



# Building on the biocultural syntheses: 20 years and still expanding

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## Abstract

*Building a New Biocultural Synthesis: Political Economic Perspectives in Human Biology* called for an integration of political economy with ecological and adaptability perspectives in biocultural anthropology. A major goal of this volume was to explore the utility of including political-economic and sociocultural processes in analyses of human biological variation, nutrition, and health. A second goal was to enhance collaboration among subfields and work against the “chasm” that separated complementary perspectives in cultural and biological anthropology. Twenty years hence, new ways to link social inequalities and human biology have emerged in part through contributions of developmental origins of health and disease, epigenetics, microbiomes, and other new methods for tracing pathways of embodiment. Equally important, notions of “local/situated biologies” and “reactive genomes,” provide frameworks for understanding biology and health at the nexus of ecologies, societies, and histories. We review and highlight these contributions toward expanding critical approaches to human biology. Developments over the past two decades have reinforced the central role of social environments and structural inequalities in shaping human biology and health. Yet, within biocultural approaches, a significant engagement with historical, political-economic, and sociocultural conditions remains relatively rare. We review potential barriers to such analyses, focusing on theoretical and methodological challenges as well as the subfield structure of anthropology. Achieving politically and socially contextualized and relevant *critical biocultural* approaches remains a challenge, but there is reason for optimism amid new theoretical and methodological developments and innovations brought by new generations of scholars.

## 1 | INTRODUCTION

The organizers of this special issue invited us to reflect on the current status of biocultural anthropology given the many theoretical and methodological advances in the field of human biology and biocultural anthropology since the publication of *Building a New Biocultural Synthesis: Political Economic Perspectives in Human Biology* (Goodman & Leatherman, 1998a) over two decades ago.

On the biological side, a key element for consideration is the juxtaposition of evolutionary theory and human biological plasticity (Hicks & Leonard, 2014; Meloni, 2014a), and specifically how new understandings of epigenetics and microbiomes might reshape our understanding of the interplay of plasticity and evolution. These new directions reaffirm the importance of plasticity in biological variation, and with new ideas of a “reactive genome” (Fox-Keller, 2014; Gilbert, 2003; Lock, 2017), reaffirm a



central role for anthropogenic environments in shaping local bodies and biologies (Lock, 2017).

On the more social and cultural side, scholars have articulated how local environments are embodied in “local and situated biologies” (eg, Lock, 2017), and how both local environments and local biologies are, in turn, products of broader and historically deeper macrosocial forces linked to global political economies. The need to recognize and problematize the role of political economic forces in the study of human biology, and develop new perspectives to facilitate this analysis was a central theme of the 1992 Wenner-Gren conference and subsequent volume *Building a New Biocultural Synthesis: Political-Economic Perspectives on Human Biology* (Goodman & Leatherman, 1998a).

Now, there is an increased sophistication of biological analyses and we have a better set of tools for describing and understanding the biocultural process or how society and culture become biological.<sup>1</sup> In this article, we assess the development of biocultural anthropology in the past two decades, with a specific focus on prospects for both expanded syntheses and a deeper integration of sociocultural and biological processes.

While the term biocultural is employed to describe a tremendously broad and seemingly all-encompassing set of interactions (Wiley & Cullin, 2016), and hence is beyond the purview of a single paper or review, we are speaking more specifically of a critical biocultural anthropology, and the avenues for expanding the biocultural synthesis. This entails a focus on the role of social inequalities in human health and well-being, and seeks to integrate political-economic and other perspectives emerging from a fuller engagement with social theory and ethnography, along with those of human evolution, ecology, and adaptability.

We have three objectives for this article. As historical background, to first review the contexts and rationale behind the Wenner-Gren Conference *Building a New Biocultural Synthesis: Political-Economic Perspectives on Human Biology*, and the volume that grew out of the conference. Second, to consider what new understandings of evolutionary processes and bodies themselves might mean for linking social inequalities and human biology.

<sup>1</sup>A word on nomenclature. We have historically used the term biocultural over biosocial for two reasons. First, biocultural has been the dominant term used for models attempting to integrate biological and sociocultural elements of humankind (see Bindon, 2007 for discussion of early examples and terminology depicting biosocial and biocultural research). Second, we wish to avoid any association or misconstrued alignment with sociobiological approaches. While many contributions to critical biocultural anthropology might be more biosocial than biocultural (see Dressler, 2005) in a strict sense, we continue to use “biocultural” and see the two terms as interchangeable.

