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Contemporary Evolutionary Theory in Biological Anthropology: Insight into Human Evolution, Genomics and Challenges to Racialized Pseudo-Science

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In a 2010 article, I suggested that our discipline has moved beyond the label of “physical” anthropology, and asked the question “are we Biological Anthropologists yet?” as the starting point. I answered in the affirmative, stating that:

“I sincerely believe we are Biological Anthropologists, and there is a great diversity of fantastic multidisciplinary and interdisciplinary work within our practice. As Sherwood Washburn called on us to do nearly 60 years ago, we must foster and enhance these activities and perspectives inside and outside of our association and discipline. Looking forward, we need more than ever to continue heeding the advice of Washburn and to build on the strengths and advances made in the recent history of our science” [Fuentes 2010].

Today, biological anthropologists find ourselves in the midst of multidisciplinary and interdisciplinary work that has created a revolution in evolutionary theory. I suggest that in familiarizing ourselves with contemporary evolutionary theory and applying it to core areas of our practice biological anthropologists situate themselves very well to contribute within and beyond the discipline. In other publications I have discussed the misconceptions and myths commonly associated with public (and on occasion academic) perceptions of evolutionary theory and laid out a suite of clarifications, explanations, and examples to guide readers through the core components of evolutionary theory [Fuentes 2009, 2012]. In this essay I target the anthropological community with an outline of the current paradigm in

contemporary evolutionary theory, and offer brief illustrations of how it engages with the interests of biological anthropologists.

ON THE "EXTENDED EVOLUTIONARY SYNTHESIS" (EES)

"Organisms are constructed in development, not simply 'programmed' to develop by genes. Living things do not evolve to fit into pre-existing environments, but co-construct and coevolve with their environments, in the process changing the structure of ecosystems" [Laland *et al.* 2014: 162].

A basic, early twenty-first-century understanding of how evolution works is captured in the following five statements:

1. Mutation introduces genetic variation which in interaction with epigenetic and developmental processes produces biological variation in organisms, which may be passed from generation to generation.
2. Natural selection shapes variation in response to specific constraints and pressures in the environment (*sensu lato*) and gene flow and genetic drift structure the distribution and patterns (landscape) of that variation.
3. Dynamic organism-environment interaction can result in niche construction which can change/shape the patterns, foci, and intensity of natural selection and creates ecological inheritance.
4. Phenotypic plasticity, developmental plasticity/reactivity, and the acquisition and biological assimilation of non-genetically induced traits, states, and processes all can play substantive roles in the patterns and production of variation.
5. Multiple pathways of inheritance (genetic, epigenetic, behavioral and symbolic) can affect evolutionary processes.

In addition to this basic understanding, it is also apparent that niche construction (NC) -i.e. the process where organisms simultaneously shape and are shaped by their ecologies- plays a key role in human evolutionary processes via our ability to heavily modify our surroundings through behavioral means [Odling-Smee, Laland and Feldman 2003]. Niche construction results in the building and destroying of niches¹ by organisms and the

¹ I am using the term "niche" in the contemporary ecological and evolutionary view: it is the dynamic N-dimensional space in which an organism exists—the totality of the biotic and abiotic factors that make-up an organism's main context for the

mutually mutable and synergistic interactions between organisms and their environments. Niche construction activity is best envisioned as a feedback process of reciprocal causation within the evolutionary dynamic, with organisms engaged in niche construction modifying the evolutionary pressures acting on them, on their descendants, and on unrelated populations sharing the same landscape [Laland *et al.* 2014].

Human cultural processes are major factors in human niche construction [Kendal 2012]. For example, O'Brien and Laland [2012] apply an NC approach to the evolution of dairying by Neolithic groups in Europe and Africa, and the rise of the "sickle-cell allele" among agricultural groups in West Africa. In these cases, they describe processes of niche construction (and concomitant gene-culture co-evolution) as involving the shifting behavioral actions, cultural perceptions, and ecological conditions that interfaced in a suite of feedback loops to produce genetic and physiological changes which themselves resulted in further modification to behavior, physiology, and ecologies of particular human populations and the other organisms (cows, mosquitos and the malaria plasmodium) involved in the NC processes. Via NC processes cultural patterns and behavioral actions and perceptions can impact genetic and other biological patterns and thus affect the process of natural selection, which in turn can affect developmental outcomes, which can then feedback into the cultural patterns and behavioral actions [Boyd, Richerson and Henrich 2011]. In the contemporary version of evolutionary theory, sometimes labeled "extended evolutionary synthesis" [EES; see Laland *et al.* 2015, and references therein], human evolution biological, cultural and ecological systems are entangled [*sensu* Hodder 2012], and are therefore not separate processes.

