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Original Synthesis Article

Exceptions to the rule? Ethnographic alternatives to cumulative cultural evolution

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Abstract – In suggesting that the rules that govern the evolution of cumulative culture are observed in all modern societies, gene-culture coevolution theory implies that the biases that affect the successful 'ratcheting' and efficient transmission of innovations are cross-cultural universals. In the modeling of the theory the stress is placed on demographic strength, the absence of which would render small and isolated populations vulnerable to the 'treadmill effect', the inevitable consequence of impaired social learning. However, the ethnographic literature documents small groups of isolated hunters and gatherers who have devised intricate risk-reduction networks that do not necessarily proliferate technological innovations and function only in low demographic settings. Moreover, with merit and abilities being equally distributed, the model-based and conformist biases that influence social learning in gene-culture coevolution theory become irrelevant and elaborate 'leveling mechanisms' inhibit the acquisition of status and prestige. As a result, no cultural models can rise to prominence and sway the trajectory of cultural change. 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. The model forwarded in this paper resolves this apparent paradox by enrolling the hypothesis of 'cultural neoteny'. It is contended that egalitarian societies – despite their simple (immediate-return) mode of subsistence – are not the vestiges of an ancestral/universal stage from which more complex (delayed-return) economies would linearly evolve, but a relatively recent and idiosyncratic achievement through 'subtractive cultural evolution'.

Keywords**:** anarchic theory in ethnography, cultural heterochrony, cumulative/subtractive cultural evolution, immediate-return/egalitarian societies, ratcheting/leveling mechanisms.

Introduction

Recent inquiries into the origin of human-specific culture and its evolution adopt, almost unanimously, the framework outlined in dual inheritance theory (DIT, also known as gene-culture coevolution theory, or biocultural evolution – for a comprehensive description see McElreath and Henrich 2007). The analytical models of the theory were successfully tested and widely applied in the understanding of the underlying mechanisms that drive cultures ranging from hunter-gatherer traditions to intricate contemporary configurations. Unfortunately, the modelings construe modern cultural developments as the inevitable outcome of a cumulative cultural evolutionary process and, albeit inadvertently, a simple-to-complex Eurocentric bias spoils the otherwise elegant theoretical construct. As in other endeavors that study our deep past, the available evidence is often misleading and phenomena that cannot be detected in archaeologically preserved artifacts are ignored in the variables that inform the analytical models applied in the reconstruction of our species' cultural trajectory. Extended periods that do not yield artifacts pointing to technological innovation are perceived as culturally stagnant intervals. The Acheulian is perhaps the best example: from a strictly technological perspective it is, undoubtedly, a period of cultural stasis (Anghelinu 2014). However, on the cognitive plane, this apparently stagnant interlude was one of the most dynamic phases in hominin cognitive evolution. The emergence of recursive memory (Donald 1991) and the development of mimetic cultural transmission based on social learning (*ibid*., Shipton and Nielsen 2015) enabled, in their turn, a culturally orchestrated mnemonic convergence (Coman *et al.* 2016) which, ultimately, defined human-specific consciousness (Steiner 2020). Although the esthetically pleasing Acheulian bifaces that display conscious intentionality in their execution may suggest an underlying cognitive sophistication, the sequence of the far-reaching non-material cultural innovations listed above could be reconstructed only by relying on the dedicated work of cognitive archaeologists. However, even their pioneering endeavor is constrained by the scarceness of material remains. Fortunately, *exograms*, defined by Robert Bednarik (2014) as "memory traces stored outside the brain," offer a window into the mind of *Homo erectus*, the first hominin mark-maker. Although their antiquity was initially met with skepticism, universally occurring cupules and geometric patterns carved in rock and the presence of Acheulian bifaces on three continents denote already well-established cultural transmission techniques and point to the existence of effective social learning and networking in

a period that, according to dual inheritance theoreticians, was characterized by cultural stasis and loss. For fairness' sake, and as Shipton and Nielsen (2015) also cogently point out, the Acheulian does not qualify for what gene-culture coevolution theory defines as *cumulative* culture. Yet, the longevity and success of Acheulian technology question the rules of a theory according to which, the far-reaching cognitive achievements of this technologically stable period should have been lost to the 'treadmill effect', the backward motion of which is caused by errors in copying and in cultural transmission (Henrich 2004).

The same question must be posed in our interpretation of the long stasis observed in the material culture of several modern hunters and gatherers. Unfortunately, their descendants survive only as marginalized, encapsulated (Woodburn 1988) and acculturated shadows of their former selves. However, ethnographic reports from the 19th century (republished by Dowson 1993, 1994; Low 2004 – to mention only a few) and anthropological studies from the second half of the 20th century (a comprehensive review of which is offered by Barnard for southern Africa [2007] and Endicott [2013] for South East Asia) offer insights into the recent past of foragers and document their non-material culture. Reading these accounts, one is struck by the rich mental, social, and spiritual traditions of these communities.

The ancestors of the hunter-gatherer societies on which this paper will focus have lived in small and isolated bands scattered across remote and inhospitable landscapes, for more than ten millennia (Morris 2002, Stynder *et al.* 2007). The technology they were using when first contacted by outsiders remained at a level of *sufficiency* that was achieved, all over the world, during the terminal Pleistocene. In some cases, techniques that were known to have been previously mastered were lost, as in the predictions of DIT. In other cases, as I will argue later, relatively elaborate subsistence strategies became reverted to simpler ones. My explanation of such *conscious cultural reductions* contradicts the reasoning offered by gene-culture coevolution theoreticians. My arguments are supported by Andersson's and Read's (2016) critique of the mathematical models that link efficient social learning to group size, most notably Joseph Henrich's (2004) already mentioned 'treadmill effect'. However, the argument will be restricted to the specific case of hunters and gatherers who are the 'exceptions to the rule' and not generalized, given that Henrich's formula was successfully tested in analytical models

that explain the cultural evolution of most hunter-gatherer societies in which model-based and conformist biases (Henrich and McElreath 2003) are observed.

Another flaw in the theory is that, although gene-culture coevolution claims that culture evolves through a Darwinian selection process (e.g., Richerson and Boyd 2000, 2005), a crucial peculiarity of hominin biological evolution – namely, *pedomorphosis* (Gould 1982), is utterly ignored. Although not unanimously incorporated in mainstream evolutionary models, the role of *neoteny* in what made us human is increasingly gaining traction in paleoanthropological, psychological, and cultural studies (Ashley-Montagu 1989, Winnicott 1971, Gould 1982, Bjorklund 1997, Charlton 2006, Bednarik 2008, Steiner 2017, 2019). With its key role in our biological and cognitive evolution, neoteny must also be accommodated in theories that follow the evolution of human-specific culture. In this paper, I will attempt to correct this short coming by dedicating an entire section to 'cultural neoteny', one of the three possible manifestations of *cultural heterochrony*, the rudimental framework of which I have sketched elsewhere (Steiner 2017). A unified *biocultural* approach will be adopted, which will offer a novel understanding of the unique developmental processes that enabled the emergence of egalitarian societies. This takes us back to the abovementioned hunter-gatherer societies which, although genetically unrelated, share markedly neotenous physical traits like, short stature, globular braincase and reduced body hair, to name only a few (Hulse 1962, Ashley-Montagu 1989, McKinney and McNamara 1991) and, perhaps as a consequence of the psychological side-effects of neoteny (see below), egalitarian social structures (Dale *et al.* 2004, Steiner 2017).

It is often presumed that, as a rule, all hunters and gatherers live in egalitarian and peaceful social organizations. This is partly due to Rousseau's idealized perception of the 'noble savage' (see Cranston 1991), but also to the ambiguity of many anthropological texts that present hunters and gatherers as a homogenous cultural entity. Moreover, the same misconception has led to the impression that the mythical 'golden age' in which modern hunters and gatherers are 'stuck' is an ancestral cultural stage from which *all* modern social structures have incrementally evolved. However, as any anthropologist knows, hunter-gatherer societies span the entire anarchical – heterarchical – hierarchical social spectrum and display various degrees of internal and intergroup aggressiveness. In effect, only six societies that can be defined in every practical sense as 'harmless' (Marshall 1989) and egalitarian (Woodburn 1982) have been documented.

Out of these, the Mbuti Pygmies of the Congo (Turnbull 1965), the !Kung (Ju/'hoansi) Bushmen (San) of southern Africa (Marshall 1976, Lee and DeVore 1976, Lee 1979), the Batek Negritos of South East Asia (Endicott 1974) and the Hadza of East Africa (Woodburn 1968, 1970, 1972) were studied in a manner that is comprehensive enough for the scope of this paper. Although the Sandawe of Tanzania (Ten Raa 1969) and the Palyan hunters-gatherers of South India (Gardner 1980) are usually included in the short list of egalitarian societies, the available literature – although concurring on the main commonalities with the four classic examples – does not cover every aspect of their lifestyle.

Despite living in small mobile bands dispersed over remote and inhospitable areas, these hunters and gatherers have devised intricate social networks that are not necessarily meant to entrench or proliferate technological innovation but, rather, to cement ties based on non-committal mutualism (Wiessner 1977) and keep at bay the danger of social entanglement (Hodder 2012). Beside their commonly shared 'pedomorphic' (neotenous) features, these hunters and gatherers also display high degrees of cognitive flexibility, which becomes manifest not only in their idiosyncratic and unorthodox religious belief and practice (Lewis-Williams 1988, Marshall 1989, Dowson 1994, Chidester *et al.* 1997, Low 2004), but also in their 'childish' and life-affirming attitudes in everyday life – e.g., curiosity, playfulness, affection, sense of fairness, sociability, and an innate desire to learn and cooperate (for a full discussion of the psychological dimension of neoteny, see the seminal work of Charlton 2006).

The leveling mechanisms that make egalitarianism possible (as observed and listed by Woodburn 1982) seem to derive from such psychological traits and they are the exact opposites of the mechanisms that encourage cumulative culture (as enumerated by Henrich and McElreath 2003). The only common denominator of these mechanisms is, that they both focus on skill, prestige, success, and conformism. However, instead of selecting for cultural models who stockpile merit, as in cumulative culture, egalitarian societies – in which skills are, more or less, equally distributed–hoarding success and prestige is not only ridiculed, but also consciously inhibited and ostracized. The similarity biases addressed in gene-culture coevolution are also antithetical to the non-conformist attitudes that dominate egalitarianism (Morris 1985, Layton 2006) and thus, another dichotomy in the evolution of cumulative vs. 'subtractive' cultures becomes discernible. Hence, no leaders or privileged individuals can rise to prominence

and sway the trajectory of cultural evolution. Woodburn (1982) suggests that, under such circumstances, political change and any form of economic intensification become inhibited and egalitarianism can only flourish in a stable and unspecialized *immediate-return* economy, which is another commonly shared trait of these societies – and, specific only to them.

The values and ideology outlined above are, to an extent, echoed in the tenets of a novel approach to cultural evolution that seeks the application of anarchic theory in archaeology and ethnography. 'Anarchaeology' is defined as the study of how people throughout history have progressed and thrived with limited government or with no government at all (Sanger 2017, Angelbeck *et al.* 2018). More specifically, anarchic theory in the study of hunters-gatherers discusses the underlying philosophies that inform a view of the world in which equality of power is seen as critical and alienation as antithetical to human happiness. Matthew Sanger (*ibid*.) calls for studying the techniques conducive to power equality with the same enthusiasm as we study the 'evolution' of inequality. This paper is, to an extent, an answer to Sanger's challenge.

In the forthcoming discourse, I will address and consider various evolutionary, anthropological, ethnographic, and methodological lines of reasoning that will help resolve and accommodate the paradox outlined in the introduction in a novel multidisciplinary synthesis. In the first section, the principal tenets of gene-culture coevolution theory will be debated, with a focus on the transmission biases that affect social learning and thus, play a key role in the specific trajectory of cumulative culture. This will be followed by a consideration of the arguments that question the importance of the demographic component of the theory and the ubiquity of the mathematical models that predict cultural loss in low demographic settings. Next, a perspective that advocates for the application of anarchic theory in ethnography will be adopted in a review of egalitarian hunters and gatherers. Their apparent disregard of the rules that govern the evolution of cumulative culture will also be addressed. An entire section will be devoted to ethnographically documented leveling mechanisms conducive to egalitarianism and the similarities and disparities between these and the ratcheting mechanisms that drive cumulative cultural evolution. This will be followed by a discussion of the physiological and psychological dimensions of neoteny, which will inform an inquiry into the origins of egalitarian societies, meant to dispel some prevalent misconceptions about their antiquity and rapport to more elaborate forms of social and economic organization. A

final synthesis will attempt to accommodate heterochronic processes in cultural evolution in general and in the development of egalitarian societies in particular.

Gene-culture coevolution and niche construction

The postulates and analytical models of dual inheritance theory (DIT, also known as gene-culture coevolution, or biocultural evolution) have become, since their formulation in the 1980s (Boyd and Richerson 1985), the most widely accepted and frequently applied approaches to cultural evolution. One of the theory's central claims is that culture evolves partly through a Darwinian selection process, which is often described by analogy to genetic evolution (*ibid*., Richerson and Boyd 2000, 2005). 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.

