scene (by disregarding leveling mechanisms meant to inhibit such a possibility) or that the ability to enter trance at will became eroded drastically, on a communal level. Dowson (ibid.) follows the erosion of egalitarian trance and suggests that the change was due to neither of the possible reasons mentioned above, but to *external stress*, namely: *contact* with the encroaching European colonists and Bantu agro-pastoralists, and the social interactions with them. This was a second contact, which had more far-reaching consequences than the arrival of Khoe pastoralists in southern Africa at around 4,000 years ago. (The same scenario may be suggested for the Sandawe and Hadza of East Africa, who were similarly exposed to the values of Bantu, Cushitic and Nilotic agriculturalist and/or pastoralist populations.)

Dowson relies again on rock art in his illustration of the phenomenon. He cogently observes that, in such cases, the social processes in the production of rock art involved not only the Bushman 'artists' and their communities, but also the European colonists and Bantu-speaking agro-pastoralists. For example, Bushman shamans – who were known for their efficiency in rainmaking – made rain not only for their own people, but also for their Bantu neighbors and were, at least sometimes, rewarded by being given cattle or a portion of the farmers' crops (Hook 1908; Stanford 1910). The paintings therefore do not point to Bushman beliefs exclusively. Bushman medicine men were only 'contracted' by the Bantu for their services and rewarded by them. The farmers were probably the viewers of the paintings and the significance of these must have reflected beliefs that they were familiar with (Dowson 1993). Moreover, *the rewards created a situation in which the leveling mechanisms meant to inhibit the accumulation of prestige and property became seriously threatened.*

Hunting skills, like shamanic talents, are not equally distributed in a community, but meat is shared up equally, and so is 'potency.' Leveling mechanisms take care that no prestige is accumulated, neither by the talented hunter, nor by the gifted shaman.

The changing roles of shamans can be followed in parallel with the chronology of the paintings that depict medicine men/women in different ways: in communal settings as described above, and as pre-eminent 'lone' ritual specialists.  Beside the rewards for rainmaking, the marriage of San women into farming communities resulted in some Bushman families acquiring cattle through the payment of the bride price. In some circumstances Bushman 'chiefs' emerged and controlled territories of their own. Some of these chiefs were either rainmakers themselves or entered alliances with rainmakers. Power and prestige were accumulated in addition to wealth, and leveling mechanisms became meaningless.

Increasing sedentary lifestyle followed, and the cave shelters chosen by shamans became associated with *potency*, *prestige*, and *power over resources*, that is, over cattle and crops that were either the reward for their services or acquired for their own sake.

Where the land was appropriated by white farmers, some of the Bushmen – including shamans – were forced to accept permanent employment with them. They became fewer and itinerant, moving from farm to farm to perform their healing rituals. Slowly, their *fame* as healers and their *wealth* in cattle kept at a home base transformed them into political – and not just spiritual – 'leaders' (Guenther 1986). Moreover, when the nineteenth-century colonial presence had all but annihilated the herds of game, and when grazing and agricultural land replaced former hunting and subsistence grounds, life without close ties with agro-pastoralist Bantu chiefs became impossible, and an increasing number of Bushman families went to live in the chiefs' villages. Among these families were also rainmakers, whose descendants are still recognized and respected in many parts of southern Africa. According to Jolly (1986), and Prins (1990) some of these people continued painting until the end of the nineteenth-century. Then, as Dowson sees it, the 'potency' of the images painted in abandoned rock shelters eroded gradually because of their painters' continuing residence in the farmers' villages, and Bushman healers and rainmakers ceased making rock art.

Dowson restricts his research to an area known to have been a last refuge for comparatively 'free' Bushman communities. The sequence from communal trance to specialized shamanism can be followed in the rock art of the area, and relevant superimpositions that have been found in rock art panels suggest that the chronological sequence of the changes discussed in his article correspond with that of the rock art.

Bushman shamans responded to changing social circumstances in *innovative* ways, in other words, they were adapting to the culture of their agro-pastoralist neighbors.

Forager communities had formerly maintained long-distance relations between scattered groups and when resources within a camp's territory were seriously reduced – as a result of drought or other factors – members of that camp could resort to their long-distance relations and go live with other groups (see Wiessner's [1977] description of *hxaro* networks).

By the nineteenth century, the number of communities was so reduced, and resources so greatly diminished that people could no longer resort to this option for their long-term survival. Therefore, *new relations* were forged with their Bantu neighbors, and *a gradual* – but destructive – *adaptation* to their cultural needs and values occurred.

To sum up, the transformations documented by Dowson reflect behavioral changes that were imposed on the Bushmen of southern Africa. Pictorial representations gained in importance during the first contact (when they re-affirmed *threatened* egalitarian practices) and, again, following the second contact (when they accompanied the adaptation to an externally-imposed cultural environment and the gradual erosion of previous cognitive abilities). Iconographic expression did not appear all of a sudden as 'mature' cognitive faculties, but *an already extant iconic skill became 'mobilized' in novel cultural environments.*

Paradoxically, the massive and systematic application of symbolling abilities during the African Late Stone Age (*abstract* in the Batwa example, or *figurative* with the San and Sandawe) does not indicate the acquisition of 'superior' or elaborate cognitive potentials but, quite the opposite, it may be perceived as an index of cognitive 'loss.'