Jablonka and Lamb [2005, 2014] add context and potential mechanisms to this concept via their demonstrations that evolutionarily relevant information can be transferred from one generation to the next by many interacting inheritance systems (genetic, epigenetic, behavioral, and symbolic). Genetic inheritance is in the passing of gametes (primarily DNA). Epigenetic inheritance, the inheritance of molecular or structural elements outside of the DNA, is found in all organisms. This gives rise to phenotypic variations that do not stem from variations in DNA but are transmitted to subsequent generations of cells or organisms. Behavioral inheritance is the transmission, across generations, of behavioral patterns and/or specific behavioral

evolutionary dynamic. The interaction between organisms and evolutionary forces; [e.g. Wake *et al.* 2009].

actions, and is found in many organisms, and symbolic inheritance, the cross-generational acquisition of symbolic concepts and ideologies, is found only in humans and can have pronounced effects on behavioral patterns.

There are two areas where, I think, these emerging understandings about evolutionary processes are particularly critical for biological anthropology: improving our understanding of human evolution and confronting racial pseudo-science.

CONTEMPORARY EVOLUTIONARY THEORY AND HUMAN EVOLUTION

Most paleoanthropological and biological anthropological approaches to understanding humanity focus on the fossil record, on biological influences on human behavior, or on human biological development. Many social anthropologists focus on experiences of being human and the trajectories and contexts of our lives as social and symbolic creatures. However, recent work in human evolution demonstrates an integration of perspectives that destabilize such boundaries by focusing on the processes of becoming human in the context of a more integrative evolutionary framework [Dunbar *et al.* 2010, Ingold and Palsson 2013, Fuentes 2015]. This approach, drawing on contemporary evolutionary theory (i.e. the EES), advances in neurobiology and in the realm of the fossil and archaeological datasets, presents a conceptualization of the biological and social as intertwined processes and constitutes a powerful approach to the understanding of human evolution [Fuentes 2015].

We are in a data and theoretically rich time period with regards to human evolution [Anton *et al.* 2014; Fuentes 2015; Gamble, Gowlett, and Dunbar 2011, Tattersall 2012]. Evolutionary processes produce continuities and discontinuities in lineages and given what we now know about our genus (*Homo*) it is increasingly evident that to best understand human evolution over the last 2 million years we need to focus as much, if not more, on discontinuities in our line relative to other hominins and hominoids [e.g. Calcagno and Fuentes 2012]. A key contemporary challenge to human evolution is to explain why the genus *Homo* succeeded while all other hominins went extinct, and in particular what suite of evolutionary processes facilitated the emergence of *Homo sapiens sapiens*. And as Leslie Aiello and Susan Anton [2012] remind us, the extant data support a model of evolution in the genus *Homo* in which integrated feedback loops involving enhanced cooperation and cognition and changes in life history variables,

including reduced extrinsic mortality risk, are central—a scenario that contemporary evolutionary theory provides a particularly robust toolkit to address.

Given the above contexts, it is clear that in the study of the evolution of human beings biological anthropologists need to go beyond explaining just our bodies and ecologies, and develop a theoretical approach that can describe an effective toolkit for an evolving system [Fuentes 2015]. We need models that explain the processes that facilitated the transitions of populations of hominins from the production of simple stone tools 2 million years ago to increasingly complex tools and widening geographic spread 1 million years ago, to the use and control of fire, to complex hunting and rudimentary language, to art, and complex multi-community social networks, to agriculture and towns, to the megacities, global religions, and world economies of today [Fuentes 2015; Gamble, Gowlett and Dunbar 2014]. The human ability to deploy diverse sets of behavioral and developmental responses to evolutionary pressures and the resulting human influence on ecological landscapes are likely the key factors that facilitated the emergence of the aptly named “sapiens” by ~200,000-100,000 years ago. Over time, this process has also led to regional, and local, divergent human niche construction histories, evidenced via the multifarious successful human cultural patterns and cognitions of nature.