The formulation enlarges standard evolutionary theory, which 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. Hence, cultural diversity is believed to reflect variations in the environments that different human populations evolved in, and nothing else. Standard evolution theory also overlooks the fact that humans can modify their selective environments through cultural activity, thus feeding back to affect selection. This is the basic postulate of niche construction theory (NCT), as summarized by Odling-Smee (2003). NCT complements the basic tenets of DIT (dual inheritance theory) and both recognize that certain cultural environments have completely eliminated the natural component and, as a result, there is an inherent risk of selecting for maladaptive traits that only benefit survival in the specific cultural environment, but may affect negatively biological fitness. According to Odling-Smee (*ibid*.), and concurring with DIT, 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.

In this general context, culture is defined as behavior acquired through social learning (Boyd and Richerson 1985) and, in its turn, social learning is understood as the ability for copying behaviors observed in others or, acquiring behaviors through being taught by others. Analytical models show that social learning becomes adaptively bene-

ficial when the cultural environment changes with enough frequency for the genetic inheritance not to be able to track the changes. Therefore, social learning can *accelerate* learning beyond that of individual abilities (Marriott *et al.* 2010) and, when *effective*, it may initiate cumulative cultural evolution (Whiten *et al.* 2011, Mesoudi *et al.* 2006, Henrich and McElreath 2003). Cumulative cultural evolution is an adaptive process in which each generation can make improvements on the learned information inherited from their parents' generation (Dean *et al.* 2014, Kempe *et al.* 2014), with each innovation building on and incorporating a long chain of previous innovations.

Michael Tomasello (1999) suggests that cumulative cultural evolution is the result of a 'ratchet effect' and it depends on creative invention and faithful social transmission. Conversely, Henrich's (2004) 'treadmill model' connects faithful social learning and transmission to group size and the existence of social networks, 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, which are the inevitable results of low demographic settings and isolation.

These formulations imply that demographic strength is a requirement that must be met before effective social learning may even be considered. Richerson and Boyd (2000) argue that the climatic changes and demographic realities during the Late Pleistocene may have provided the right environmental and social conditions for the onset of the cumulative dimension of culture. They have also defined and modeled several transmission biases that affect the adoption of specific innovations, depending on individual preferences (Boyd and Richerson 1985). The list has been refined over the years, especially by Henrich and McElreath (2003):

1. *Content* biases result from situations where some aspect of a cultural variant's content makes them more desirable to be adopted (McElreath and Henrich 2007). Content biases can result from genetically predetermined preferences, preferences determined by existing cultural values, or a combination of the two.

2. *Context* biases ensue from individuals using social clues to determine what cultural variants to adopt. The decision is made without reference to the content of the variant. There are two major categories of context biases: a) *model-based* and b) *frequency-dependent* biases:

   a) *Model-based* biases arise when an individual is inclined to choose a particular 'cultural model' to imitate. There are four major categories of model-based biases, namely, *prestige*, *skill*, *success*, and *similarity* biases:

- A *prestige* bias results when individuals are more likely to imitate cultural models who are perceived as having more prestige. A measure of prestige could be the amount of deference shown to a potential cultural model by other individuals.
- A *skill* bias ensues 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.
- A *success* bias derives 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).
- A *similarity* bias arises when individuals are more disposed to imitate cultural models who are perceived as being similar, based on specific traits.

b) *Frequency-dependent* biases appear when an individual is inclined to choose specific cultural variants based on their perceived frequency in the population. The two most explored frequency-dependent biases are the

- *conformity* bias, which evolves when individuals attempt to copy the mean or accepted cultural variant in the population, and the
- *non-conformity* bias, which arises when individuals preferentially choose cultural variants that are less common in the population. The non-conformity bias is also called a rarity, 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 than copying, the same potential biases apply to both, namely: s*uccess*, s*tatus*, *similarity*, and *conformist/non-conformist* biases.

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

The evolution of inequality

Although *content biases* are not as extensively discussed by DIT theoreticians as those relating to context, they deserve, nonetheless, a closer inspection. They ensue from situations in which certain aspects of a cultural variant's content, makes it more desirable to be adopted (McElreath and Henrich 2007). They are theorized to result either from genetically *predetermined* preferences, or choices *determined* by existing cultural values. *Group selection* plays a crucial role in how content biases influence social learning and, because of the conformist biases that direct the latter, it also becomes an important force

in cumulative cultural evolution. Hence, content biases – which reflect a cultural ethos – must be understood as being *a priori* incorporated in the texture of any cultural inheritance that is the outcome of cumulative processes. The nature of any novel cultural configuration that is the result of an extended period of choices affected by context biases– in accordance with the definition of cumulative culture – would incorporate the same biases, ratchet their outcome, and evolve toward fresh cultural configurations where they would become objective content biases. Hence, the longer the history of a cumulative culture, the stronger the influence of prestige, status, skills, and similarity biases that would shape the nature of future developments. For simplicity's sake, I will reduce this intricate causal nexus to the incentives that drive it and to which I will refer in this paper as 'ratcheting mechanisms'.

When individuals who accrue status and prestige serve as cultural models and become favored in cultural selection, the societies in which they thrive are, evidently, not egalitarian. Skills also become important in cultural configurations with a well-defined division of labor, where specialists do also build up prestige and status. The content biases that drive the development of such societies become increasingly hierarchical in nature and, since context biases support them, social differentiation and division of labor will intensify accordingly (and become part of the cultural ethos).

Because cumulative cultural evolution can be imagined only in such a context, content biases incorporating and encouraging hierarchical values must have already been firmly embedded in the texture of Late Pleistocene cultural inheritance which, according to Richerson and Boyd (2000), was the period when the social environment became complex enough for the onset and acceleration of cumulative culture. Although they refer to the Middle/Upper Paleolithic transition, starting at already 60,000 years ago, a patchwork of 'social memory units' becomes recognizable all over Europe (Richter 2000). Content biases accrued at the time would become entrenched during the Upper Paleolithic and, supported by context biases, 'evolve' toward increasingly hierarchic and specialized social organization.

The presence of cumulative culture can be easily detected in cases when development is measured by material innovations, as it seems to have been the case for Upper Paleolithic Western Eurasia. Barter and long-distance trade were likely influenced by preferences for skillfully executed tools and trinkets and must have also played a role in boosting replication and diffusing innovation. Let us not forget that the increasing

presence of shells, beads, and pendants already during the Middle Paleolithic (Bednarik 2003 and references therein), beside defining group identity – which already points to the existence of complex demographic realities – may also declare and advertise status (d'Errico *et al.* 2003). Although the impressive parietal and mobiliary art of the period may point to cognitive developments removed from prosaic material or technological concerns, Bryan Hayden (2003) has cogently pointed out that even such apparently non-material pastimes were likely pursued by 'awe-inspiring' ritual specialists, with an eye on gaining prestige and consolidating status, in the context of what he has suggestively defined as emergent 'trans-egalitarian societies' (*ibid*.).

Bearing in mind that DIT was devised to accommodate and model the causalities that drive cumulative cultures by ratcheting their hierarchical content and that, with the rate of cultural change becoming accelerated beyond the ability of the genetic heritage to keep up with it, within a complex cultural niche (as envisioned in NCT), cultural change rather *directs* a population's genetic evolution than *co-directs* it (as posited in DIT). By biasedly selecting for traits that only benefit survival in a specific cultural environment, the genetic heritage becomes altered by cultural demands (Cochran and Harpending 2009) and may result in biologically maladaptive outcomes (Odling-Smee 2003) that are reminiscent of the domestication syndrome (Bednarik 2008, Benítez-Burraco *et al.* 2017, Theofanopoulou *et al.* 2017, Steiner 2020). Therefore, I will refrain from using the terms 'biocultural' and 'gene-culture *co*-evolution' when referring to cumulative cultural trajectories, and I will instead settle for 'dual inheritance theory' – DIT. Nonetheless, the designations become appropriate in the case of less elaborate cultures that have, in effect, evolved in a *biological–cultural* continuum in which cultural changes did, indeed, *co-direct* genetic evolution in a *biocultural* feedback loop, which is in stark contrast to the *cultural–biological* discontinuum modeled by DIT theoreticians. I will return to this later.

Not by the treadmill alone

If hierarchy is an integral part of cumulative culture, it must be less 'evolved' – or absent – in societies that have a shorter history of cumulative cultural evolution or, in some cases, do not observe its rules. As the content biases that affect the contextual preferences of the latter reflect different values and attitudes from those that define the ethos of cumulative cultures, DIT cannot accommodate them in its theoretical frame-

work. Moreover, apparently intentional reductions in material culture were interpreted – by focusing only on the demographic weakness of these isolated societies and adopting the Darwinian denial of free will – as objective losses. The demographic factor is also invoked for explaining the absence or the slow rate of technological innovation.

Although the demography/complexity connection was first suggested by Shennan (2001), it is not his model that became famous, but that introduced by Henrich and Boyd (2002), which became more anthropologically contextualized in Joseph Henrich's (2004) 'treadmill model'. Henrich posits that the cultural transmission of skills requires imitation that is usually imperfect when only a limited number of a population masters the skills. His model suggests that a minimum population size and a basic level of social complexity and interaction with other similar groups are needed to ensure sufficient innovation to compensate for a constant drain due to errors in transmitting knowledge and skills[1]. He argues that 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. Henrich (*ibid*.) attempts to explain a major 'puzzle' in anthropology with the help of the treadmill model namely, the apparent cultural 'devolution' of Tasmanian Aboriginals during the Holocene. On the face of it, the Tasmanian case study appears to be ideal for testing the model, for two reasons. First, because of the assumption that a drastic drop in the number of potential imitators must have occurred when Tasmania became isolated from mainland Australia. Second, because the Tasmanian tool assemblage appears to have decreased in complexity. This was believed to be indicated by the disappearance of bone points used to make clothing prior to the rise in sea level around 8,000 years ago, when the ancestors of Tasmanians became isolated and, that at the time of contact with Europeans, they were not wearing clothing. Several convincing counterarguments to Henrich's use of the 'Tasmanian case' for the illustration of his treadmill model were listed by Read (2009) and Andersson and Read (2016 and references therein):

[1] This cannot be generalized and applied to small populations where skills are equally distributed and mastered by the majority. For example, almost all Kalahari Bushmen are versatile in the art and science of tracking (Liebenberg 2013), in a fairly similar degree. The skill is learned not only through mimicking, but also while playing, storytelling, and re-enacting the hunt. Tracking is not restricted to the time of the hunt, but also practiced as a favorite pastime, during leisure. Moreover, innovative tracking techniques cannot be invented, because after more than 10 millennia of constant practice the skill has reached a level of near-perfection. Although the smallpox epidemics of the 1950s decimated the already small population, the skills and knowledge of the survivors were not affected (*ibid*.).

- Despite claims to the contrary, the only documented loss of a tool is that of bone points.
- The bone points were not particularly sophisticated and were produced by using a simple technology that was easy to imitate.
- There is no evidence that the quality of the bone points declined after Tasmania was isolated.
- Lithic artifacts continually made by the Tasmanians were more complex than the bone points that were lost.
- There are environmental factors that explain why Tasmanians could have stopped making bone points and clothing. With but one exception, where the points may have been used for making nets, bone points only occur during extremely cold periods, when simple clothing was made in response to environmental conditions. After the climate substantially ameliorated at the end of the last Ice Age, the need for clothing diminished.
- The fact that the Tasmanians abandoned fishing, despite an abundance of fish in the surrounding waters, has also been put forward as evidence of maladaptive losses. This assessment is, however, not without problems. A study of the historical Tasmanian diet concluded that it was considerably in excess of protein and greatly deficient in carbohydrates. To make up for the shortage of plant carbohydrates, animal fat and bone marrow can be consumed. This may be the reason that sites prior to the Holocene have thousands of wallaby and wombat bones broken open to obtain the marrow. Another important source of carbohydrates was shellfish, exploited through historical times. The Tasmanians did not consider fish to be edible, likely due to the fact that fish were neither needed for protein nor as a source of carbohydrates; hence, the investment required to obtain fish may actually have been maladaptive.

However, as Andersson and Read (*ibid.*) remark, 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? Timothy Taylor, in his book *The Artificial Ape* (2010), makes the case that cultures can be expected to pursue either of two trajectories with respect to investment in technology. The first is the one that we tend to expect, where the functioning of the body is augmented by complex material technology. However, reliance on material technology also has the effect of *entangling* individuals in various requirements, such as obtaining and transporting raw materials, maintaining, and repairing tools and other 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 culture, 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 not based on the ratcheting of innovations for innovations' sake – as prescribed by DIT theoreticians – but rather on a degree of flexibility that allowed for the reduction of unnecessary technology following their isolation from mainland Australia. Despite living in isolation for 8 millennia, at the arrival of the Europeans they were healthy, happy, and well-fed, albeit in small numbers (Davidson and Roberts 2008). Unfortunately, by the time when modern anthropology took an interest in their peculiar mode of cultural evolution, the Tasmanians were already acculturated and on the brink of extinction.