Therefore, the Upper Paleolithic cognitive 'big bang' associated with the Franco-Cantabrian iconographic explosion must be reconsidered. The sheer scale at which iconographic abilities were applied may denote cognitive losses of a much higher magnitude than those encountered by the discussed egalitarian societies of Africa.

### *8.2 Cultural Predisplacement and Postdisplacement*

While the still robust ancestors of IR HGs were undergoing neotenization under conditions of isolation during and following the LGM, Eurasian populations were already steadily gracilizing for tens of millennia. Shrinking neural capacity, one of the side-effects of gracilization, led to increased reliance on external storage. The entanglement in the realities of an already elaborate cultural niche, together with the behavior focused on navigating the social complexity that is the implicit part of cumulative cultural evolution may have resulted in the reduction of associative cognitive abilities and *a blockage* in the convergent mode – culturally very adaptive, but biologically confining. The phenomenon was graphically illustrated in *Fig. 4* as *the narrowing of the 'cognitive ceiling.'* By 40 ka, humans find themselves in an already artificial cultural environment in which the disparity between biological inclinations and cultural demands is bridged by recurring to *coping techniques*.

I would suggest that the sudden and massive display of figurative 'artistic' abilities – which is the hallmark of this crucial period – illustrate, literally, the application of such coping techniques.

I have equated *coping mechanisms* with *cultural acceleration* (marked on the horizontal axis of the cultural field), as opposed to *leveling mechanisms*, which I have associated with *cultural stabilization* (as marked on the vertical coordinate of the field). I have also floated the idea that the rock art traditions of egalitarian hunters and gatherers are the expression of such a *cultural stabilization*: I have theorized that the massive application of latent symbolling abilities was triggered out at the contact between these hitherto isolated groups and foreign populations. Rock art was likely meant to re-affirm their social and cognitive structures/abilities – in other words, to stabilize extant cultural configurations that were under threat.

By the same token, but considering the peculiarities of cumulative cultural evolution, I understand the emergence of the Franco-Cantabrian cave art as an expression of *cultural acceleration*. The grand-scale application of latent symbolling abilities was triggered out as a reaction to the demands of an elaborate constructed niche – in other words, *to cope with* biological (physiological/cognitive) *losses inherent in self-domestication.*

Franco-Cantabrian cave art may also be understood as a *cultural predisplacement*, i.e., an *early application* of extant figurative abilities (triggered out because of *self-created stress*) while, say, southern African rock art exemplifies cultural *postdisplacement*, i.e., *a late application* of iconographic talent (caused by *external stress*). As emphasized in the previous sections, stabilizing techniques may assume abstract expressions when their objective is to re-establish a conceptual order (e.g. Batwa rock art), but also figurative – when rock art is employed to re-affirm a social (behavioral) order (e.g. San rock art).

### *8.3 Aurignacian Paleoart*

The ‘artistic’ standard of the Chauvet murals shows that iconographic skills – although expressed all of a sudden and at such an impressive level 37 ka ago – are *far from being incipient*.

The La Pasiega painting (Hoffman et al. 2018), although cruder in execution, shows that figurative abilities, albeit not systematically applied, were already mastered 66 ka ago. What made the application of such highly refined but hitherto unexhibited skills suddenly meaningful? There must have been a significant change in order to apply an ancient – already 30 ka old – talent all of a sudden, and in all its splendor. Following my discussion above, I would suggest that the Chauvet murals (and their East European counterpart, the Coliboaia paintings, Ghemiş et al. 2009) are the graphic expressions of coping with the erosion of the ability for divergent associative thought, after tens of millennia of cognitive specialization. That is, the obsessive probing of the upper limits of the operational range of the contextual focus (Gabora 2003) which, after tens of millennia of self-domestication, was restricted to creativity. (in contrast to the egalitarian hunters-gatherers addressed previously, with whom the ability could still be practiced by one third of the women and half of the men in any camp, as late as the 1970s [Lewis-Williams 1988; Dowson 1994]).

Creativity assembles *culturally-tainted information packages* based on *causally-biased associative possibilities* in the re-sequencing of *collective* memory traces. In the illustration of the cultural field (*Fig. 4*), ‘creativity’ is marked as a dot on an already very low level of the ‘cognitive ceiling’ and very close to the horizontal coordinate, which represents cultural specialization. The associative end of the operational range of the contextual focus decreases in direct proportion with the degree of the elaboration of a cultural niche. I have addressed in detail the psychological mechanisms that play a role in creative endeavors elsewhere (Steiner 2018). As for now, l would only suggest that subconscious interactions between the conformist and non-conformist aspects of frequency-dependent biases theorized in DIT (Henrich and McElreath 2003) are of crucial importance in the creative process.

Interestingly, the famous Chauvet paintings in which animals are depicted as occupying more than one physical space at the same time and in which rhinos and lions are as if caught in movement – in an almost super(im)posed state – are reminiscent of the consciously layered images of southern African rock art which, according to Lewis-Williams (1981) may reflect *intentional* and *meaningful* relationships between the two aspects, i.e., *the manifestation of contradictory but potentially equal causal probabilities* (as also understood by Low 2004 and Gabora 2003, albeit not related to rock art).