Third, to discuss some of the continued challenges to developing a deeper integration of biology and culture.

## 2 | BACKGROUND: BUILDING A NEW BIOCULTURAL SYNTHESIS

The volume *Building a New Biocultural Synthesis: Political-Economic Perspectives in Biological Anthropology* (Goodman & Leatherman, 1998a), was the product of a Wenner-Gren International Conference, held in Cabo San Lucas, Mexico in November, 1992. The conference brought together biological anthropologists, archeologists, and sociocultural anthropologists. Many of the participants shared interests in medical and nutritional anthropology as well as political-economic and political ecology perspectives. The central goal of the conference was to expand the scope of research in biological and biocultural anthropology by explicitly incorporating political-economic perspectives into analyses and interpretations of human biological variation and well-being. The organizers and contributors sought to explore new directions in biocultural analysis that could enhance our understandings of human biological variation. We also sought to enlist the interest and collaboration among sub-disciplines of anthropology, and help traverse the theoretical and methodological chasms that separated scientific from humanist perspectives, and most especially that separated biological from sociocultural anthropology, even when they shared interests in human health, suffering, and other biocultural topics (Goodman & Leatherman, 1998b).

In particular, the participants envisioned a need to develop approaches capable of addressing critical social and biological dimensions of an ever-expanding list of global problems ranging from growing economic inequalities and health disparities, to environmental degradation and climate change, to conflicts and violence. Problems such as these with prominent social, economic, and political dimensions had largely been absent in biocultural research. There was no biocultural theory that addressed human biology within the power relations of global world systems or local-level lived realities. Likewise, most sociocultural theory and anthropological political economy simply ignored biology. We felt, that a biocultural perspective that could more deeply integrate the social and biological dimensions of the human experience, including global and local power relations, was clearly needed but hampered by a growing separation (and seemingly irreconcilable epistemological differences) between social and biological anthropologies. The relevance of these global problems (and biocultural perspectives that more fully integrate the social and biological)

has not diminished in the past two decades, and if anything has intensified. And we believe that momentum for the view that critical biocultural approaches can help us better understand and ameliorate the human impact of such problems is increasing.

For many of us working with vulnerable people in marginal environments around the world, it was (and is) increasingly apparent that marginality and vulnerability, often framed as a result of stressful physical and biotic environments, were neither natural nor inevitable. Rather, the grinding poverty of structural violence, social and political inequalities, and the subjugation of groups in colonial and postcolonial political economies, created vulnerabilities. Thus, consideration of the origin and nature of these contexts was central to a deeper understanding of human biology and health. A goal of most who were involved in constructing a new biocultural synthesis was to find ways to better make sense of a broad range of observations on human variation that emerged in fieldwork around the globe. This required new models and formulations that moved beyond evolutionary and adaptability theory that is ill-equipped to address social processes of inequality.

For example, over decades of research on the biology of high altitude populations in the Andes, an array of researchers came to consider that some of the most important forces shaping human biology at altitude were extreme poverty stemming from centuries of coloniality (Quijano, 2000), rather than the hypobaric hypoxia of high mountain zones (Carey, 1990; Greksa, 1986; Hoke & McDade, 2015; Leatherman & Thomas, 2001; Leonard, Leatherman, Carey, & Thomas, 1990). While the low oxygen pressure and hypobaric hypoxia at altitude do generate compensatory biological responses (Baker, 1969; Beall, 2014; Frisancho, 1993; Frisancho & Baker, 1970), evidence points to a more profound set of developmental responses than genetic adaptation to the exigencies of multistress high altitude environments. Developmental and sometimes even multigenerational responses emerge within local ecologies (Hoke & McDade, 2015).

Moreover, there is evidence of great plasticity in face of changing political ecological contexts (Hoke & Leatherman, 2019; Leatherman, 1994). Local ecologies in the Andes are defined by access to land, labor and other resources, by social inequalities, and in many cases by abject poverty (Leatherman, 2005). Yet, while the changing economic environments as a result of changing political economies arguably explained more ecological and biological variation, they were seen as less relevant to studies of human biology. Why would we not study human biological variation within these local ecologies and larger political economic structures? A partial answer was postulated as an overreliance of seeing variation as the consequence of evolved adaptations.