The Andamanese were brought up by Henrich (2004) as another illustration of cultural loss due to small numbers and isolation. 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 the difference by assuming that unlike the Tasmanians, the Andamanese were "known to the outside world" and, therefore, not completely isolated. He enrolls genetic evidence in support of this suggestion. However, the genetics that he relies on is less convincing than that cited by the advocates of a substantially longer period of isolation (Thangaraj and Hagelberg 2003). Moreover, only because the Andamanese were 'known' to the outside world does not necessarily mean that they were also contacted: actual contact was made only during the second half of the 19th century with the Onge of Little Andaman (Portman 1899) and as late as the 1990s with the Jarawa (Kumar 2012). The Jarawa and Sentinelese were never studied in a scientific manner, and the latter are fiercely opposing any kind of contact, even today.

To sum up this lengthy discussion, the lack of technological and social elaboration displayed by the societies brought up to illustrate the treadmill model cannot be satisfactorily explained by applying Shennan's (2001) and Henrich's (2004) demography/complexity link. Having in mind Ian Hodder's (2010) remark that "reliance on material technology also has the effect of entangling individuals in various requirements," I would suggest that the values that permeate the content biases (McElreath and Henrich 2007) of (modern and contemporary) small and isolated groups, instead of being conducive to material and social entanglement do rather discourage them. Only simple and unspecialized economic contexts allow for a degree of material disentanglement that also inhibits the hoarding of merit and, ultimately, make egalitarianism possible (Woodburn 1982).

Isolation, in the case of small hunter-gatherer societies was not a cultural choice, but a consequence of objective environmental factors. Societies that became isolated and could not renounce unsustainable complexity – because of engrained beliefs or attitudes –would lose it to the treadmill effect. Conversely, cultures that were flexible enough to hone down obsolete material and social complexity to a level of *sufficiency*, would survive and go on evolving, even if not as predicted by the mathematical models of DIT. Fortunately, the mechanisms that have enabled the material and social disentanglement of the latter were documented in the ethnographic and anthropological literature of the 20th century.

Anarchic theory and the study of hunters-gatherers

Although largely absent in scientific inquiries, the question of the rapport and ideal balance between simplicity and sufficiency on one hand, and complexity and efficiency on the other, was extensively considered in the philosophical discourse on cultural evolution. Several philosophical anthropologists have concurred that, once a level of material sufficiency is achieved, any further technological development would become a cultural hypertrophy and result in deleterious physical and psychological adaptations to technological demands and in spiritually impoverished cultures (Ellul 1964, Mumford 1967, Fromm 1973, Shepard 1998, Zerzan 1999, Poenaru 2019). In anthropology, this hypothetical dichotomy became translated to a concrete simplicity/complexity polarity, where simplicity was often taken to be a pre-existing condition and a 'natural' state hardly worth investigating (although see Bettinger 2015). In line with this perception, the study of hunter-gatherers became dominated by questions regarding complexity (e.g., Arnold *et al.* 2016) and, as seen in the previous sections, dual inheritance theory has also adapted this restricting perspective that cannot accommodate modern and contemporary small-scale hunter-gatherer societies that, against all odds and mathematical predictions, did not 'devolve' as it would have been expected according to the complexity/demography nexus elaborated by Shennan (2001) and Henrich (2004).

An underrated anthropological contribution to the ongoing debate is Sahlins's *The Original Affluent Society*, an essay in a volume titled *Stone Age Economics* (1972). The book was overtly shunned by many of his peers because of its Marxist and, to an extent, anarchist slant. Sahlins has argued that with hunters-gatherers, people's material wants are easily satisfied and that they enjoy a "material plenty with a low standard of living."

In his book, he denounces the engrained anthropological disposition to exaggerate the economic inefficiency of hunters-gatherers in comparison with Neolithic economies. According to Sahlins, the simplest hunters-gatherers lived in a kind of material plenty because they adapted their livelihood to materials and resources that were sufficient for the needs of the population and which lay in abundance around them and free for anyone to take. They could always use more than they needed, and with this ease, they did not develop a tendency for hoarding. Therefore – and concurring with Marshall (1961), whom he cites extensively – there was no accumulation of objects that could be associated with property or status. He stresses that 'material plenty' depends both on the simplicity of technology and democracy of property. Products are homespun, and everybody possesses the skills to produce them. Hence, the division of labor is likewise simple, predominantly a division by gender. Because of the liberal customs of sharing, everybody can participate in what he calls "affluence without abundance." The mobile lifestyle makes wealth "grievously oppressive," and hunters-gatherers have devised various techniques that facilitate disentanglement from the burdens and commitments coming with material possession. Sahlins concludes that the hunter-gatherer, at least from our capitalistic perspective, is an "uneconomic man." He winds up his *Stone Age Economics* with the reflection that, although the world's most 'primitive' people have few possessions, they are not poor. Poverty, as Sahlins sees it, is not a certain small amount of goods, nor is it just a relation between means and ends but, above all, it is a relation between people. Poverty is a social status that has grown incrementally and in parallel with the evolution of complexity and the advent of civilization.

It does not come as a surprise that Sahlins' work was warmly embraced and often referred to by the acolytes of the anarcho-primitivist school. Unfortunately – with the notable exception of John Zerzan – it was also often misquoted in the faction's zeal to portray the lifestyle of the 'noble savage' as a viable alternative to the discontents of civilization.

Recently, several archaeologists have also posed pertinent questions about the underlying philosophies that inform a view of the world in which equality of power is seen as critical and alienation as antithetical to human happiness (Sanger 2017, Borck and Sanger 2017, Angelbeck *et al.* 2018). In their view, 'simplicity' – understood as balanced power relations – is rarely 'simple' but rather, an achievement. As such, simplicity should be an object of inquiry equivalent to the study of complexity, particularly

within the research of hunter-gatherers, whose societies are often described as egalitarian, balanced, or heterarchical. In other words, the study of power equality (simplicity) should be taken up with the same enthusiasm as the study of inequality (complexity). This will become possible only when it is recognized that simple social systems often require a great deal of energy to form and maintain. Although they have been warned against assuming that simplicity is a 'natural state' (Trigger 1990), archaeologists have typically taken for granted that egalitarianism arises with little or no effort. Anarchic theory, long ignored by academics, is particularly well suited to understanding simplicity and the mechanisms of balanced power systems, especially when applied to hunters-gatherers (Sanger 2017). As Matthew Sanger sees it, the lack of archaeological engagement with simplicity is surprising, given that there is a rich ethnographic literature, largely documenting hunter-gatherers, in which detailed accounts of balanced power systems are offered. These ethnographic accounts are brimming with descriptions of 'leveling mechanisms', like ostracism, public disgrace, and violence used to resist centralization of authority (Cashdan 1980, Woodburn 1982, Boehm 1993; 1999) and they also report community codes in which individual ownership over materials is quite tenuous, and 'demand-sharing' often occurs (Peterson 1993). From an archaeological point of view, anarchic theory holds great potential because it flips many engrained notions of human development and society on their head. As Sanger (2017) points out, archaeological chronologies are flush with terms that emphasize not only periods of transition, but also periods in which domination was at its peak: 'classical', 'formative', or 'climax' periods are typically identified as cultural 'golden ages'. Conversely, other periods are perceived as minor 'dark ages', characterized by cultural 'decline', 'devolution', or 'collapse'. Economic 'collapses' in which vertical power structures fail and societies revert to more simple configurations can be seen instead as the successful promotion of horizontal structures and the development of more equitable societies. Likewise, long periods of 'stasis' can instead be viewed as times marked by remarkable achievements in which balance was reached and preserved over generations. However, Sanger warns against advocating for social atomism, instead, he associates balanced power relations with strong but non-committal community relationships, pursued through voluntary forms of association and mutual agreement. Again, the ethnographic literature abounds with concrete examples of such non-committal social relationships (e.g., Wiessner 1977).

Obviously, the main objectives of this paper overlap with the ambitions of the archaeologists who advocate for the application of anarchic theory in their discipline. The following sections will introduce the ethnographic literature documenting the egalitarian hunters-gatherers fleetingly mentioned by Sanger (2017), with a special focus on their fractious rapport to the tenets of dual inheritance theory.

Egalitarian societies

Most anthropologists recognize a broad distinction between hunters-gatherers with elaborate social and economic systems and those who are technologically less sophisticated, but socially more egalitarian. They were also described as *generalized* and *specialized* (Price and Brown 1985), *egalitarian* and *non-egalitarian* (Woodburn 1982, Kelly 1995), or *immediate-return* and *delayed-return* hunter-gatherers (Woodburn 1970, 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). In contexts that are independent of economic considerations, I will also refer to IR HGs as *generalized* or *egalitarian*, mostly because of the engrained negative associations of the term 'immediate-return', which is often associated with a 'primitive' and 'inferior' 'natural state' (Trigger 1990).

Contrary to the widespread layman belief that most hunters-gatherers belong to this technologically less elaborate category, a surprisingly small number of HG societies can be defined in every practical sense as egalitarian (Cashdan 1980, Woodburn 1982, Kelly 1995). Out of these, only the Mbuti Pygmies of the Congo (Turnbull 1965), the !Kung (Ju/'hoansi) Bushmen (San) of southern Africa (Marshall 1976, Lee and DeVore 1976, Lee 1979), the Batek Negritos of South East Asia (Endicott 1974) and the Hadza of East Africa (Woodburn 1968, 1970, 1972) were documented in a rigorous and detailed manner. Although the Sandawe of Tanzania (Ten Raa 1969) and the Palyan hunters-gatherers of South India (Gardner 1980) are usually included in the short list of egalitarian societies, the available literature – although concurring on the main commonalities with the four classic examples – does not cover every aspect of their lifestyle. Several hypotheses were forwarded to explain the origin of immediate-return hunters and gatherers, ranging from social (Woodburn 1988, Hayden 1990, Hegmon 1991, Kelly 1991) to ecological theories (Binford 1980, Oyuela-Caycedo 1996). I will

return to these suggestions and discuss them at large toward the end of this paper, in the section dedicated to the antiquity of egalitarian societies. As for now, let us enumerate the main characteristics that set delayed- and immediate-return hunters-gatherers apart (Table 1).

In addition to the attributes listed in the table, Darla Dale *et al.* (2004) also mention *intentional avoidance of formal long-term binding commitments*, *relational autonomy in personal affairs*, *distributed decision-making* and *reverse dominance hierarchy* (as in Boehm 1993), as fundamental principles that define IR/egalitarian societies. That is, commitments, debts, and assertiveness, which are forms of social entanglement, are consciously avoided. Ritual and religious behaviors are also non-committal, which makes them very fluid and tolerant in character (Dowson 1994, Chidester *et al.* 1997, Low 2004). Moreover, a benign view of nature is dominant, which was phrased by Sahlins (1972) as "a trust in the abundance of nature's resources rather than despair at the inadequacy of human means."

Table 1 A comparison of the main attributes of delayed-return (DR) and immediate-return (IR) hunters and gatherers (HGs) (after Dale *et al.* 2004)

DR HGs	IR HGs
– large, less-mobile groups	– small, mobile groups
– ownership, incipient social stratification	– no property, egalitarian principles
– social systems oriented to future	– social systems oriented to present
– delays in return for labor invested	– immediate gratification from labor
– hoarding, storage, and delayed consumption	– no storage or hoarding, immediate consumption
– technological investment and elaboration	– low levels of technological investment and elaboration
– resource specialization	– generalized resource exploitation
– ownership rights over valued assets	– minimal ownership rights, sharing of valued assets
– planned strategies	– flexible, spontaneous activities
– conformist	– individualist, non-conformist
– more aggressive, warlike	– peaceful
– specialized ritual	– communal ritual

Storage is considered obsolete, "because through the entire year and with almost limitless generosity, nature puts all kinds of animals and plants on the path of the man who hunts and the woman who gathers" (*ibid.*). Paradoxically, IR societies are isolated in

harsh peripheries like deserts, draught-prone savannas, and impenetrable rainforests. However, they have a philosophy of under-exploiting resources (Lee 1969). Conversely, DR groups live in more abundant environments but doubt nature's providing capacities and tend to overexploit resources and supplement them by recurring to storage (Binford 1980 and, for a convincing mathematical model relating demographic density to environmental carrying capacity, see Read 2010).

Of course, it is easy to idealize the 'lifestyle' of immediate-return hunters-gatherers. Egalitarian societies are so unlike all others that it is difficult even for anthropologists who have not personally experienced one to conceive how they can exist; it is almost impossible for non-anthropologists to do so (Dale *et al.* 2004). Therefore, it is important to keep in mind that the main characteristics of IR societies, as briefly summarized in this section, are not based on romantic narratives like Rousseau's, but on the hard work of professional anthropologists who have spent the best years of their lives studying these 'simple' social systems that often require a great deal of energy to form and maintain.

Leveling vs. ratcheting mechanisms

James Woodburn is a leading anthropologist and theorist on egalitarian hunter-gatherer societies, and he has documented extensively both how these simple social systems were formed (1988) and how their egalitarian structures are maintained (1982). I will return to the origin of egalitarian societies in the final section, while here I will restrict myself to addressing the techniques that sustain egalitarianism.