Likely, the ritual associated with the art was also employed as a coping technique, i.e., as a modality to share the already reduced ability to shift the contextual focus to its associative end with those who, due to tens of millennia of cognitive specialization, could not do it anymore. However, the scenario is very different from the San egalitarian trance addressed by Dowson (1994). The presence of children (Snow 2003, Bednarik 2007) hints at the possibility that the ability was eroded to such an extent that only children could still demonstrate it. Having in mind that neoteny, or rather its psychological side effects (Bjorklund 1997; Charlton 2006) are easily recognizable with and are characteristic of children (in the lack of cultural conditioning) and ‘natural people’ (for the same reason), the cognitive abilities of children became suddenly meaningful and applied in earnest. Only children could ‘zoom out’ beyond cultural restrictions. The ability of Aurignacian adults – who were already caught in the rut of causality and entangled beyond hope in the artificiality of the constructed niche – must have been already severely impaired. Moreover, considering the paleoclimatic setting, the constructed niche became of utmost importance, meant to counter the environmental threat in a compensatory and exclusively cultural manner.

Considering that the authorship of Chauvet is assigned to Neanderthals or to their still markedly robust descendants (Bednarik 2007, 2017), the *ongoing gracilization* of these people must have, inevitably, resulted in *cognitive impairments*. This, in a manner that does not reflect the transformations that would occur – at a much later date – with certain southern African populations in the case of which, neoteny led to the acquisition and stabilization of cognitive potentials that only Neanderthaloid children seem to have still possessed 37,000 years ago.

The perceptions of the ‘savage mind’ in anthropological and ethnographical works of the 19th century seem to document a less restricted operational range of the contextual focus. As Chris Low (2004) observes, “the cognitive capacities of natural people were considered to be ‘childish,’ *with cause and effect randomly sequenced in a world of probabilities* that was also *able to accommodate contradictions* that were not recognized and ‘corrected,’ and in which the spiritual side was not a stranger to reality.”

To sum up, childish cognitive potentials were likely in demand 40 millennia ago in western Eurasia while, in southern Africa, such cognitive abilities were still common with adults, as late as the 1970s.

At this point, some might argue that, in case that the authorship of Chauvet is acknowledged as that of Neanderthals, the cave art could be interpreted – following my discussion of Bushman rock art – as the product of ‘contact.’ With ‘contact,’ of course, meaning the arrival of AMHs in West Eurasia! But, as I have repeatedly stressed, it was not the physical encounter with a foreign population that precipitated the emergence of mid-Holocene San rock art, but rather the contact with a novel, ‘un-natural’ cultural environment. I have also pointed out that an impressive number of transitional industries between the Mousterian and Aurignacian traditions (Bednarik 2007) hint to the possibility that the Aurignacian was *not imposed on* Neanderthals but *developed by them*.

In the case of isolated egalitarian hunters-gatherers, laboratory and and zoo chimps and bonobos, or the hospitalized Jarawa boy, contact, i.e., an externally imposed cultural or environmental reality may trigger out the massive and sudden application of latent but not relevant cognitive or behavioral abilities. However, the ‘switch’ can also be self-initiated – as in the case of UP Eurasians. With them, cultural rhythm was inflated: this was the time of the UP ‘singularity,’ when biology could not catch up with the pace dictated by culture. The buffering between slow biological evolution and rapid cultural elaboration was effectuated with the help of *coping techniques* (*sensu* Ellul 1964) which in this case, was the application of figurative art, as discussed above. To stay with Ellul, the *artificiality* and *rationality* of the novel cultural environment was likely to impact Aurignacians much stronger than mere physical contact with culturally not so different newcomers. The Aurignacians did not become obsessed with their creative abilities only to cope with another hominin group, but in order to cope with their own cultural construct which, after 20 millennia of cumulative (horizontal) cultural evolution became ‘alien’ enough to demand buffering techniques. Indeed, Ellul (ibid.) considers art – and the magic related to it – as the first technique.

### *8.4 Magdalenian Art*

The climatic deterioration of the Last Stadial and the LGM had surprised already heavily gracilized Eurasian populations. The degree of gracilization which defines anatomical ‘modernity’ seems to have been reached by the Gravettian (Bednarik 2007). The psychological side-effects of self-domestication cannot be compared to those entailed in biological neoteny. Beside maladaptive side-effects, cultural gracilization is inevitably accompanied by neural storage reduction.

I have already mentioned the genes NOTCH2NL and SRGAP2C, which are thought to have played a major role in the increase of human brain size and, implicitly, in the number of connections between neurons (Fiddes et al. 2018). The site of the genes on the long arm of chromosome 1 is also involved in genetic defects in which large segments of DNA are either duplicated or deleted, leading to neurological disorders known collectively as 1q21.1 deletion/duplication syndrome. Deletions are often associated with *autism*, while duplications are often associated with *schizophrenia*. An apparent switch in the deletion/duplication of NOTCH2NL genes in an artificial (cultural) environment seems to have occurred immediately after such an environment became the main theater of evolution.