Livingstone's (1958) analysis of the evolution of sickle cell is one of the most influential and highly referenced papers in anthropology because he was able to synthesize a wide range of ecological, social, evolutionary, genetic, and historical information to show that sickle cell trait was likely an adaptation to prevent malaria, balanced against the deleterious consequences of sickle cell disease. While a monumental discovery, in the over 60 years since this article, relatively few other evolved genetic adaptations have been uncovered. Conversely, it appears that most of the challenges faced by human groups are more prosaically the result of human interactions with other humans. Interestingly, as well, while the sickle cell example is seen as a demonstration of natural selection at work in humans, the conditions that set into motion the genetic response involved human actions, specifically clearing lands for agriculture and in the process, aiding the habitat of the mosquito that carries the malaria parasite. For this reason, some cite the sickle cell adaptation as an example of "unnatural selection" (Leatherman & Thomas, 2001; Santos & Coimbra, 1998; Singer, 1996).

Evolution, adaptation, and developmental plasticity are central features in biocultural analysis, and provide a lens through which we continue to view biological, behavioral, and social responses to local conditions. Yet, critiques of the "adaptationist program" from within evolutionary biology (eg, Gould & Lewontin, 1979; Lewontin, 1978) and anthropology (eg, Singer, 1989, 1998), questioned the overreliance on programmatic evolutionary explanations and "just so" stories of human biology and behavior, and the common understanding of adaptation as response to problems posed by an environment that is external and alienated from people (Smith & Thomas, 1998); that is, adaptation without agency. Rather, drawing on Levins and Lewontin (1985), the contexts of adaptation were seen as set by the rich dialectical interplay of organism and environment (Leatherman & Goodman, 2005a, 2011). Rather than adapting to pre-existing niches, humans and other organisms use environmental features to construct niches - the environmental contexts of their own adaptive responses. In this sense, the notion of adaptive process as a series of ongoing "responses" to ever-changing conditions is more useful than "adaptation" as a product or end point. These responses carried costs and consequences, engendering future response, and were not value free.

The small but healthy debate provides a pointed example of the fallacy of "no-cost" adaptations and "quitting early" (failing to fully investigate the functional costs of undernutrition) (Martorell, 1989; Pelto & Pelto, 1989), as well as the political and economic ramifications of scientific interpretations. The identification of smaller body size among poor, rural, and marginally nourished



peasant farmers in India (Seckler, 1980) as an “adaptation” to marginal conditions starkly pointed to the abuses of the adaptation concept. Is stunted growth associated with resource shortages, clearly a response to a stressor that is part of a biological program, best thought of as an adaptation? If not, what other named adaptations are responses best described as species-level *constraints* on biology that are by-products of a larger evolutionary program (eg, broad and general “trade-offs” on growth and development that maintain body functioning).

Critiques of the adaptationist program from within evolutionary biology were in part about scale, that is, the appropriate units of adaptation (Gould & Lewontin, 1979; Lewontin, 1978). Within human adaptability research, Mazess (1975) discussed the scale of response from cell to individual to population, and made clear that you cannot apply the same adaptive criteria across these different levels of response (ie, to say that cells respond or adapt to a stressor in a specific way cannot be equated with individual adaptation). One of the major flaws in constructing evolutionary explanations for human behavior is conflating the potential for a behavior with its proximate motive and rationale (Lewontin, Rose, & Kamin, 1985). While this should be rather obvious, it seems to be at heart of immodest statements about the biological basis for behaviors.

These critiques emerged alongside parallel arguments against the biological determinism in popular sociobiological explanations for human behavior (Lewontin et al., 1985; Sahlins, 1976), and even broader critiques of ecological theory within anthropology (Orlove, 1980; Singer, 1989). Ecological models were criticized for their focus on closed homeostatic systems, circular logics (tautologies), lack of human agency, and in the words of Starn (1991), “missing the revolution,” paying so much attention to the functional inner workings of societies or communities that they failed to see the broader connections, social disruptions, discontent and brewing revolution across regions. Analytically, we were not well positioned to address social change nor explore interregional and global relations.