As Woodburn explains, societies with economies based on immediate- rather than delayed-return, nurture their egalitarian social structure through (i) direct, individual access to resources, (ii) means of coercion and mobility which limit the imposition of control, (iii) procedures which prevent saving and accumulation and impose sharing, and (iv) mechanisms which allow goods to circulate without making people dependent upon one another. Hence, "people are systematically disengaged from property and therefore from the potentiality in property for creating dependency." Woodburn's observations on the social organization of immediate-return hunter-gatherers and on the norms instrumental in promoting equality concur on the following commonalities: (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; (3) people are not dependent on specific other people for access to basic requirements; (4) 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*. The mechanisms conducive to these balanced power relations – which Woodburn calls 'leveling mechanisms' – are extensively discussed in his (1982) *Egalitarian Societies* and, although inferred from his work with the Hadza in Tanzania and from other anthropologists' research on the !Kung (Ju/'hoansi) Bushmen (San) of Botswana and Namibia, Woodburn suggests that, given the immediate-return subsistence of all other documented egalitarian hunters and gatherers – which is the only economic base allowing for disentanglement from wealth and status – leveling mechanisms must be present with all these societies. Indeed, the operation of similar techniques serving the same ends was also suggested in the anthropological studies on the Mbuti Pygmies of the Congo (Turnbull 1965) and the Batek Negritos of South East Asia (Endicott 1974). Here, because of the limited space at my disposal, I will only offer a short list of the modalities and contexts in which the systems that nurture equality – as documented by Woodburn (1982 and references therein) – become expressed and operate in practice, as powerful leveling mechanisms:

– *Mobility and flexibility*
  Individuals are not bound to fixed areas, to fixed assets or to fixed resources. They are able to move away without difficulty and at a moment's notice from constraints that others may seek to impose on them, and such possibility of movement is a powerful leveling mechanism, especially because such arrangements are subversive for the development of authority.

– *Access to means of coercion*
  The possession by all men of the means to kill secretly anyone perceived as a threat to their own well-being not only limits predation and exploitation, but it also acts directly as a powerful leveling mechanism. Inequalities of wealth, power and prestige are a potential source of envy and resentment and can be dangerous for their holders where means of effective protection are lacking.

– *Access to food and other resources*
  Any person who seeks to obtain his or her requirements either individually or in association with others can do so without entering commitments to and dependencies on kin or contractual partners. Without seeking permission, or obtaining instruction, individuals in these societies can set about obtaining their own requirements as they think fit. They need considerable

knowledge and skill, but this is freely available to all. What matters here, in Woodburn's view, is the lack of dependence on the sharing or pooling of resources.

– *Sharing*
It has often been suggested that meat-sharing is simply a labor-saving form of storage. The hunter surrenders his rights to much of his kill to secure rights over parts of the kills of other hunters in future. Woodburn thinks that there are problems with this formulation: as hunting success is unequal, donors often remain 'on-balance donors' and may not receive anything like an equivalent return. Apparently, a socially-imposed leveling mechanism is at work here and not a mere practical convenience for the hunter.

– *Sanctions on the accumulation of personal possessions*
Personally-held and owned objects are relatively simple, made with skill, but not elaborately styled or decorated and not vested with any special significance. They can be made or obtained without great difficulty. No one depends on receiving such objects by formal transmission. Woodburn has noticed that, generally, the sanctions against accumulation are very elaborate. This cannot be explained simply in practical terms by seeing nomadic peoples as having to carry everything they possess with ease. Sanctions against hoarding go far beyond meeting this requirement and apply even to the lightest objects such as beads or arrowheads.

– *The transmission of possessions between people*
The circulation of goods is accomplished not through some form of trade that would bind participants to one another in potentially unequal relationships of contract. In the gambling practiced by the Hadza, transactions are depersonalized by being passed through the game. No doubt, gambling involves effort and skill, but distributes its proceeds at random, in a way that subverts the accumulation of individual wealth by the 'hard-working' or by the skilled. It further subverts any tendency to regional differentiation. It is paradoxical that a game based on the desire to win and, in a sense, to accumulate should operate so directly against the very possibility of systematic accumulation. The !Kung transmit personal possessions in a quite different way: each individual enters into formal exchange partnership, known as *hxaro*, with a number of other people with whom systematic exchanges of personal possessions and of hospitality take place. These non-committal networks based on mutualism stress the equal relationship between partners and thus provide little opportunity for property accumulation or the development of patron-client type relations between partners. The exchanged gifts are banal, and they are simple tokens of generosity and friendly intent, and no one is dependent on obtaining objects by gift giving. Both among the !Kung and Hadza, individuals who possess objects for which they appear to have no immediate need are under immense pressure to give them up, and many possessions are given away almost as soon as they are obtained and without any expectation of return.

– *Leadership and decision-making*
Decisions are essentially individual ones: even when matters such as the timing of a camp move or the choice of a new site are to be decided, there are no leaders whose responsibility it is to take the decisions or to guide people toward a general agreement. Sporadic discussion about moving does occur but, usually, it takes the form of announcements by some individuals that they are going to move and where they are going to move to. Other men will often defer a decision about whether to stay, whether to accompany those who are moving, or whether to move elsewhere, until the move actually begins. Moreover, personal qualities suggesting that an individual is ambitious for power or wealth exclude him from the very

> possibility of leadership. Arrogance, boastfulness, or aloofness disqualify *a priori* a person as a potential leader and may engender even stronger forms of ostracism.

Summing up the manifold implications of leveling mechanisms in the everyday life of immediate-return hunters and gatherers, Woodburn defines the freedom that is innate to egalitarianism as 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, and to obtain personal possessions without entering into dependent relationships.

Woodburn has recognized the need to explore the expression of egalitarianism in religious belief and practice, but he has stopped short from doing it. However, Lewis-Williams (1988) and Dowson (1994) have undertaken the exploration and have concluded that, indeed, the spiritual practices of these societies were also affected by egalitarian principles. Thomas Dowson (*ibid.*) suggests that the thematic of pre-contact San rock paintings points to social circumstances in which a large number of people in a community were in the possession of faculties that later would 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 reminds the accounts of Marshall (1969), Lee (1968, 1979), Biesele (1978) and Katz (1982) for parts of the Kalahari in the 1950s and 1960s when about half of the men and one third of the women in any camp were shamans. Hence, and as supported by Dowson's interpretation of rock art, sharing was apparently not restricted to meat or objects, but it was also a common practice in the spiritual realm, where the benefits of trance were shared with the other half of the men and two thirds of the women who could not enter trance at will.

Leveling mechanisms seem to be also at work when it comes to the inhibition of specialization and the division of labor that would ensue from it and, inevitably, result in gaining prominence through skills. As such, leveling mechanisms are also conducive to skills being equally distributed, this safeguards them against loss. Woodburn thinks that a cultural achievement like egalitarianism 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, leveling mechanisms inhibit, albeit indirectly, not only political change, but also any form of economical intensification (for a supportive but highly technical formulation of Woodburn's conclusion, see Read and LeBlanc 2003, Read 2010).

The modalities and contexts in which simple systems promote balanced power relations may be added, without reserve, to the conceptual framework sketched by the advocates for the application of anarchic theory in ethnography and archaeology (Sanger 2017, Borck and Sanger 2017, Angelbeck *et al.* 2018). They also explain clearly why Marshall Sahlins' (1972) 'uneconomic man' does not behave according to the postulates of dual inheritance theory regarding the content and context biases that are observed in the evolution of cumulative culture. With content biases reflecting a cultural heritage that embeds equality, the context biases that affect cultural selection and social learning in DIT (Boyd and Richerson 1985, Henrich and McElreath 2003) are not only flipped on their head, but they also seem to work in reverse. With the accumulation of prestige, skills and success being inhibited, these are replaced by polarly different parameters which, in their turn, become conducive to antithetical outcomes. That is, instead of ratcheting and accelerating material and social complexity, the values promoted by egalitarian societies decelerate and stabilize the rate at which material and social elaboration grow. Moreover, with leveling mechanisms tempering any inclination to specialization, they also become instrumental in the equal distribution of skills, which is a safeguard against the dangers of Henrich's (2004) 'treadmill effect'. Furthermore, because growth and elaboration are discouraged, Tomasello's (1999) 'ratchet effect' becomes meaningless. Group selection – a function of the strength of conformist biases in cumulative cultural evolution – operates, similarly, in reverse, because of the stress on non-conformist biases in the cultural evolution of egalitarian societies.

In lack of a fitting term, let us provisionally call these 'simple'/egalitarian cultures which have evolved by systematically 'retarding' potential material/social elaboration – through leveling mechanisms – 'subtractive cultures'. The designation contrasts their specific mode of cultural evolution to that adopted by complex/hierarchical cumulative cultures, which have evolved by methodically accelerating the degree of material/social elaboration – through 'ratcheting mechanisms'. While *entanglement* (Hodder 2012) is the main signature of cumulative cultural evolution, *disentanglement* is the obvious mark of subtractive cultural evolution. However, this provisional designation

can be validated and forwarded with confidence only when the immediate-return subsistence of egalitarian societies is proven not to be a 'natural' archaic state from which more elaborate delayed-return/heterarchical societies would linearly evolve[2]. This will be debated at large in the final section of this paper, but only after several additional peculiarities of the biocultural evolution of egalitarian societies will be introduced and discussed.

Neoteny and its psychological dimension

Beside common economic strategies (immediate-return subsistence) and ideological similarities (egalitarianism), the hunters-gatherers discussed here – although genetically unrelated – display several identical physical attributes like, short stature, globular braincase, reduced body hair, and peppercorn hair (Hulse 1962, Ashley-Montagu 1989, McKinney and McNamara 1991). The origin of these features is discussed at large in Steven Jay Gould's *Ontogeny and Phylogeny* (1982), where he reproduces Bolk's (1926) list of such phenotypic characteristics, which he identifies as juvenile traits of great apes that became permanent features in humans (Table 2). The phenomenon of retaining juvenile anatomical features and behavioral plasticity into adulthood is known in biology as *neoteny*, or *pedomorphism*. According to Gould, evolution occurs when ontogeny is altered in one of two ways: (i) when new features are introduced at any stage of development with varying effects upon subsequent stages or, (ii) when features already present undergo changes in developmental timing (heterochrony, Fig. 1). Together, these two processes exhaust the formal content of phyletic change. Understanding neoteny in this larger evolutionary 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). Similarly, 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. Modern humans, in their turn, have more neotenous skulls than *Homo erectus* and archaic *H. sapiens*.

[2] I must specify that this paper follows the cultural evolution of the modern and contemporary immediate-return hunters-gatherers who are documented in the ethnographic literature. The supposedly immediate-return subsistence of *Homo erectus* and other archaic hominins (as suggested in the paleoanthropological literature) has, arguably, preceded the delayed-return strategies elaborated by modern humans. Therefore, interpreting and understanding the immediate-return economies of contemporary egalitarian societies as an inherited trait from a primitive past is very misleading and not necessarily correct.

Ashley-Montagu (1989) theorized that part of the differences seen in the morphology of modern types of man can also be attributed to different rates of 'neotenous mutations' in their early populations. Thus, the East Asian skull is the most neotenized human cranium. The European skull is less neotenized than the East Asian and African, with the Australian Aboriginal cranium still less than the European, and with the Neanderthal skull even less neotenized than that of the Australian Aboriginal. Observing the Bushmen (San) of southern Africa, he has identified several well-defined neotenous traits relative to other humans (Table 2). In addition, McKinney and McNamara (1991) have remarked that African Pygmy and Asian Negrito populations also display highly neotenous features.

Table 2 List of the juvenile traits of archaic humans that became permanent features in *Homo sapiens* (left column) (after Gould 1982) and of the juvenile traits of *Homo sapiens* that became permanent features in San Bushmen (right column) (after Ashley-Montagu 1989)

Juvenile traits of *Homo sapiens* in rapport to archaic humans	Juvenile traits of San Bushmen in rapport to other humans
– orthognathy	– large brain
– reduction or lack of body hair	
– loss of pigmentation in skin eyes and hair	– light skin pigment
– the shape of the external ear	
– the epicanthic fold	– the epicanthic fold
– high relative brain weight	
– the central position of the *foramen magnum*	– less body hair
– persistence of the cranial sutures to an advanced age	– rounded head
– the structure of the hand and foot	– bulging forehead
– the form of the pelvis	
– the *labia majora* of women	– small cranial sinuses
– the ventrally-directed position of the sexual canal in women	– flat roof of the nose
– certain variations of the tooth row and cranial sutures	– small face
– absence of brow ridges and cranial crests	
– thinness of skull bones	– small mastoid processes
– position of orbits under cranial cavity	
– brachycephaly	– wide eye separation
– small teeth and late eruption of teeth	
– no rotation of the big toe	– median eye fold
– prolonged period of infantile dependency and of growth	– short stature
– longer life span	

The immediate-return hunters and gatherers on which this paper focuses belong to such Bushman (the Ju/'hoansi), Pygmy (Mbuti), and Negrito (Batek) populations. It may be safely suggested that, before their acculturation (which occurred already before anthro-

pologists could have described their lifestyle), the rest of the southern African San, the Sandawe of East Africa, all the Pygmy groups of Central Africa, and the numerous Negrito tribes of South East Asia – who until recently were still immediate-return hunters and gatherers – must have also had egalitarian social structures.