The terminal Pleistocene is also marked by the sudden reversal of several million years of continuous encephalization (*Fig. 5*), when the cranial volume of humans abruptly began to plummet (Henneberg 1990; Hawks 2011; Bednarik 2012). The etiology of neurodegenerative symptoms must, therefore, coincide with the onset of cumulative cultural evolution and self-domestication. Niche construction and dual inheritance theories (NCT and DIT) admit the possibility of such developments.

According to Odling-Smee (2003), certain cultural environments have completely eliminated the natural component and, in such an *artificial* context, *selecting for maladaptive traits that only benefit survival in the specific cultural environment – but affect negatively biological fitness – becomes the driving force of 'cultural evolution.'* Richerson and Boyd (2000) propose that *the climatic changes occurring in the Pleistocene may have provided the right environmental conditions for the onset of the cumulative dimension of culture*. Therefore, the cognitive side-effects mentioned above can be confidently associated with this specific modality of cultural evolution.

Indeed, Srinivasan et al. (2016) argue that s*chizophrenia emerged after humans diverged from Neanderthals*. That is, the origin of schizophrenia lies in gracilization: thus far, we already know that 'divergence from Neanderthals' means the 'gracilization of Neanderthals.' As Frantz et al. (2015) and Tcharnov and Horwitz (1991) have attracted the attention to, domestication – in this case *self-domestication* – leads, eventually, to speciation. Benítez-Burraco et al. (2017) do, indeed, suggest that schizophrenia and human self-domestication are intricately related phenomena and that they occur in synchronicity. To stay with Benítez-Burraco and colleagues (2016), they also float the idea that ''schizophrenics are hyper-domesticated humans,'' while ''autists are undomesticated humans.''

The Solutréan and Magdalenian art of western Europe is c. 20 millennia younger than that of Chauvet. Unfortunately, the cave art of the Aurignacian and the paintings of Lascaux and Altamira are mentioned in the same breath and referred to as undisputable illustrations of a 'fully maturized' symbolling ability (e.g. Culley 2016, SGM p. 2). However, *ongoing cumulative cultural evolution*, *physical gracilization* and *the emergence of neurodegenerative syndromes* – the 'cultural products' of these 20 millennia – must have left their imprints on Magdalenian cave art which, far from being a communal coping technique with climatic change and cognitive loss, should rather be understood as *the display of a novel type of behavior that had evolved during the said 20 millennia*.

I argue that the cognitive abilities of children – who, during the Aurignacian, could still zoom-out beyond the culturally-imposed limitations on adult cognition – were traded for the apparently similar 'abilities' displayed by schizophrenics. The natural ability to shift the contextual focus became corrupted to such an extent that *only cultural techniques would have approximated it – ranging from the use of hallucinogens to the display of impressive shamanic techniques* (as described by Witzel 2011). The *external illustration* of *visions* acquired during *culturally-induced hallucinations* is very different from the *experiences acquired* in a *naturally defocused mental state*. The illustration of defocused experiences characterizes Bushman trance, while the illustration of culturally-biased visions is a peculiarity of Upper Paleolithic 'shamanism.' Both techniques employ *illustration* as the means for externalization, but the experiences of 'natural trance' are shared and are in the service of the community (Dowson 1994). Moreover, given that a large segment of the population is made up of 'shamans,' (ibid., Deacon and Dowson 1996; Lewis-Williams 1988) those who experience 'visions' are not treated differently. Furthermore, leveling mechanisms (Woodburn 1982) see to it that prestige and power cannot be accumulated. In contrast, the 'special' faculties of Magdalenian shamans become means of accumulating prestige and status, ritual specialists become set apart and serve as role models who also initiate novices – here we recognize cultural transmission based on biases listed by Henrich and McElreath (2003).

Shamans become ritual *specialists* and monopolize ritual, which becomes their 'field' (which leads us, again, back to Ellul: the first *division of labor*[10] following the first *technique*, namely, 'art.'

Spikins et al. (2018), in their article titled '*Autistic traits in European Upper Paleolithic Art,*' suggest that *local processing bias* played a role in the execution of the Chauvet, Lascaux and Altamira paintings. Unfortunately, like many other researchers, they do not differentiate between *Aurignacian paleoart* and the much

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[10] Not to be confused with the biological division of labor based on gender – at this stage, biology and 'natural' inclinations are already *mystified* and *suppressed* categories that belong to the subconscious and to the taboo (for a discussion see Steiner 2018).

later *Magdalenian art*. Their observations cannot be generalized and applied to the entire spectrum of Upper Paleolithic cognitive manifestations in the Franco-Cantabrian region, but must be restricted to the Aurignacian stage in which, indeed, *child-like 'undomesticated' abilities* (cf. Benítez-Burraco et al. 2016) were applied. However, 'undomesticated' in Aurignacian contexts is very different from what Spikins or Benítez-Burraco call 'autistic traits,' or what Henrich and McElreath (2003) identify as 'non-conformist biases.' The designations may be applied only to art-like productions in contemporary settings in which they acquire negative connotations and are perceived as 'aberrations' from the prevalent psychological and/or cultural norms. Having this in mind, Spikins' assumption may be re-worded as *undomesticated traits in rock art* – not only in the cave art of the European Aurignacian, but also in the rock art of 'natural' people. While, in the European example, only children display such abilities, 'undomesticated traits' were successfully retained by adults in egalitarian societies. As for Lascaux and Altamira, the interpretations that emphasize the role of schizophrenic, i.e., 'domesticated' traits in their execution are, apparently, well grounded.