Thus, in addition to rethinking adaptive process, an important goal of the biocultural synthesis was to expand our views of time and space to envision environments more broadly, pay attention to historical contingencies, examine global-local and macropolitical economic forces and relations of power and control, and assert a greater sense of human agency (albeit constrained agency) in biocultural models (Goodman & Leatherman, 1998b; Leatherman & Goodman, 2011). In this sense, critical biocultural approaches shared much with perspectives emerging from critical medical anthropology and the complementary rise in critical approaches in public

health and social medicine that came out of a shared intellectual climate of dissatisfaction with existing paradigms in biomedicine that looked for biological explanations to medical problems (Farmer, 1999, 2004; Krieger, 2001; McKinley, 1986; Singer, 1998). Like structural violence approaches, they seek to combine history, political economy, and biology in a framework that examines inequalities and biology in social and environmental contexts that are “geographically broad and historically deep” and that recognized the limits of human agency in dealing with structures of inequality (Farmer, 2004). Like eco-social approaches in public health (Krieger, 2001), they share an explicit focus on pathways to embodiment; how lived realities “get under the skin” and directly impact human biology (Krieger, 2001). Eco-social public health, critical medical, and critical biocultural anthropology generally share the goal of linking structures of inequality and constrained agency to pathways to embodiment and biocultural well-being.

These approaches, which we see as quintessentially biocultural, interestingly developed in parallel fashion by integrating perspectives from political economy and political ecology into approaches previously defined by cultural and human ecologies, and lifestyle factors. Given somewhat similar intellectual roots albeit from very different starting points, they comprise what we see as examples of critical biocultural or biosocial approaches in anthropology and public health. Not surprisingly, they tend to address issues of human health which are ineluctably grounded in material and social bodies, in biology, in social experience, and in power relations. Additionally, anthropologists foreground studying these processes in ethnographically grounded local contexts, lived experience, and local biologies.

Finally, an additional feature of the *biocultural synthesis* was to recognize context not only in history and environments but also in the production of scientific knowledge, and align with critiques of notions of objectivity and universal truths/facts out of social and political contexts of knowledge production (Morgan, 1998). We maintained that closer attention to biases and subjectivities in our science improve the science, rather than detract from it. Here, we make two points. First, uncontextualized “objectivity” and “truth claims” are not attainable, and we would do well to both acknowledge and reckon with this. Recognizing the way science is shaped socially and politically strengthens rather than weakens the science. Second, all work is political—it emerges in a social and political climate and has political implications—even if not consciously. To simply conform to normative approaches is a political act to support the status quo. Why not recognize the implications of our research and interpretations for their emancipatory impacts as an element of their success?

### 3 | EXPANDING THE BIOCULTURAL SYNTHESSES

Biocultural anthropology has slowly been transformed in the two decades since the publication of the *Biocultural Synthesis* in 1998. Biocultural research now often includes greater concern with the biological dimensions of social and environmental problems, paying attention to broader social contexts and contingencies, and employs new insights and methodologies that can better elucidate the pathways to embodiment. Some of the former points of contention around the goals and possibilities of “objectivity” in science are also no longer so divisive. For the most part, a new generation of students increasingly understands that scientific questions, methods, and interpretations emerge within social contexts, and understand that the way we do our science and the results we produce inevitably have political implications.

Examples of biocultural research of biological trained anthropologists or bioculturally oriented medical and nutritional anthropologists that illustrate trends toward a more socially contextualized research include work on poverty, inequalities, and health (Leatherman, 2005; Lende, 2012; Singer, 2011), on food and water insecurities (Hadley & Crooks, 2012; Himmelgreen & Romero-Daza, 2009; Ruiz, Himmelgreen, Romero-Daza, & Peña, 2015; Wutich & Brewis, 2014; Wutich & Ragsdale, 2008, Young 2012), on violence, trauma and conflict (Leatherman & Thomas, 2008; Martin, Harrod, & Perez, 2012; Panter-Brick, Eggerman, Gonzalez, & Safdar, 2009; Pedersen, 2006; Perez, 2016), on lifestyle and status incongruities and loss of cultural consonance (Bindon, 2007; Dressler, Balieiro, Ribeiro, & Dos Santos, 2015; McDade, 2002), on stress and distress of social status and vulnerabilities (Brewis & Wutich, 2015; Mendenhall, 2012; Seligman, 2014; Sweet, 2010, 2011; Tallman, 2016), and on the embodiment of race as biology (Blakey, 1994, 1998; Goodman, 1997; Gravlee, 2009; Kuzawa & Sweet, 2009). And we could cite other examples as well, including many contributions from bioarcheology (Zuckerman and Martin, 2016).