Yet, as Hulse (1962) has pointed out, neoteny is not the only dimension of *heterochrony* (changes in developmental timing, Fig. 1) that plays a role in human diversification. He brings up the example of Western Eurasians and Australian Aboriginals, who have retained similar skeletal and craniofacial characteristics to those which most people possessed in earlier times (*gerontomorphic* characteristics, as opposed to the *pedomorphic* traits that the Kalahari Bushmen display).

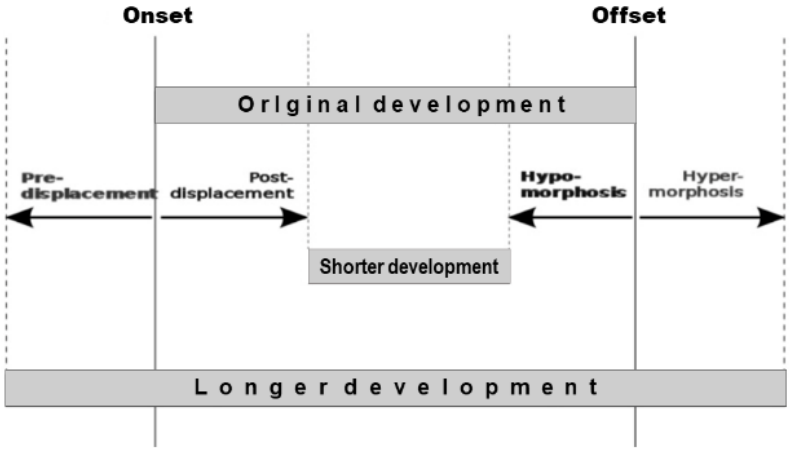

Fig. 1 Biological heterochrony
The six types of shift in heterochrony, a change in the timing and rate of embryonic/genetic/phenotypic development. Predisplacement, hypermorphosis and acceleration extend development (= *peramorphosis* – resulting in gerontomorphic phenotypes); postdisplacement, hypomorphosis and deceleration truncate it (= *pedomorphosis* – resulting in neomorphic phenotypes).
(source:https://en.wikipedia.org/wiki/Neoteny#/media/File:Heterochrony.svg).

Indeed, neoteny is only one of the two (or three, if development at 'normal' rates is also considered) possible outcomes of *heterochrony*, a change in the timing, extent, and rate of embryonic/genetic/phenotypic development (Fig. 1). Heterochrony may alter the *rate* of development through (i) *acceleration* (faster) vs. (ii) *deceleration* (slower) and its *extent*, through (iii) *hypermorphosis* (further) vs. (iv) *progenesis* (not as far). It may also affect its *timing* through (v) *predisplacement* (begins earlier) vs. (vi) *postdisplacement* (begins later). There are two tangible phenotypic and/or genotypic evolutionary changes that result from heterochronic processes (Bogin 1999):

1) *Peramorphosis* (gerontomorphism), where a descendant incorporates all the ontogenetic stages of its ancestor, including the adult stage, in its own ontogeny, so that the adult descendant 'goes beyond' its ancestor. This occurs by acceleration, hypermorphosis, or predisplacement.

2) *Pedomorphosis* (or neomorphism, neoteny), where a descendant retains only the juvenile stage of its ancestor in its ontogeny, so that the adult descendant 'does not go as far' as its ancestor. This occurs by deceleration, hypomorphosis, or postdisplacement.

Pedomorphosis is also common in many animal species domesticated by humans (Tcharnov and Horwitz 1991, Theofanopoulou 2017). It is believed to be a side-effect of the selective pressure of human-directed breeding for juvenile behavioral characteristics, such as docility (Byelyaev 1979). However, as I have extensively discussed it elsewhere (Steiner 2019), and as I am also hinting to in this paper, the domestication syndrome, in the case of humans, becomes manifested as 'cultural gracilization', which is not to be confused with biological neotenization. Dual inheritance theory also recognizes that cultural change may direct a population's genetic evolution by biasedly selecting for traits that only benefit the demands of a specific cultural environment and which may result in biologically deleterious outcomes (Odling-Smee 2003) that are reminiscent of the domestication syndrome observed with the animals mentioned above (for a full discussion on human self-domestication see Bednarik 2008).

The retention of juvenile anatomical features *and* behavioral plasticity into adulthood also has far-reaching psychological implications. As Bruce Charlton (2006) argues, what looks like 'immaturity' – or, in his terms, "the retention of *youthful attitudes and behaviors* into later adulthood" (emphasis mine) – 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, such as 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 suggestively calls human neoteny "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 the human-specific coping with reality and in developing our culture, sciences, philosophy, and arts. Following Gould, Jules Bemporad (1991) has observed 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) has put it, "humankind is still an especially playful species possibly because we are neotenous creatures who benefit from a much longer childhood than other species." He has also remarked 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) has emphasized that "… there is no other species that demonstrates curiosity and play into adulthood to the extent that *Homo sapiens* does. Novelty and the unknown are typically avoided in adult animals, with the notable exception of humans."

Having in mind that egalitarian hunters and gatherers display markedly neotenous features in rapport to other human populations (Ashley-Montagu 1989, McKinney and McNamara 1991, Table 2), it would not be far-fetched to suggest that they also exhibit a wider range of psychological traits associated with neoteny[3]. Although the main behavioral signatures of 'psychological neoteny' (Charlton 2006) may be recognized

[3] Although Ashley-Montagu (1989) considers East Asians the most neotenized human population, I would suggest – concurring with Bednarik (2008) – that the gracilized features that they exhibit are rather the consequence of a long history of cumulative cultural evolution in which group selection driven by conformist biases has likely played a pivotal role. Albeit Western Eurasians had a comparable cultural history, archaic content biases that became ratcheted and carried into cultural modernity resulted in gerontomorphic phenotypes that, although gracilized when compared to their Upper Paleolithic ancestors, are still markedly robust (*ibid*.). On the same note, but contrary to commonly held beliefs, Australian Aboriginal cultures also have a long history of cumulative cultural evolution, the antiquity of which is, arguably, in excess of 60,000 years. However, the idiosyncrasies of their ratcheting mechanisms point to their being rather 'additive' than cumulative cultures (Steiner 2019). In the next section I will offer more details on the connection between culture and phenotype. Here, I would still like to mention that the differences between human populations attributed to heterochronic processes were often amplified in arguments for scientific racism, which was also recognized and warned against by Gould (1982). Indeed, the perspective adopted in the first text that has considered the role of neoteny in human phenotypic variation (Bolk 1926) was ripe with racist presumptions, which reflect the biases of the early 20th century Western anthropological discourse.

with all living humans, their role in forming and maintaining egalitarian social structures must have been essential and decisive. The often-mentioned gentleness and peacefulness that characterize immediate-return societies (Marshall 1989, Dale *et al.* 2004) are likely behavioral outcomes ensuing from such psychological traits. Hence, the contents of egalitarian cultural configurations must also reflect preferences centered on these values which, in their turn – and as dual inheritance theory predicts – affect cultural selection. Besides being expressed in cultural values, psychological neoteny also becomes conspicuous in the 'attitudes' of immediate-return hunters and gatherers which, unfortunately, were misunderstood and misinterpreted in the anthropological literature of the 19th and early 20th centuries. As Chris Low (2004) has summarized it, "… the cognitive attitudes 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." Fortunately, modern anthropology understands such attitudes as tangible examples of the cognitive flexibility pertained in the psychological dimension of neoteny.

I would suggest that, with physiological and psychological neoteny playing such a crucial role in the biocultural evolution of egalitarian societies, the term 'cultural neoteny' would clearly express the peculiarities that both set them apart and integrate them in the wide spectrum of human cultural diversity. On the same note, having in mind that 'simple'/egalitarian cultures seem to have evolved by systematically 'retarding' their material and social elaboration, 'subtractive culture' – a term that I have forwarded in the previous section – may be regarded as an outcome of 'cultural neoteny'.

The antiquity of subtractive cultures

The physiological and psychological traits common to San Bushmen, Pygmies and Negritos led to an erroneous presumption according to which these populations were believed to have had a common descent from a phenotypically similar region-wide substrate of humanity in southern and East Africa (Tobias 1978) or, in the case of Pygmies and Negritos, in Central Africa and South East Asia (for a discussion see *The Negrito Hypothesis Revisited*, a collection edited by Phillip Endicott (2013). The assumption was likely motivated by the engrained belief that considers such different, 'simple', 'childish', egalitarian and technologically 'backward' populations a natural condition

that reflects an archaic state common to the cultural ancestors of all modern humans. Conversely, the various degrees of cultural complexity exhibited by the 'common phenotype' was understood as a linearly succeeding 'mature' form of the 'innocent' condition of these 'primitive' hunters and gatherers. However, a closer examination of the anatomical and cultural development of both 'childish' and 'adult' societies will flip such stereotypical presumptions on their head.

The differences that set apart these populations from the rest of hunters and gatherers and are *specific only to them* are, their a) economy (immediate-return subsistence), b) phenotype (markedly pedomorphic morphology), and c) social structure (egalitarianism). Instead of being archaic traits, these three common characteristics seem to have resulted from relatively recent evolutionary processes. This assumption is strongly supported by the archaeological record presented in this section. Because of the rich paleoanthropological and archaeological literature that has been dedicated to the ancestors of the San (Bushmen), the argumentation will focus on the African theater of cultural evolution, with a probably disproportionate emphasis on southern Africa. However, the conclusions of the discussion may be generalized to all the egalitarian groups addressed in this paper and several 'rules of the thumb' that stress on the similarities between them forwarded and recommended for future research and testing.

African modern humans at around 30 to 10 thousand years (ka) ago were, as a rule, far from the popular image of the diminutive Bushman (Stynder 2006). The reassessment of the fossil assemblage shows that most specimens were markedly robust, which suggests a mosaic evolutionary pattern in which cranial and postcranial elements evolved at different rates (Rightmire and Deacon 1991). Regarding the behavioral traits of these robust humans, it may be presumed that they were more aggressive and hierarchical than their contemporary descendants. Having in mind that *Homo sapiens* is more neotenized than *Homo erectus*, and *Homo erectus* more than *Australopithecus* (Thiessen 1997), it may be safely inferred that such a gradual process of physiological neotenization would be accompanied by an incremental increase in psychological neotenization which, in its turn, would result in higher levels of sociability and peacefulness (*sensu* Charlton 2006). As bonobos display more neotenous features than chimpanzees (de Waal and Lanting 1997), their case is a good example for the behavioral manifestations of neoteny. With the markedly hierarchical chimpanzees, males display a high degree of aggressiveness. Besides being hostile to each other, they are also extremely aggressive

toward males from neighboring communities, whom they often ambush and kill. 'Warfare' between neighboring groups was also reported (Van Lawick-Goodall 1968). In comparison, neotenous bonobos (Shea 1983), also known as 'pygmy' chimpanzees (de Waal and Lanting 1997), have developed a high degree of sociability by inhibiting aggressiveness. Apparently, the peaceful bonobos are capable of altruism, compassion, empathy, kindness, patience, and sensitivity (*ibid*.). The development of these traits took approximately one million years of gradual 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 aggressive behavior through conflict resolution and post-conflict reconciliation (Manson *et al.* 1997). In the case of modern humans, aggressiveness and hierarchy would be further reduced at later developmental stages, either by cultural means (through suppression resulting in 'docility') or, by additional neotenous developments (through inhibition resulting in 'gentleness') (for a lengthy discussion see Steiner 2019).

During the Late Pleistocene, a genetically Khoe(san) population already dominates the ethnographic landscape of southern and East Africa (Tobias 1978, Nurse *et al.* 1985, Kim *et al.* 2014)[4]. According to Tobias (*ibid*.), the geographical range of this proto-Khoe(san) genetic substrate extended over much of South, East, and North East Africa. 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 before present (BP). However, a common genetic substrate does not automatically imply phenotypic or behavioral identity. For example, an almost complete human cranium that was discovered in 1954 in the Hofmeyr district of the Eastern Cape Province contradicts the interpretation that a homogenous Khoe(san) phenotype was

[4] The degree of genetic/phenotypic relatedness between eastern and southern African Stone Age hunters-gatherers has long been a subject of interest and it is still misconstrued 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 East and southern African (EA/SA) Late Pleistocene people were 'unreduced' robust 'Bushmanoids', and concurs with Morris (2002), who argues for the San (Bushmen) being a relatively late South African development. It was an ancestral genetic 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 cold and dry climate of the Late Glacial Maximum resulted in population fragmentation and the ancestors of San split into their eastern and western branches 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 only after 18 ka (Pickrell *et al.* 2012, Tishkoff *et al.* 2007). Therefore, and in order to avoid confusion, Khoe(san) in this paper 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 the modern San and most Khoe.

distributed from the Cape of Good Hope to the Horn of Africa (Grine *et al.* 2007). The morphology of this 36,000 years old skull was described as a mosaic of archaic and modern traits (Morris and Grine 1999). Grine *et al.* also 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 reveal a markedly robust individual, which situates the cranium within the range of variation of European Upper Paleolithic crania.