### *8.5 The Age of Exograms*

The cognitive ability described by Marshall (1969), Lee (1968, 1979), Biesele (1978) Katz (1982), Lewis-Williams (1988) and Dowson (1994), namely, to enter trance at will – still observed with one third of the women and half of the men in any Kalahari Bushman camp in the 1950s and 1960s – must not be perceived as reflecting a loss from, say, a situation in which a higher percentage of people were able to shift the contextual focus to its associative end at will. I would suggest that the faculty was a development entailed in vertical cultural evolution, i.e., a heightening of the 'cognitive ceiling,' as opposed to its narrowing in cumulative (horizotal) cultural contexts (*Figs. 4*, *7*). The psychological side-effects of neoteny must have been directly responsible for the acquisition of such cognitive abilities. The perceptions of the 'savage mind' in anthropological and ethnographical works of the 19th century point similarly to a less restricted operational range of the contextual focus. The 'childish' cognitive capacities of natural people in which, cause and effect were randomly sequenced, enabled the simultaneous and conscious experience of 'worlds' behaving according to different causal probabilities (Low 2004). The risk of losing such a cognitive achievement was managed by sharing such associative experiences with those who could not access them, with the help of egalitarian communal ritual.

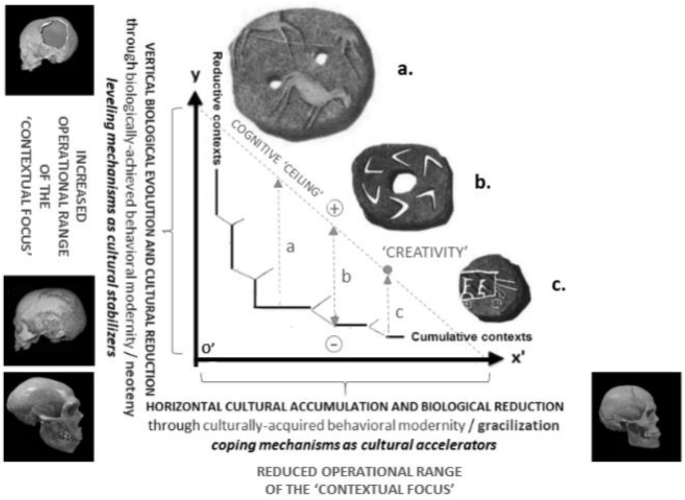

*Fig. 7* – a. *A Bushman healer's two-holed pebble (the shaman enters and leaves the spirit world naturally, whenever he/she wants to).* b. *A Bantu witchdoctor's one-holed stone (the sorcerer has access to the spirit world but he cannot escape it and becomes mad).* c. *An unperforated Boer pebble (the preacher is unable to enter the spirit world, he can only ideate it). From a painting by Pippa Skotnes (For //Kunn, 1993). The terms Bushman, Bantu and Boer are not meant pejoratively: the designations are borrowed from 19th century sources used in the explanation of the painting (Groenwald 2008).*

Conversely, in cumulative cultural orientations, the cognitive rigidity which was the aftermath of specialization to a specific causal probability, resulted in the inevitable narrowing of the 'cognitive ceiling' and the loss of the ability to 'escape' the causal order that governs the cultural niche. *Creativity* was the *technique* recurred to in order to access different causal dimensions, as described in the previous section. However, the 'alternate reality' that was created could not escape the causal stencil to which cognitive functioning became reduced and, instead of accommodating contradictory causal sequences, the ideated models of reality became mere extensions of our own.

In *Fig. 7* (above) I have inserted three images from a painting by Pippa Skotnes (see Groenwald 2008 and explanations therein) which illustrate the differences between the vertical (a), median (b) and horizontal (c) cognitive possibilities and limitations, as a function of the ability to shift the contextual focus to its associative end. Notice the two wheels depicted on the Boer pebble (c) and how they are substituted for the two holes of the Bushman stone (a). While the Bushman has a natural ability to converge/diverge the contextual focus to its both ends (the two holes), the ability of the Boer is blocked in the convergent end, i.e., stuck in a single causal model of reality. Technological 'innovation' (the two wheels) compensate for the cognitive loss.

Cognition becomes culturally-extended on the horizontal, with an accent on technologically-acquired, stored and accessed information. Information is causally sequenced according to prevalent cultural trends and perceived as 'knowledge.' Instruments must be developed in order to access information and external storage capacity must also be technologically-expanded. Social learning becomes, similarly, based on the transmission of technological know-how to access information and of the techniques devised for that (*Fig. 8*, below).