Two characteristics are evident in these profiles. One is that work that more deeply blends social and biological perspectives is often applied. The other is that it is carried out in domains of medical and nutritional anthropology. In other words, deeper biocultural integration seems to emerge when asking practical and applied questions about human biology and health. There are a growing number of examples. Wiley's (2004) work on milk and Brewis and Wutich (2015, 2019) on obesity and the stigma surrounding obesity are two good examples. The community-based participatory Tallahassee project

directed by Lance Gravlee focusing on racial inequalities and health points to important direction for biocultural research (Boston, Mitchell, Collum, & Gravlee, 2015). A range of other examples are found in the 2015 special issue on “Translating Human Biology” in the *American Journal of Human Biology*, and in several special issues of *Annals of Anthropological Practice*, such as the 2011 issue on HIV/AIDS and Food Insecurity in Sub-Saharan Africa, the 2012 Issue on Syndemics in Global Health, and the 2014 issue on Biocultural Approaches to Health Disparities in Global Contexts.

The research on health syndemics (Mendenhall, 2012; Singer, 2011) has become an important locus for collaboration among biological and bioculturally oriented medical anthropologists. Singer and Clair (2003) introduced the notion of “syndemics” to label the synergistic interactions of two or more diseases often clustering within populations suffering from multiple axes of inequalities in biosocial contexts. Syndemics has been adopted as a framing concept to address clusters of disease and social problems such as substance abuse, violence, and HIV/AIDS in inner-city impoverished women (SAVA Syndemic—Singer, 2001), and depression, diabetes, and social distress among Latina immigrants in Chicago (VIDDA Syndemic—Mendenhall, 2012). Syndemics research is grounded in an integrated bio-social approach that links structural forces to structural vulnerabilities to disease, and explores biological and social pathways of embodiment (Singer, Bulled, Ostrach, & Mendenhall, 2017). This then requires a mixed-method approach integrating quantitative with qualitative data, ethnographic as well as more structured and biomedical analyses. And it has obvious applied implications for how we create policy and provide care to those living with greatest inequalities and at greatest risk to illness and disease (Mendenhall, 2017).

Studies of the biology or embodiment of racism that are responding to questions about the source of racial health inequalities present another fertile area of research within a critical biocultural approach (Armélagos & Goodman, 1998; Blakey, 1994, 1998; Dressler, Oths, & Gravlee, 2005; Goodman, 1997; Gravlee, 2009; Gravlee & Dressler, 2005; Kuzawa & Sweet, 2009). Earlier rejections of race as biology in favor of race as socially constructed formed part of an initial rethinking of the race concept, but decentered material, biological, and health implications of racism. A focus on embodiment of racism (eg, how the social life of people of color in racialized societies “gets under the skin”) allowed analyses of race as socially constructed *and* with very real biological effects (Goodman, 2013; Gravlee, 2009). This takes biological matter (bodies) seriously and worthy of serious analysis, not just representation, and can work against the dichotomies of internal–external and nature culture that have dominated scientific thought and reason (Barad, 2003).



Thus, deeper biosocial/biocultural integration can take many forms, often expanding from political economic processes. They might emphasize psycho-bio-social integration, cognitive dimensions and dissonances, social and disease stigma, and might emerge from within biological anthropology or other related fields employing biosocial and biocultural approaches. Yet, all benefit from a close attention to the historical contexts and social relations that define human experience in local environments.

### 3.1 | Expanded pathways of embodiment

A central challenge to biocultural analyses of biology and health has always been identifying and tracking more explicitly the pathways by which lived experiences are embodied. For example, links between poverty and health can follow many pathways including food insecurity and disrupted diets and nutrition, through the immune system, autonomic stress response, genetic and epigenetic processes, and gut microbiomes. A quarter century ago, it was much more difficult to directly and clearly connect large scale political economic processes to biomedical processes. We might have known the ends but the translation events in the middle were murky.