Morris (2002, 2003) has also argued against such a region-wide distribution and suggested that the San (Bushman) phenotype arose relatively late in South Africa. According to Morris' convincing ecological hypothesis, the still robust common ancestors of modern southern African Khoe and San underwent a bottleneck situation associated with the Late Glacial and the Last Glacial Maximum (LGM) between 24,000 to 17,000 years BP. At this time, the cool and dry glacial climate resulted in the desertification of much of southern Africa and in the pronounced aridification of East Africa, particularly in the interior regions. A scarcity of inland archaeological occurrences suggests a 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 in 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 environmental changes had an impact on evolutionary processes and resulted in the differentiation of the coastal population and in the emergence of the ancestral KhoeSan (Morris 2002, 2003).

At the end of the glacial period, there would have been a rise in sea level and a population displacement that prompted an expansion toward the already habitable interior, which 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) supports Morris' hypothesis of a relatively recent southern African origin of recognizably KhoeSan cranial morphology. Indeed, terminal Pleistocene/Early Holocene human crania already display a general KhoeSan craniofacial pattern, particularly regarding the upper facial form (Bräuer and Rösing 1989). As they (*ibid.*) point out, 10,000 years old remains like Albany Man and several similarly aged fossils from Matjes River Rock Shelter, Wilton Large Rock Shelter, and Oakhurst already possess the small, broad upper faces typical of recent

KhoeSan. However, one notable aspect of these Early Holocene people is their large size and robust bone structure, which is not the norm among modern KhoeSan (*ibid*.).

Interestingly – but not surprisingly – these populations were practicing delayed-return subsistence strategies (see Mitchell 2002 and references therein). Bousman (2005) also attests the presence of Late Pleistocene storage pits in the Kalahari. Given the variety of environments in which these people were dispersed, it is safe to assume that they developed various cultural approaches, ranging from 'moderate' (Dale *et al.* 2004) to fully-fledged delayed-return economies (Mitchell 2002).

The terminal Pleistocene already sees pedomorphic KhoeSan craniofacial patterns, particularly which of the upper facial form (Bräuer and Rösing 1989), which may indicate an incipient or ongoing neotenization process. However, cranial gracilization was documented with all archaic populations, world-wide, at approximately the same time (Bednarik 2008). Yet, it may be confidently suggested that the terminal Pleistocene neotenization would become biologically advantageous and *intensified* – in rapport to other humans – and reach its full expression only following a consequent isolation of small groups of this still robust, but undoubtedly KhoeSan phenotype. This came about in the tumultuous period during and following the African Humid Period (AHP) that began around 14,000 years ago (Menocal *et al.* 2000) and came to an end about 12,000 years ago, when the Younger Dryas led to a failure of the African monsoon (Yannick *et al.* 2007) and to the displacement of the climatic zones to the north. Africa became arid between the Kalahari and Sahara – including the Congo Basin – but more humid south of the Kalahari and in the Sahara (Jansen *et al.* 1995, Abell and Plug 2000, Roberts *et al.* 1993). This was followed by an *abrupt* and lasting resumption of monsoon activity and the establishment of contemporary ecological configurations in southern and East Africa (Yannick *et al.* 2007). Small groups of delayed-return hunters and gatherers became fragmented and isolated in the interior deserts and dry savannas, and in the encroaching rainforest of the Congo Basin. These ancestors of modern and contemporary San, Sandawe, Hadza, and Pygmy groups would continue their cultural and biological evolution in such conditions of isolation.

Although delayed-return subsistence continued to be practiced in more abundant areas, as evidenced by the Albany industry of the Oakhurst complex in South Africa (Mitchell 2002, Bousman 2005), immediate-return strategies would have become more advantageous for the populations stranded in the inhospitable interior regions, in ac-

cordance with the 'risk-reduction' hypothesis for the origin of immediate-return hunters-gatherers forwarded by Hegmon (1991) and Kelly (1991). This may be augmented with an ecological theory (Binford 1980, Oyuela-Caycedo 1996), which proposes that immediate-return strategies develop where resources are patchy, in contrast to delayed-return economies, which are practiced in lush environments. On this note, it must be specified that, contrary to the common belief, rainforests are not necessarily 'lush', but rather 'harsh' environments, especially for delayed-return savanna hunters and gatherers like the ancestors of the Batwa (Pygmies) who found themselves isolated in the rapidly expanding forests.

In the Kalahari and other arid parts of southern Africa, the interior Lockshoek industry, already associated with the San – and belonging to the same Oakhurst complex of which the coastal Albany industry is a delayed-return example – is an attested reversal to immediate-return subsistence, which took place at 10,000 years BP. In the same areas, at around 8,000 BP, a dramatic reduction in stature and robustness seems to have occurred (Pfeiffer and Sealy 2006, Stynder 2006, Stynder *et al.* 2007) and continued until 4,000 BP, when a slight increase would take place which, I would suggest, was the aftermath of the arrival of Khoe pastoralists from East Africa, as hypothesized by Blench (2008) and Smith (2005)[5].The reduction to the contemporary (pedomorphic) phenotype was, as evidenced by the osteological record (Stynder 2006, Pfeiffer and Sealy 2006), a gradual process that played out through the 6,000 years extent of the Lockshoek – classical Interior Wilton (Smithfield A) cultural sequence.

Comparable population fragmentations and evolutionary processes took place in South East Asia where, like the 'Bushmanoid hypothesis' for Africa, a '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 the forests of Peninsular and Island South East Asia. 'Negritos' were presumed to derive from an ancestral population whose former distribution may have also included parts of New Guinea and Australia, but who were either believed to have been absorbed or, replaced by later migrants (Barnard-

[5] Contact with pastoralist populations at the end of Smithfield A and through Smithfield B had a heavy impact on egalitarian societies and – as 'read' by Thomas Dowson in their rock art (1994) – their culture became introverted and, as a defense mechanism, focused on the entrenchment of its achievements. Unfortunately, this phase was followed by encapsulation (Woodburn 1988) and acculturation.

Davis 1867, de Quatrefages 1895, Radcliffe-Brown 1922). To accommodate the Negrito hypothesis, it would be reasonable to expect evidence for short stature in the terminal Pleistocene fossil record. However, modern human remains indicate the presence of predominantly robust phenotypes (Dizon *et al.* 2002, Détroit *et al.* 2013).

An alternative explanation for the Negrito phenotype is that of convergent evolution, whereby similar physical traits developed independently among multiple populations. A plausible suggestion for the existence of short stature and a generally pedomorphic appearance is that these have evolved as a 'life-history trade-off' favoring early reproduction and cessation of adult growth (Migliano *et al.* 2007, Endicott 2013). Such a life-history trade-off may also explain the Early Holocene dramatic size-reduction in southern (and, by further inference, in East and Central) Africa and, the short-statured and peppercorn-haired San, have likely evolved locally, from isolated robust populations. By the incipient Interior Wilton, that is, at around 8,000–7,000 years ago, there is an increasing occurrence of *hxaro* exchange goods in the archaeological record (Stynder 2006), which already points to emerging egalitarian structures, for reasons that were already discussed. By the start of the developed phase of Smithfield A (at 4,000 years BP) a recognizably Bushman phenotype and culture, like that encountered by the anthropologists who have first documented them, seems to have been firmly established.

Section summary and conclusions

The picture that emerges from this review is that the three specific characteristics that set apart egalitarian societies from other hunters-gatherers (immediate-return subsistence, pedomorphic morphology and egalitarian social structure) are the result of a ten millennia long process of reductions and not archaic biological or cultural legacies that have survived without change to the present. In southern Africa, the origin of these three characteristics is clearly evidenced in the archaeological record and a causal sequence of (i) *economic and material reductions* followed by (ii) *anatomical reductions* that were conducive to (iii) *behavioral reductions* can be faithfully reconstructed. Let us summarize this sequence and compare its outcomes to the predictions of gene-culture coevolution theory:

(i) Confirming the risk-reduction hypothesis for the origin of immediate-return hunters and gatherers, the archaeological remains that define the Lockshoek period of the African Late Stone Age (10,000 to 8,000 years BP) attest that a relatively elaborate toolkit – inherited from a delayed-return past and, as such, in excess of the demands of the newly adopted mode of subsistence – became honed down to answer the novel environmental conditions

and mobile lifestyle of isolated hunters-gatherers. During the initial (8,000 to 7,000 BP) and classical (7,000 to 4,000 BP) phases of the subsequent Smithfield A period (8,000 to 4,000 BP), also known as Interior Wilton, the material culture that would be carried into the relatively recent past became firmly established. A slightly 'improved' technology (becoming common at the end of isolation at the onset of the developed phase of Smithfield A (4,000 to 2,000 BP) and through Smithfield B (2,000 BP) was still widely used by the Ju/'hoansi before their acculturation.

Gene-culture coevolution theory would explain such economic and technological reductions as 'losses', by citing the 'Tasmanian case'. Not incidentally, the Tasmanians became isolated at around the same time (8,000 BP) from their mainland brethren, and their 'case' rather conforms to the South African model than to the mathematics behind the 'treadmill model'. Considering that the technological set of the Smithfield A industry was preserved without falling victim to the treadmill – and, against all odds, by small and mobile bands living in isolation and spread over large inhospitable areas – the existence of an elaborate social network that would have enabled the preservation of the Smithfield material culture should be presumed. However, elaborate networks, at least from the perspective of dual inheritance theory, would have resulted in technological ratcheting and innovation which, in turn, would have prompted the onset of cumulative cultural evolution – which, as we know, is not the case. The 6,000 years old period of 'stasis' cannot confirm such a hypothetical causality.

(ii) Reverting to immediate-return subsistence and honing down the material culture to a level of sufficiency were *cultural responses* that could not have been possible without the behavioral plasticity that characterizes the psychological dimension of neoteny. The incipient neotenization observed in the Early Holocene osteological record became, following the reversal to immediate-return subsistence, advantageous and likely selected for. Small body size would appear in isolation as a 'life-history trade-off' favoring early reproduction and cessation of adult growth. This is also believed to be a risk-reduction strategy. Indeed, at around 8,000 years BP, that is, 2,000 years after the reversal to immediate-return subsistence, a dramatic reduction in stature and robusticity seems to have occurred and, as evidenced in the osteological record, it has continued until approximately 4,000 years ago. This *biological response* (size reduction from a previously robust physique) seems to have run in parallel with the *cultural response* (reversal to immediate-return subsistence/reduction of the technological toolkit of a previous cultural phase), both initiated during the Lockshoek period and accelerated in a probable feedback loop for almost the entire span of the initial and classic Smithfield A (8,000 to 4,000 BP), with material culture and morphology reaching their present expressions by the onset of the developed Smithfield A, 4,000 years ago.

Gene-culture coevolution theory predicts that cultural changes direct a population's phenotypic adaptation and, in this case, the prediction must be taken at face value. However, immediate-return subsistence is only the economic dimension of the specific culture discussed here and it must not be identified with egalitarian social structure. The latter would only develop because of higher degrees of sociability and reduced levels of competitiveness and aggressivity, which are recognized as signatures of psychological neoteny. Therefore, the emergence of egalitarian societies would be physiologically and psychologically pre-

conditioned, which reverses the causality predicted by gene-culture coevolution and introduces the possibility of culture being co-directed by phenotype[6].

(iii) By the incipient Smithfield A – between 8,000 and 7,000 years ago – the archaeological record documents an increasing occurrence in *hxaro* gift-exchange goods. Not surprisingly, the emergence of *hxaro* partnerships was also explained with the risk-reduction hypothesis. Moreover, *hxaro* is intricately linked to the rules that regulate the transmission of possessions between people, which were identified as a powerful leveling mechanism. The presence of the non-committal and mutuality-based *hxaro* partnerships suggests, by inference, the existence of egalitarian structures at already 7,000 years ago, at the beginning of the classical stage of the Smithfield A tradition (7,000 to 4,000 BP). The traits and attitudes of psychological neoteny must have played a crucial role in the further refinement of the leveling mechanisms that regulate egalitarianism, which must have been already fully developed during the said classical phase of Smithfield A (7,000 BP to 4,000 BP). By the beginning of the developed phase of Smithfield A (4,000 years BP) the recognizably Bushman pedomorphic phenotype and egalitarian culture were already well-established.