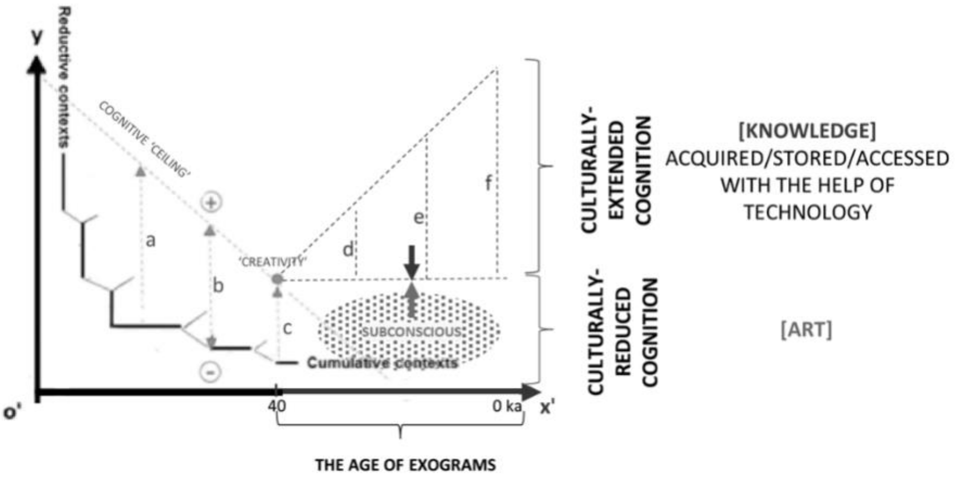

*Fig. 8 – The artificially-extended 'cognition' that relies on the technological compensation of cognitive losses.*

Knowledge, in such cases, is not acquired in a zoomed-out associative mental state, but by an additional zoom-in which can be effectuated only with instruments that complement our senses. Our technologically-extended senses register only physical phenomena that can be detected by instruments devised in order to model additional aspects of the same causal reality. Divergent mental states – art, religious fervor, meditation, the use of hallucinogenes – are, likewise, mere buffering techniques, *sensu* Ellul (1964). The 'alternate' aspects of reality acquired with the help of such techniques cannot be experienced consciously and thus, they remain phenomenal perceptions 'banished' by the cultural 'self' to a psychological dimension known as the *subconscious* – which, itself, is a cultural product that reaches its maximal elaboration in advanced stages of self-domestication.[11]

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[11] I have dedicated an entire volume to the psychological mechanisms involved in cultural conditioning and the limitations of the creative process within an elaborate cultural niche (Steiner 2018).

## CONCLUSIONS

The Middle/Upper Paleolithic transition is still perceived in mainstream paleoanthropology and archaeology as the period when a ‘standard’ of anatomical, behavioral and cognitive ‘modernity’ was suddenly reached. Since then, it is assumed that only cultural evolution defines the human condition. Unfortunately, most models of cultural evolution strive to conform to this prevalent understanding. However, gene-culture coevolution theory recognizes the obvious fact that for the last 50,000 years cultural evolution had a marked impact on our anatomy, behavior and cognition. Moreover, far-reaching genetic changes were also detected, especially since the Neolithic ‘revolution.’ The influence of the climatic fluctuations and environmental instability of the Late Pleistocene on the trajectory of cultural evolution is also considered in the model. Niche construction theory augments the picture by placing the cultural process within a conceptual space that, in its turn, attracts adaptation to its realities and thus affects anatomical, behavioral and cognitive changes. At first sight, the two complementary theories seem to be the ‘ultimate word’ on culture. Indeed, if only the cumulative type of cultural evolution is considered, the tenets of the theories model perfectly the mechanism and dynamics of the transformations that characterize the last 50 millennia of human evolution. But, unfortunately, gene-culture coevolution starts with the presumption that technological innovation is the index of cultural change and that the ‘ratcheting’ of innovations becomes the main ‘goal’ of cultural evolution. This is accomplished by developing a certain degree of social complexity in which social learning and the copying of cultural models – favored in cultural selection because of their skills, success and prestige – become the main engines of *cumulative cultural evolution*. Small and isolated populations are, *a priori*, perceived as ‘doomed.’ Innovations cannot be ratcheted in isolation and the ‘treadmill model’ takes effect, in which the lack of demographic strength results in impaired social learning, loss and infidelity in copying, and the absence of cultural models.

Contrary to the model proposed by gene-culture coevolution theory, the anthropological literature documents small and isolated groups that have developed intricate social networking systems that are not necessarily based on technological exchange and function only in low demographic settings, which is their very strength. Not only that the parameters upon which biased cultural transmission is based in cumulative cultural evolution – prestige, skills, success – are absent, but certain ‘leveling mechanisms’ take care that such parameters become inhibited and thus, no cultural models can rise to prominence. These societies do not seem to be plagued by cultural ‘loss’ and, instead of hopelessly running the treadmill, they have developed egalitarian and, to an extent, ‘affluent’ societies. Minimal technological elaboration, small and flexible group size and the lack of the obsessive preoccupation with the future are some of the characteristics of these *generalized* immediate-return hunters and gatherers. The cultural evolution of such small and isolated groups does not rely on accumulation but, curiously, on ‘reduction.’ Obviously, the Batek Negritos of Malaysia, the Mbuti Pygmies of the African rainforest, the !Kung San of the Kalahari, and the Sandawe and Hadza of East Africa do not obey to the rules of gene-culture coevolution, or dual inheritance theory (DIT).