In this light it is relevant to note that theoretical and practical work in biology clearly illustrates that plasticity in development and phenotypic reactivity is more widespread in organisms than previously thought [West-Eberhard 2003], and that these patterns can have substantive effects on evolutionary change [Paenke *et al.* 2007]. This connects directly with what we know about the substantial phenotypic plasticity in response to selective pressures displayed by members of our genus, even early in our evolutionary history [Kuzawa and Bragg 2012; Wells 2012]. If niche construction is also particularly characteristic of the human lineage [Laland *et al.* 2000; Kendal *et al.* 2011, Odling-Smee *et al.* 2003], then the its deployment in the contexts of the EES can be a central tool in integrating behavioral, biological and ecological factors in modeling human evolution [Fuentes 2015]. While we now know that there are multiple evolutionarily relevant processes of inheritance [not just genetic ones: Jablonka and Lamb 2005; Bonduriansky and Day 2009], there is strong support for the assertion that behavioral and cultural actions, and their related processes of inheritance, play critical roles in evolutionary patterns and outcomes for members of the genus *Homo* [Kendal 2012; Richerson and Boyd 2005]. Placing the emerging datasets on the biology, archaeology and behavior of the genus *Homo* in the

context of the current, dynamic state of evolutionary theory, we are able to more effectively develop narratives and hypotheses about the trajectories and processes in human evolution.

CONTEMPORARY EVOLUTIONARY THEORY
AND "RACE"/HUMAN DIVERSITY

"We feel that it can never be said often enough that scientists, more than any other group, have a moral obligation to remain faithful to the famous maxim of Jose Marti: Words are not for destroying truth but for revealing it" [Comas 1961].

In reaction to the launch of the periodical publication *Mankind Quarterly*, Spanish-Mexican physical anthropologist Juan Comas wrote a comprehensive attack on "scientific racism" in the pages of the journal *Current Anthropology* [Comas 1961]. In that article, Comas' arguments are cogent and scientifically robust, but reading some of the commentary by prominent anthropologists and biologists of the day is terrifying. Many commentators applaud Comas' essay, but many do not. And the most disturbing aspect is that the pro-race arguments some commentators make are the same, or very similar, to those being made by the new wave of scientific racists today. The "words" used by some authors invoking "evolutionary" explanations about race and human variation do much to destroy the truth as Comas, following Martí, warns us of.

For example, the former *New York Times* science writer Nicholas Wade argues in a recent book that there are definable and genetically identifiable groups we can identify and label as biological races in humans today [Wade 2014]. This author relies on a miniscule review of the available data on human genetics to support his case; he suggests that believing in biological races (esp. African, Caucasian and East Asian) is just common sense. Wade tells us that it is different evolutionary trajectories that created the differences in these races and that evolutionary processes are the key explanation for the dissimilarities in histories, economies and societies between them; in short, according to Wade, evolution is the reason why "Chinese society differs profoundly from European society, and both are entirely unlike a tribal African society" (p. 123). He also argues that DNA sequence differences and separate evolutionary histories help us understand why Chinese dynasties lasted so long, why it was so difficult for the USA to instill democratic social institutions in Iraq after the war, and why so many Jews win Nobel prizes.

Wade's approach is particularly dangerous, because of his invocation of "evolutionary" processes as his core argument. As I have argued elsewhere [Fuentes 2014], his book misrepresents genetic and evolutionary data.

Wade makes two core assertions:

- A. Humans are divided into genetically identified "continental races".
- B. There are significant differences in genetically based social behaviors between these "races", as a result of the last 50 000 (or 15 000) years of human evolution.

These points are both wrong. Wade's mistakes in evoking genetic patterns and processes are horribly inaccurate and have been attacked extensively by anthropologists and geneticists alike [Marks 2014; Raff 2014; Stein 2014]; I will not review those critiques here. Wade's take on human evolution is also an exercise in "destruction of the truth" that Comas warned us of. Thinking about this in the light of what we know about the human evolutionary record and about contemporary evolutionary theory assists us in rectifying his inaccuracies and fabrications.

In regards to "races" (whether it is 3 or 5, or 7) and societies, Wade asserts that their differences "stem from the quite minor variations in human social behavior (...) that have evolved within each race during its geographical and historical existence". These differences are based on different races' social institutions, which are "largely cultural edifices resting on a base of genetically shaped social behaviors". Setting aside the fact that these "continental races" don't actually exist, such a simplistic version of evolution is just not accurate in the light of what we know about how evolutionary processes work.