Hxaro *is the Ju/'hoansi designation for a wide-ranging social network that, instead of promoting technological innovation by spreading it in a population and inviting replication, relies on non-committal mutualism. The goods exchanged between* hxaro *partners remained banal and constant through the 8,000 years history of this network based on mutuality, from its emergence to modern times. As the ability to manufacture such artifacts was likely mastered by all members of the community, the skills could not be employed as means serving the accumulation of prestige. The fact that* hxaro *became established and has proven itself in conditions of demographic weakness and cultural isolation points to the possibility that sustainable social networks may be developed under circumstances that do not encourage their emergence. According to the demography /complexity link in gene-culture coevolution theory, demographic strength is a requirement that must be met before effective social networking may even be considered and, adhering to its own rules, the theory does not consider that such networks might be present among populations that do not* a priori *fulfil the demographic condition.*

The archaeologically reconstructed causal sequence summarized above shows clearly that the ten millennia of immediate-return subsistence were not spent in 'idle stasis': the egalitarian social structure and the elaborate leveling mechanisms that have gradually emerged during this long period are impressive *achievements* resulting from a *cultural evolutionary process*. Although driven by the very mechanisms and biases that were postulated for cumulative cultures, paradoxically, these appear to have acted in reverse. I have already suggested the term 'subtractive cultural evolution', which I have linked to 'cultural neoteny'. I have justified my suggestions with the observation that sim-

[6] Heterochrony generates phenotypic diversity through shifts in the rate or timing of development, but it requires only negligible genetic innovation (Drake 2011). That is, San (Bushmen) did not undergo major genetic changes resulting from the Early Holocene size reduction. This also explains why the robust genetic ancestors of the contemporary pedomorphic San could be traced back to 150,000 years BP (Soodyall and Jenkins 1992): it required small genetic variation to express the big phenotypic differences.

ple/egalitarian subtractive culture is systematically 'retarding' potential material/social elaboration through leveling mechanisms, in contrast to complex/hierarchical cumulative cultures, which have evolved by methodically accelerating and inflating the degree of their material/social elaboration through ratcheting mechanisms. Moreover, the content biases that influence the evolution of cumulative cultures are also polarly opposed to those that motivate subtractive cultural evolution. Last, but not least, context biases – skills, success, prestige, and similarity – while being culturally encouraged and selected for in cumulative cultures, are discouraged, inhibited, and selected against in subtractive culture. On the same note, group selection, which is determined by conformist biases in cumulative cultures, becomes swayed by non-conformist biases in subtractive cultural evolution.

However, my suggestion was only provisional and laid on ice until I could enroll enough evidence to support the presumption that immediate-return subsistence and egalitarian structures are not a 'natural' archaic state from which more elaborate delayed-return/heterarchical societies would linearly evolve. This section has, hopefully, proven the assumption right. The suggested linkage of subtractive cultural evolution to 'cultural neoteny' will be discussed and validated in another section.

The antiquity of cumulative cultures

Richerson and Boyd (2000) argue that the Late Pleistocene climatic changes and demographic realities have provided the right environmental and social conditions for the onset of the cumulative dimension of culture. The origins of both cumulative cultural evolution and of the cultural niche (Odling-Smee 2003) within which the 'evolution of cultural evolution' (Henrich and McElreath 2003) would take place were, more specifically, linked to the Upper Paleolithic 'big bang' in the material and cognitive domains of culture (e.g., Mithen 1998). However, the Middle – Upper Paleolithic interchange was less abrupt than commonly believed. Finds that had clearly developed from the region's final Mousterian, but also showed Aurignacian characteristics were discovered all over Europe (Svoboda 1993, Kuhn and Stiner 2001). The Châtelperronian, Bohunician, Szeletian, Jankovichian, Uluzzo-Aurignacian, Proto-Aurignacian, and Altmühlian – to name only a few– have likely prepared the transition between the long-lasting Mousterian stasis and the accelerated pace at which culture would evolve beginning with the Aurignacian (Bednarik 2007). These transitional industries were shown to

have belonged to Neanderthals and, similarly, the early phases of the Aurignacian were also associated with them (*ibid*.). This has led to the hypothesis that the achievements of the Upper Paleolithic were independently effectuated by the aboriginal population of Europe and not a 'revolutionary' change accomplished with the arrival of anatomically, behaviorally, and cognitively modern humans from Africa.

Following this line of reasoning, the gradual anatomical transition from robust/archaic to gracilized/modern phenotypes was interpreted as an outcome of the rapid cultural changes that took place during the initial stages of the Upper Paleolithic, and both cultural and anatomical developments were understood as transitions effectuated *in situ* by cognitively modern Neanderthals[7]. The hypothesis eliminated the necessity for an exotic population intrusion (Bednarik 2007, Brace 1979, Caspari and Wolpoff 2013). Beside the transitional industries, the osteological record also points to such a possibility – anatomically modern humans would appear only during the Gravettian, with robust 'Neanderthaloids' dominating the European human landscape for the entire Aurignacian (Bednarik 2007, 2008). However, this is not the place to debate these hypothetical interpretations of the factual changes that have occurred in both culture and anatomy during the Western Eurasian Upper Paleolithic. Let us rather review and understand the origin of these transitions from a neutral position that can accommodate both interpretations and does not contradict the consensus view.

The 36,000 years old South African Hofmeyr cranium mentioned in the previous section was placed within the range of variation reported for European crania of the same age (Stynder *et al.* 2007, Grine *et al*. 2007). That is, prior to 30,000 years BP, the

[7] According to Jürgen Richter's (2000) article *Social Memory Units Among Late Neanderthals*, cumulative cultural evolution looks back to a longer history than that suggested by gene-culture coevolution theoreticians. Richter reports that between the first and the second glacial maximum (60,000 to 28,000 years ago) a patchwork of different 'social memory units' occurred all over Europe. The exchange of information became 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 is 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. Innovations, under such circumstances, tend to disappear very quickly. Inventions are thus made repeatedly – and they are forgotten again, and again. Richter echoes the tenets of DIT, especially those regarding Henrich's (2004) 'treadmill' and Tomasello's (1991) 'ratchet' effects. Richter suggests that starting with 60 ka BP, unlike all the earlier innovations – which had been reinvented and re-lost several times during the Middle Paleolithic – 'new' innovations became firmly entrenched parts of the technological knowledge. Richter labels the groups that have managed to ratchet them 'social memory units' (SMUs), which must not be perceived as strictly ethnical or geographical developments, but rather as chronological sequences that witness the development of social networking by small and isolated populations on the brink of extinction as an answer to climatic stress.

actors of both African and European theaters of evolution were relatively archaic robust humans. At that time, neotenization seems to have been an ongoing gradual process affecting human populations all over the world (Thiessen 1997). This was the commonly shared anatomical substrate from which human cultural diversity would emerge and, influenced by objective environmental factors, assume either subtractive or cumulative trajectories. However, the environmental conditions in which culture and phenotype would evolve in Western Eurasia were markedly different from those in southern Africa. Europe was in the grip of an Ice Age, in which robusticity was adaptively advantageous and likely selected for. A reliable cultural niche became a necessity, as an answer to environmental unreliability[8]. Between 40 to 30,000 years ago, the rate of cultural change became markedly accelerated in rapport to biological change. Neotenous processes became, literally, laid on ice. Hence, behavioral reductions associated with the psychological dimension of neoteny were likely non-existent, and aggressiveness linked to adaptively advantageous competitiveness must have been the normal behavioral signature of the period. In such a cultural configuration, ratcheting mechanisms have likely encouraged the accumulation of prestige and status, while social complexity resulted in the emergence of specialized skills which, in their turn, also became conducive to hoarding status. Indeed, Hayden's (2003) 'trans-egalitarian societies' must have reflected – in their content and context biases – such values and attitudes.

Social networks became the means for ratcheting innovations, enabling their accelerated appearance, diffusion, replication, and entrenchment, thus contributing to ever-increasing material complexity. With an eye on efficiency, cultural change became accelerated beyond the ability of the genetic heritage to keep up with it and, as dual inheritance theory predicts, it started affecting the phenotype (Cochran and Harpending 2009). Increased selection pressures would have asked for adaptation to the rapidly self-elaborating niche. Both gene-culture coevolution and niche construction theories posit that the speed at which humans can construct niches modifies the selection pressures and either genetic evolution or further niche construction can result (Odling-Smee 2003). Apparently, both have occurred – anatomical gracilization and further ratcheting.

[8] This simplified chronological sequence may help in understanding the extent of climatic fluctuations during the European Upper Paleolithic. A brief interstadial event between 43 to 41 thousand years ago was followed by a relatively cold phase that lasted between 41 to 39 ka ago, succeeded by a mild phase from 39 to 36 ka ago, with the climate taking a bad turn at 36 ka ago, when another stadial commenced. Cool and semi-arid conditions returned approximately 28 ka ago, which culminated in the Last Glacial Maximum (LGM) between 22 and 14 ka ago. A rapid warming and moistening of the climate took place 13 ka ago, which was interrupted by the Younger Dryas, 11 ka ago. (after Frenzel and Pécsi 1992)

The cultural niche would increasingly consolidate, to the point that it became an artificial environment and altered selection pressures, beginning to direct its population's phenotypic/genetic development (*ibid*., Boyd and Richerson 1985).

At around 30 ka ago, specimens displaying a gracilized anatomy and reduced cranial volume become dominant in the osteological record (Bednarik 2007). They were the outcome of ten millennia of cultural selection. Although reminiscent of neotenous phenotypic expression, cultural gracilization – the result of artificial selection – is rather a condition that is associated with domestication (*ibid*. 2008, Byelayev 1979, Benítez-Burraco 2017). Gracilization has also assumed many deleterious characteristics. The psychological dimension of gracilization is radically different from the psychological side-effects of neoteny and, like the physiological dimension –which is advantageous only in specific cultural configurations but biologically maladaptive– it is also deleterious. Such detrimental psychological developments, paired with archaic behavioral traits, would predetermine the content of post-Gravettian cultures and the biases that would influence further cultural selection. Group selection based on conformist biases would, however, suppress aggressiveness, supplanting it with culturally acquired docility. Deleterious traits – but also several genetically determined 'natural' inclinations– would also become culturally suppressed, which would inevitably result in an increased number of neurodegenerative syndromes. Gracilization has primarily affected the anatomy of women, because of mate selection favoring juvenile features (Gould 1980, Bednarik 2008). With males, gracilization was for long only incremental, which allowed for the retention of markedly gerontomorphic features (Hulse 1962). However, anatomical gracilization is an ongoing process, and in the contemporary artificial environment in which many humans live, it is increasingly affecting both sexes (Nyborg 1994)[9]. Other instances of cumulative cultural evolution were initiated in less extreme environmental conditions and – because they were not compensatory in character – they have

[9] Helmuth Nyborg's (1994) suggestion that 'feminized', slower maturing 'neotenous androtypes' will differ from 'masculinized,' faster maturing gerontomorphic '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 anatomical development. 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'. Robert Sapolsky's (1996) thoughts on the relationship between hierarchy, aggressiveness and chronic stress become pertinent in such a context: the environment in which Nyborg's 'androtypes' thrive is the complex contemporary cultural niche. According to Sapolsky, the chronic stress that characterizes social complexity, beside shrinking our brains, also fattens our bellies, which is precisely what happens to Nyborg's gracilized 'androtypes' in an urban environment.

developed at a stable rate, as a natural growth of the moderate complexity displayed by most delayed-return hunters and gatherers (Dale *et al.* 2004). Although division of labor is more pronounced, there is a limit to the prestige and status that can be accumulated through skills – with the notable exception of the ritual domain, where sorcerers often accumulate status through their impressive techniques (Ellul 1964, Hayden 2003). Thus, the social structure of these societies covers the entire heterarchical to hierarchical spectrum, with the former being more common. Aggressivity, although part of the cultural heritage, is constrained by technological limitations and pales in comparison to the industrial warfare practiced by 'civilized' societies. Social interaction differs from the non-committal and direct immediate-return mutualism and is rather defined by delayed and third-party reciprocation (Sterelny 2014). With cultural development taking place at a stable rate, biological development can catch up with cultural dictates and the line separating ongoing neoteny (which did not become intensified like in the case of immediate-return hunters-gatherers, but also not inhibited like in Ice Age Europe) from gradual gracilization becomes blurred.

With the onset of the Younger Dryas at around 11-12 ka ago, the environmental challenge was met – where it was ecologically possible – with a strong cultural response, namely, the adoption of agriculture. Because delayed-return economies can easily resort to sedentary lifestyle, which seems to have been the case during the optimal conditions preceding the Younger Dryas in the Near East (Bar-Yosef 1998), agriculture became perhaps the means to support it (Cauvin 2007). However, some delayed-return hunters and gatherers have reacted differently and, very much like the ancestors of contemporary egalitarian societies, reversed to immediate-return subsistence (again, where the environment allowed for such a step).

The Natufian case is a classic example (Bar-Yosef *ibid.*): within the same population, those in better-watered areas adopted agriculture, while those stranded in the southern arid regions reversed to a mobile lifestyle and immediate-return subsistence, developing the Desert Natufian. This took place at the same time when parts of the South African Oakhurst people developed the Albany tradition in areas where the continuation of delayed-return subsistence was still possible, while in the arid inland regions, isolated groups of the same people reverted to immediate-return strategies and initiated the Interior Lockshoek tradition, as discussed in the previous section (Stynder 2006, Bousman 2005). The only difference between the Natufian and the Oakhurst tra-

ditions is that agriculture could not be adopted in southern Africa and, instead, an elaboration of delayed-return lifestyle had occurred.

At around 10,000 years BP, subtractive cultures were likely initiated in many parts of the world affected by the climatic changes of the Younger Dryas (Yannick *et al.* 2007) where formerly homogenous delayed-return hunter-gatherer populations became fragmented. However, with the latitudinal advance of agriculture (Diamond 1997) they became either absorbed or, more likely, encapsulated (Woodburn 1988). With the longitudinal spread of pastoralist economies, even the places that were unsuitable for agriculture could be penetrated. The six egalitarian societies documented in the anthropological and ethnographic literature were the last to survive[10].