The postulates of the theory introduce a paradox when the cultural evolution of these populations is studied. If the onset of cumulative cultural evolution is dated to and equated with Late Pleistocene ‘modernity’ and presented as the ‘natural choice’ of ‘moderns,’ then populations that do not follow such a model are either in a pre-modern state or vulnerable to cultural ‘loss’ through the ‘treadmill effect.’

Hence, the problem of this fabled ‘modernity’ must be approached and reconsidered. Modernity has three dimensions, namely: anatomical, cognitive and behavioral (the ‘ABC of modernity’):

(i) *Anatomical modernity* is a late phenomenon which was apparently not achieved until the Gravettian in Europe and not until the Holocene in southern Africa. From the time of the emergence of *H. sapiens* and until the abovementioned dates, robust archaic *sapiens* seems to have dominated the demographical map of the Old World.

(ii) *Behavioral modernity* is apparently a function of a biological process known as neoteny. Hominin evolution seems to have been determined by neotenous processes. Neoteny manifests itself in its a) *physiological aspects* (child-like, ‘pedomorphic’ appearance/the retention of juvenile traits in adulthood/a globular braincase/bulging forehead, etc.), but also in its b) *psychological side-effects* (curiosity/playfulness/ creativity/sociability/reduced aggressiveness and hierarchy).

The importance of psychological neoteny lies mostly in the reduction of hierarchical traits, which was also observed with bonobos, a neotenized chimpanzee. The behavior of the peaceful and social bonobos is radically different from that of the aggressive and hierarchically-organized chimpanzees.

(iii) *Cognitive modernity* did not arrive as a 'big bang' or a sudden 'enlightenment' during the Upper Paleolithic but it was, apparently, a Middle Paleolithic phenomenon that coincided with a) marked *encephalization*; b) the ability to shift at will the *contextual focus* between associative and analytic mental states; c) the emergence of the ability to switch between *systematic* and *trance tracking*; d) the complementary use of *mimetic skills* and *proto-language*; e) a surge in *exogrammatic representation* and f) *ritual behavior*, which is the simultaneous and complementary application of all the aforementioned abilities, in a causally-prescribed and culturally-transmitted sequence.

During the Late Pleistocene, a cognitively modern, but anatomically and behaviorally still archaic *H. sapiens* populated the continents of the Old World and Australia. Cognitively, all these populations had similar abilities whereas, anatomically, they seem to have displayed similarily robust features. Behaviorally, these robusts were likely more hierarchically-organized and more aggressively-behaving than later Holocene populations.

In this paper, I have broached only the diametrically-opposed examples mentioned above: anatomically rugged, cognitively specialized and behaviorally trans-egalitarian populations following cumulative cultural orientations vs. anatomically pedomorphic, cognitively flexible and behaviorally egalitarian populations that follow a reductive path in cultural evolution.

I have illustrated the development of these traits by tracing a set of coordinates which place hominin biological evolution within a field defined by a vertical (o-y) and an horizontal (o-x) axis. In the biological field, vertical tendencies are dominated by the retention of a state of 'sufficient harmony' with the environment, which is accomplished through the reduction of specialized features, neoteny, and adaptive flexibility, whereas the horizontal axis is dominated by tendencies toward the attainment of a state of 'perfect harmony' with the environment, which leads to the cumulative acquisition of specialized features and adaptive rigidity.

On the o-y coordinate – which is obviously that which has exercised most influence on hominin evolution – biological change appears to be always a step ahead of cultural elaboration. The latter may be simplistically understood as a sort of 'compensation' for the biological reductions that characterize vertical evolution. Culture also accommodates behavioral changes that occur as a result of biological reductions, i.e., the psychological side-effects of neoteny: sociability, curiosity, playfulness. Cognitive modernity was apparently a biologically-developed trait and the abovementioned 'ritual behavior' its immediate cultural aftermath. However, ritual behavior cannot be classified as a purely cultural phenomenon and, because the etiology of its components is rooted in biology, I have suggested that its emergence still represents a dot on a continuous biological-cultural line. The origin of the differentiations listed above must therefore be sought in culture. In order to follow developments in a markedly cultural setting, I have rotated the biological coordinates 90 degrees clockwise, and in the complementary cultural field thus obtained, the vertical o'-y coordinate represents the continuation of the biological-cultural line, whereas the o'-x' vertical axis represents a novel cultural-biological trajectory. The same tendencies toward specialization and generalization and similar mechanisms of accumulation vs. reduction characterize the cultural field. However, on the vertical, *culture adapts to biology* and the biological-cultural continuum is not disturbed whereas, on the horizontal, *biology adapts to culture* – and, therefore, the evolutionary line is primarily cultural and biological developments are only shortcuts meant to catch up with and adapt to the inflated rate of cultural change. In such a scenario, biologically maladaptive, but culturally beneficial traits may appear and be selected for.