Wade asserts that "the evolution of human social behavior was thus different and largely or entirely independent on each continent" (p. 135). He suggests that these differences are based on the social institutions of the different "races"; such institutions are cultural creations resting on underlying variation in genetic sequences. We know that mutation introduces genetic variation, which in interaction with genetic drift, epigenetic, and developmental (biological growth and change over the life span) processes produces biological variation in organisms. We also know that gene flow moves the genetic variation around and that natural selection shapes variation in response to specific constraints and pressures in the environment. We also now know that organism-environment interactions can result in niche construction, which can alter the way natural selection operates and create new ecologies; in humans, multiple systems of inheritance (genetic,

epigenetic, behavioral, and symbolic) can all provide information that can influence biological change over time. Social structures, cultural patterns, and behavioral actions can therefore impact evolutionary processes, which in turn can affect our bodies and behaviors [*e.g.*, Flynn *et al.* 2013; Kendal 2012; Jablonka and Lamb 2005]. The bottom line is that evolution is not simply a process of natural selection shaping specific genes (as Wade emphasizes). Presenting it as such is highly misleading.

As for the fossil, archaeological, and historical record, Wade argues that it supports people radiating out of Africa and staying away from one another for much of the last 50 000 years. He says (p. 74): “People as they spread out across the globe at the same time fragmented into small tribal groups. The mixing of genes between these little populations was probably very limited. Even if geography had not been a formidable barrier, the hunter-gatherer groups were territorial and mostly hostile to strangers. Travel was perilous. Warfare was probably incessant”. He also states that these groups followed “independent evolutionary paths that led inevitably to the different human populations or races that inhabit each continent”.

I don’t have the space here to go into all the ways in which this is completely out of touch with what we know from anthropology, archaeology, paleoanthropology, sociology, and history about the last 50 000 years of the human experience—but given what we know about human history and evolutionary processes it is readily apparent that Wade’s invocation of evolutionary narratives are inaccurate, misleading and “truth destroying”.

CONTEMPORARY EVOLUTIONARY THEORY AND ISSUES IN CONTEMPORARY HUMAN GENOMICS

DNA, once held to be the unchanging template of heredity, now appears subject to a good deal of environmental change; considered to be identical in all cells and tissues of the body, there is growing evidence that somatic mosaicism is the normal human condition; and treated as the sole biological agent of heritability, we now know that the epigenome, which regulates gene expressivity, can be inherited via the germline. These developments are particularly significant for behavior genetics [Charney 2012: 1].

A core premise in some genomic work over the last three to four decades has been that we can actually understand complex human behaviors via a gene-by-environment model (GxE). Under such a model, looking at variations in allelic representation and correlating it with physiological or behavioral outcomes using some form of measurable variation in environmental

factors as a control, can shed light on causal relationships between the gene and the outcomes. As recently stated by political philosopher Evan Charney [2012, see also Charney 2014], while there are a few cases of being able to tie specific genetic variants tied to specific outcomes with some diseases, it has not proven effective in complex behaviors and complex genetic systems, even in the extensive twin studies. The GxE approach to understanding behavior gives us overly simplistic, and incomplete, answers.

Charney's views are congenial with the position defended here: genes are part of complex and dynamic systems; a focus on only one aspect of the system (DNA) is very unlikely to provide robust predictions of specific outcomes produced by the system. One needs to know about the whole picture in which the gene exists to get an idea of what it might be able to tell us. That picture includes (i) which alleles a given person has; (ii) what the sequences of DNA near the gene are; (iii) what patterns of epigenetic markers might have been laid down on that individuals' genome near the gene (or in places that turn that section on and off); (iv) what the gene's products look like in the individual in question and which are the other allied gene products they work with (i.e. the dynamics of the proteome); (v) what is the life history of the individual we are looking at, including their health and environmental histories and, of course (vi), what have their social and psychological lives been like. This kind of complexity resonates more effectively in the context of the EES, that in the standard Neo-Darwinian approach [Fuentes 2015; Laland *et al.* 2015].

CONCLUDING THOUGHTS

Recent discoveries and theoretical shifts in biological and anthropological evolutionary theories, driven by insights about human niche construction, phenotypic plasticity, epigenetics, and how our environment and life experiences can affect the functioning of our genes and bodies—along with new findings in the fossil record and ancient DNA—have changed the basic scientific narrative of humanity. The extended evolutionary synthesis (EES), our contemporary evolutionary theory, helps us more coherently and comprehensively to understand how it was that humans acquired a distinctive set of neurological, physiological, and social skills that enabled our lineage, starting from the early Pleistocene, to work and think together in order to purposefully cooperate and create at increasing levels of complexity, distributed in diverse paths across the globe.

By engaging thoroughly with the EES, and a broad array of anthropological practice, biological anthropologists can position ourselves well to contribute to scientific insights, and the popular interpretation of them. In this quest, we would be wise to habitually consider Comas' mandate to "remain faithful to the famous maxim of Jose Martí: words are not for destroying truth but for revealing it".

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