The models and predictions of dual inheritance theory were proven to be accurate for the cultural manifestations addressed in this section. However, having in mind the crucial role played by neoteny in the development of both cumulative and subtractive cultures and that gene-culture coevolution theory advocates for the recognition of Darwinian selection processes in cultural evolution, depicting the effects of heterochrony on culture could perhaps enlarge the analytical range of the theory and make it flexible enough to accommodate subtractive cultures, instead of sacrificing them to the treadmill.

Discussion: Heterochrony in cultural evolution

In dual inheritance theory 'divergent cumulative cultural evolution' occurs when the cultural and biological evolutionary trajectories become autonomous in rapport to each other. This takes place when a strong cultural niche becomes an artificial selective environment (Odling-Smee 2003, Richerson and Boyd 2000). Genetic and cultural evolution are interacting parallel processes that optimize biologically-inherited and/or socially-learned information in a population. In this context, two effects have been suggested with respect to the long-term implications of social learning: (i) the 'hiding effect',

[10] Robert Layton (2005) looks critically at Woodburn's (1988) rejection of ecological explanations for the origin and distribution of immediate-return systems among hunters-gatherers and reviews arguments to the contrary proposed by anthropologists working with a Darwinian paradigm. With Woodburn offering encapsulation as the explanation for the emergence and maintenance of egalitarianism, I concur with Layton: encapsulation would occur only when egalitarianism was already firmly established. Staying with Woodburn, his inclusion of 'some' Arctic Inuit and Australian Aboriginals in the list of simple and flexible societies was also met with skepticism by Layton (*ibid.*), who sees them as part immediate-return and part delayed-return and only superficially egalitarian and, as such, anomalous in both typologies. Again, I agree with Layton's observations. The environmental and social circumstances that have defined the contents of Inuit and Australian Aboriginal cultures are, however, too complex to be addressed here. Therefore, I have limited my discussion to the few cases where there is unanimous agreement regarding both the subsistence strategies and the social structure of these hunters-gatherers.

which occurs when sufficient learning shields genetics from selection pressure, thus *slowing down* the cultural evolutionary process (Marriott and Chebib 2016), and (ii) the 'Baldwin effect', which takes place when effective learning stimulates genetics by increasing particular selection pressures, and thus *speeding up* cultural evolution (*ibid*., Baldwin 1896, Sznajder *et al.* 2012). A hiding effect occurs in a 'simple' cultural niche with moderate selection pressures that allow for the genetic inheritance to keep the pace with cultural change, without inhibiting ongoing biological evolution. A Baldwin effect can be observed in a 'complex' artificial niche that supplants the biological environment and in which the genetic inheritance cannot keep the pace with the ever-increasing selection pressures and it becomes 'derailed', which may result in the acquisition of culturally adaptive, but biologically deleterious traits.

In biological evolution, the rate of development may also 'speed up' or 'slow down' through heterochronic processes. Hence, it is safe to theorize that, like in biological evolution, beside developmental shifts that affect the *rate* at which cultures evolve, the *timing* of the onset/offset of various cultural trajectories and the *extent* of their elaboration may also be affected by heterochronic shifts[11]. However, when compared to the objective and dysteleological heterochronic processes in nature, cultural heterochrony may be determined by consciously endorsed values/attitudes enshrined in the contents (ethos) of specific cultures which, mostly through group selection, may assume teleological properties.

The unique achievement which is egalitarianism is the outcome of reductions effectuated in both biological *and* cultural dimensions of evolution. Stephen Jay Gould's (1982) paradoxical definition of neoteny as "evolution through retardation," when applied to culture, could be reformulated by construing the reversal to immediate-return subsistence and the reduction of technological elaboration as a 'retardation' that, in its turn, would become conducive to the emergence of a *novel*, but 'juvenile' ('primitive', in absolutist cultural terms) economic and technological developmental phase

[11] Skeptics of heterochronic processes in biological (or cultural) evolution might resort to Dollo's (1893) 'law of irreversibility' – also known as *Dollo's principle*, usually applied to morphology, particularly of fossils, but also used to describe molecular events – according to which, an organism never returns exactly to a former state, even if it finds itself placed in situations identical to those in which it has previously lived (but see *contra*, Gould 1970). This is often misconstrued and evolution is presented as an irreversible process in which lost structures and organs cannot reappear in the same form by a process of devolution. Although the exact threshold for violations of Dollo's principle is unclear, there are several case studies the results of which dispute its validity. For example, many taxa of gastropods have reduced shells, and some have lost coiling of their shell altogether (Collin and Miglietta 2008). Similarly, a few genera in the *Calyptraeidae* family may have changed their developmental timing (heterochrony) and regained a coiled shell from a limpet-like shell (Pagel 2004).

taken into a cultural 'adulthood' where it would become a fixed feature retained in subsequent developments.

This is a crude formulation of the concept of 'cultural neoteny', which can be fully understood only in the wider context of the abovementioned heterochronic shifts affecting the rate, extent, and timing of cultural elaboration (Fig. 2).

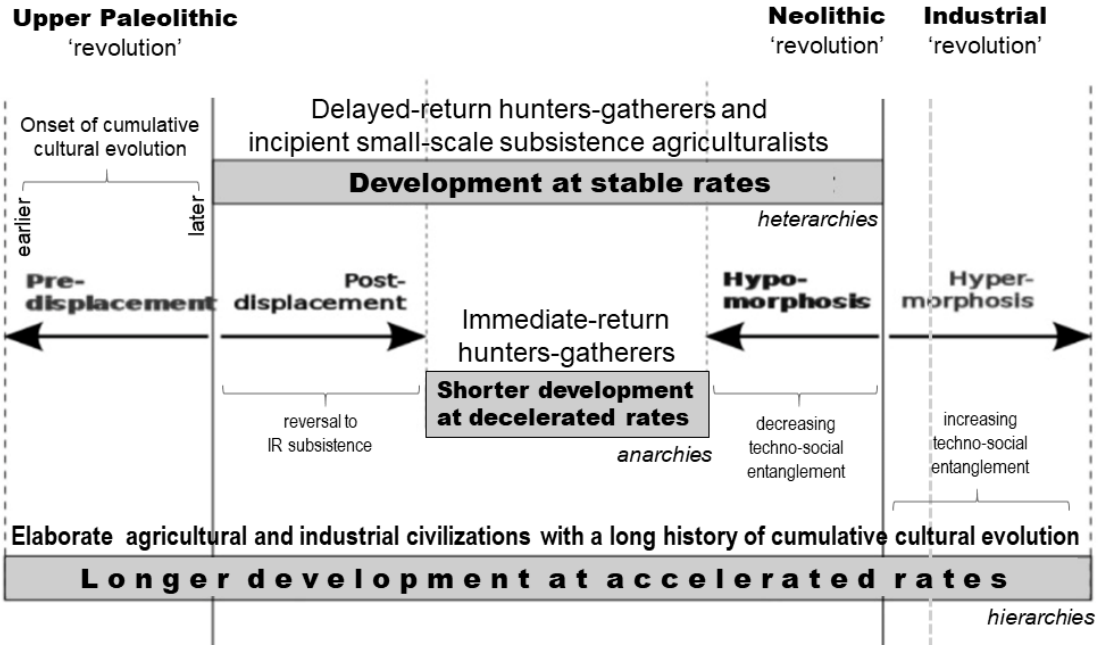

Fig. 2 Cultural heterochrony

The six types of shift in heterochrony, a change in the extent, timing, and rate of cultural elaboration. Predisplacement (earlier onset of cumulative culture), hypermorphosis (through entanglement with biologically maladaptive cultural elaboration) and acceleration (through ratcheting mechanisms) extend development (= *peramorphosis*); postdisplacement (offset of cumulative culture), hypomorphosis (through disentanglement from moderate to sufficient cultural elaboration) and deceleration (through leveling mechanisms) truncate it (= *pedomorphosis*).

Although the cognitive background allowing for the realization of fully 'mature' cultural complexity is present in all living populations, some cultural manifestations are consciously kept at a level of *sufficiency* and are '*not going as far*' as most cultures, which '*go to the full extent*' and realize a wider range of cultural possibilities but, as a consequence, they become more entangled, less flexible, and exposed to the treadmill effect. In cultures that were defined as 'subtractive', the skills necessary for the replication of a honed-down toolkit that answers all the needs are widely distributed in the population and cannot be forgotten or lost to the treadmill. Other cultures, especially those with an eye on *efficiency*, '*go beyond*' sustainability, and despite their *cumulatively* achieved

material and social complexity, become rigid and fragile, and lack the adaptability of less elaborate cultures. Moreover, also because of their cumulative character – with each innovation building on and incorporating previous innovations – social learning transmits only the latest upgrade of a long chain of already non-replicable simpler innovations, with the skills necessary for their replication being mastered only by very few *specialists*. Hence, in circumstances that might impair efficient social learning, cultures with a long cumulative history tend to crash in spectacular ways.

These three cultural examples are faithfully reflected in the *pedomorphosis* to *peramorphosis* continuum in biological heterochrony, of which neoteny is only one of three possible outcomes (Fig. 1). When applied to the cultural field of evolution (Fig. 2), we may consider the following relativistic developments:

1) *Cultural peramorphosis*, where the content of a specific cultural configuration incorporates the contents of all previous cultural stages, including the 'adult'('goes as far') stage in its further development, so that the culture 'goes beyond' its cultural ancestor (by resorting to ratcheting mechanisms). This occurs by accelerating the rate of technological and social entanglement and results in maladaptive cultural hypermorphosis (seemingly 'advanced', gerontomorphic features). These cultures also begin earlier (predisplacement), because of environmental dictates asking for compensatory cultural elaboration.

2) *Cultural pedomorphosis*, where the content of a specific cultural configuration retains an earlier ('juvenile') cultural content in its further development, so that the culture 'does not go as far' as its cultural ancestor (by resorting to leveling mechanisms). This occurs by decelerating the rate of technological and social entanglement and results in cultural hypomorphosis (seemingly 'primitive', neotenous features).These cultures also begin later (postdisplacement), because of environmental dictates asking for the reduction of obsolete elaborations inherited from an earlier stage.

Indeed, the classic examples of cumulative culture addressed in dual inheritance theory seem to have had a precipitated onset – "running ahead of time," as Vishnyatsky (1994) has cogently observed. This cultural predisplacement took place between 60 to 40,000 years ago (Richter 2000, Richerson and Boyd 2000) in Western Eurasia. Similarly, technologies and cognitive expressions resembling those of the European Middle/Upper Paleolithic transition were present in East Asia at already 47 to 43,000 years ago (Peng *et al.* 2020). In both instances, these early innovations did not disappear only to be reinvented again but became ratcheted and incorporated in subsequent cultural developments, at exponentially accelerated rates. In the ensuing gerontomorphic and technologically hypermorphic 'trans-egalitarian' (Hayden 2003) societies, individuals who would

accumulate skills and prestige kept on serving as cultural models and conformity biases would have encouraged their being continuously selected *for*.

Conversely, the examples of subtractive cultural evolution reviewed in this paper started their neomorphic (neotenous) cultural development at a relatively recent time, as a 'new beginning'. The cultural postdisplacement took place between 10 to 8,000 years ago (Morris 2003, Stynder 2006, Bousman 2005). In the novel, but technologically hypomorphic egalitarian societies (Woodburn 1982) that would result, due to the prevalence of non-conformist biases – and evidently, because model-based biases go against the grain of egalitarianism – individuals who displayed tendencies to hoard status and prestige (or use skills as a means to accumulate them) would be continuously selected *against*.

Because biological and cultural neoteny are relatively coeval occurrences in the recent *biocultural co-evolution* of these societies, they have likely influenced each other in a feedback loop that has, ultimately, resulted in a leveled *biological–cultural* continuum that cannot be observed in the ratcheted *cultural–biological* discontinuum modeled in gene-culture coevolution theory, which also envisions a rift between biology and culture, initiated with the onset of cumulative cultural evolution.

Conclusion

The analytical models of gene-culture coevolution theory were successfully tested for cumulative cultures ranging from elaborate hunter-gatherer to complex modern societies and their validity cannot be refuted. However, this paper has questioned their universality after reviewing the case of marginal immediate-return hunters and gatherers that do not seem to conform to the general rules of the theory or be affected by them. The fiercely egalitarian culture of these societies is, nonetheless, driven by the very mechanisms and biases that were postulated for cumulative cultures except that, they appear to act in reverse and result in markedly antithetical outcomes, to the extent that they may be labeled 'subtractive' cultures. Because of the compelling analogy between the variables that define both cumulative and subtractive cultures, it is concluded that the peculiar evolutionary trajectory of egalitarian societies is the exception that proves the rules of gene-culture coevolution theory. However, this becomes evident only when the theory is augmented with the hypothesis of cultural heterochrony, which would also support one of its central claims – namely, that cultures evolve through a Darwinian selection process (in which shifts in the extent, rate, and timing of development are also acknowl-

edged). Yet, having in mind that culture is a human construct, Darwinian theory's adamant stance on free will must be tempered. In addition, by heeding the call for studying the underlying philosophies and techniques conducive to equality with the same enthusiasm as we study the evolution of inequality, dual inheritance theory could become an encompassing and elegant conceptual framework that could easily accommodate and explain the entire range of human cultural diversity.

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