It would be convenient to conclude that cumulative and reductive cultural orientations parted paths at the specific moment when our biological evolution came to a halt and cultural evolution took off, but this would be a very rash and therefore, simplistic conclusion. Given the still marked continuum between biology and culture on the vertical, and its obvious absence on the horizontal, I have suggested that cumulative cultural evolution commenced as a punctuated 'sudden jump' long before a gradual transition to reductive orientations on the vertical, in which a late cultural re-orientation was apparently preceded by a biological punctuation. Because the *cultural leap* was effectuated at the very moment at which it was cognitively possible – i.e., at an advanced vertical level in the biological field – and because the compensatory character of the constructed niche encouraged traits that could become biologically maladaptive, I have floated the idea that this cultural sudden jump was taken 'before time,' at a moment when we were still not 'ready' for it, from an anatomical and behavioral point of view. To fully grasp the implications of this suggestion, reductive orientations – in which, conversely, cultural steps were taken only at a stage of morphological 'readiness' – were followed. Relying on southern African data relating the prehistory of the San – which seems to apply to all immediate-return and egalitarian contexts – one can notice that the divergence of the reductive and cumulative orientations did not occur from a 'common cultural ancestor' 60 to 40 ka ago. Interestingly, 12 millennia ago, the ancestors of modern pedomorphic egalitarian hunters and gatherers were still displaying markedly robust characteristics, with the notable exception of cranial morphology, in which neotenous developments may already be observed. Thus, the psychological traits granted by neoteny must have become crystalized during this period. These traits came to expression in the strategies adopted to overcome the severe environmental changes brought about by the Last Glacial Maximum. As it can be inferred from the archaeological record, groups isolated in the arid interior of southern Africa developed the Interior Wilton industry, which is almost identical with the technological traditions of modern Bushmen. Curiously, this industry has developed from a delayed-return background, which means that immediate-return strategies should be seen as a cultural reduction, and not as an ancestral condition of 'sophisticated' delayed-return economies. Behaviorally, the still robust ancestors of the San were likely more aggressive and hierarchical than their gentle descendants but, cognitively, they must have been more flexible than their European contemporaries, who were specializing to their own cultural constructs for over 50 millennia.

The fundamental difference between European and southern African developments was that – unlike in Europe – the environmental stress of the LGM was not compensated for with cultural elaboration, but a biological response was adopted. This could happen only at a moment when the terminal Pleistocene neotenal event mentioned above – which was missed out by already heavily-gracilizing Europeans at that time – made these populations 'ready' to undertake a reductive cultural step: a return to 'primitive' immediate-return subsistence strategies. This was likely followed by the full expression of the cranial developments of the Late Pleistocene, and a neotenal leap effectuated 'in due time' seems to have occurred. The psychological implications of this leap became manifested in behavior, like reduced levels of competiveness, aggressiveness and hierarchy: egalitarianism was developed, and its values were *stabilized* not according to the ratcheting techniques postulated by gene-culture coevolution theoreticians, but by developing 'leveling mechanisms.' These are already cultural products, just like the egalitarian societies that are regulated by them. The role fulfilled by leveling mechanisms in culture is reminiscent of that played by neoteny in biology and, therefore, I have identified them as 'cultural neoteny.' Cultural neoteny inhibits the development and accumulation of power and prestige and it also reduces the possibility of people serving as cultural models, because of the egalitarian distribution of – and the egalitarian access to – skills, resources, knowledge and experiences acquired in trance-like mental states. In such a cultural configuration, the 'holy cows' of DIT become irrelevant. The treadmill effect becomes countered by the very flexibility that characterizes these populations: small and mobile groups that may be joined and left without social commitments, the dispersal of such groups over vast territories and the constant exchange of knowledge and innovations through regional gift-exchange networks.

By comparing the biological-cultural continuum displayed by these Holocene immediate-return, technologically backward, but socially egalitarian cultures to the artificiality of the cumulative, technologically elaborate, but trans-egalitarian type of culture that has commenced at the MP/UP transition and became ratcheted during the LGM, one will inevitably notice that the former is a natural extension of the hominin evolutionary line, whereas the latter is an early split that has assumed an exclusively cultural dimension within which maladaptive breeding preferences and cognitive specialization occur. *Cultural heterochrony* seems to be at play here, i.e., a *displacement in the timing of cultural evolution*. Certain populations apparently developed first the biological base that granted the behavioral traits upon which a novel social organization became elaborated, tens of millennia after the 'sudden jump' into the cultural field effectuated by the anatomically and behaviorally still archaic ancestors of populations whose present anatomy, behavior and cognitive peculiarities are the products of cumulative cultural evolution and self-domestication.

The conclusions of this paper should not be seen as contradicting but, rather, as complementing the tenets of dual inheritance theory which only seem to cover half of the spectrum of cultural evolution. On one hand, DIT (gene-culture coevolution theory) strives to project the mechanisms of biological evolution on culture but, on the other hand, it ignores the decisive role that neoteny seems to have played in our biological evolution. Therefore, any theory of cultural evolution that does not include neoteny as a component is incomplete. In this paper, I have attempted to correct this shortcoming by showing that neoteny has a cultural extension that should be acknowledged and added to the variables upon which the equations of gene-culture coevolution theory are constructed.

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