One exponential area of growth in biocultural research has been in the greater number of explicit pathways of embodiment which are somewhat better mapped and for which there are field measures which can be paired with ethnographic data collection. For example, advances in the use of biomarkers enhance the ability to link ethnographic contexts, local biologies, and a variety of indicators of stress and health. A diverse set of biomarkers can provide information on multiple physiological pathways (neuroendocrine, cardiovascular, metabolic, and immune/inflammatory) through which social factors can contribute to health (McDade, Williams, & Snodgrass, 2007; Worthman & Costello, 2009).

Both theoretical and methodological advances in work that encompasses fetal and/or metabolic programming, developmental origins of health and disease (DOHaD), and epigenetics also represent a significant area of advancement in biocultural anthropology. This work has provided new insights into how biological impacts of lived realities might be traced across the life course and generations (Gluckman & Hanson, 2006), and thus new potentials for connecting evolution, social inequality, and biological plasticity (Hicks & Leonard, 2014). Research on the DOHaD hypothesis has demonstrated the importance of early life environments to the programming of a number of major physiological systems including the hypothalamic-adrenal-pituitary axis, the

immune system, and metabolic functioning (Barker, Eriksson, Fors'en, & Osmond, 2002).

Perhaps the best-known example is the thrifty phenotype hypothesis that proposes a relationship between prenatal and early life nutrition and adult obesity, diabetes, and cardiovascular disease (Barker et al., 2002; Hales & Barker, 1992), especially where there is a mismatch between the nutritional landscape during fetal development and the subsequent life course. Such studies have advanced biocultural anthropology by working against genetic determinism and revealing instead the complex interplay between genetics, life course, and environments in the embodiment of human experiences.

One of the primary mechanisms by which anthropologists are turning to study developmental programming and its effects is epigenetics, heritable changes in gene expression and phenotype that are not caused by changes in the underlying DNA sequence. Rather, these changes (eg, via methylation and histone modification) are caused by a wide variety of environmental exposures ranging from psychosocial stress to toxic chemicals to the kinds of foods we eat. Because our environmental exposures are largely influenced by both cultural and social factors, epigenetic changes and developmental plasticity as pathways of embodiment provide links between broader social worlds and human biology. New findings in epigenetics make clear that the human genome is more reactive than directive (Gilbert, 2003). Communication among DNA, RNA and proteins is multidirectional. As Lock (2017) summarized (p. 7), "... a dynamic epigenetic network with a life of its own has been exposed, which can best be understood as a context-dependent reactive system of which DNA is just one part. Thus, contingency displaces determinism." Indeed, Evelyn Fox-Keller (2014), 2423 sees the most important and radical conceptual contribution of epigenetics is that "it challenges the very distinction between "genetic" and "nongenetic." As such, it is part of a much larger revolution in our thinking both about the relation between genes, genomes, and organisms, and about the relations between all three of these entities and their environments."

New work on the microbiome has further changed way we view biologies. Microbial cells outnumber human cells in the body and the number of microbial genes in the body are at least 100 times greater than in the human genome (Knight et al., 2017). As Knight et al. (2017, p. 66) surmise, "The impact of this enormous number of microbial genes and cells on human biology must be profound. Furthermore, unlike the fixed human genomes, these microbial gene repertoires are highly malleable, offering exciting prospects for novel therapies."

The microbiome changes during human development, especially over the first 3 years of life, and in

association with specific life events such as pregnancy and birth, and has been implicated in the DOHaD (Kerr et al., 2015). Mode of delivery affects the microbiome of the newborn, and weaning forces a maturation of microbiome, which changes with the introduction of solid food, and diet has an especially strong effect on gut microbial communities (Knight et al., 2017). The microbiome is also affected by infections, stress, sleep, and especially the widespread use of antibiotics. In turn, alterations in the microbiome have been linked to diseases such as dental caries and a host of bacterial infections, as well as chronic problems such as obesity, diabetes, cardiovascular disease and even unsuspected diseases such as depression and Parkinson's disease. Some of the strongest associations have been found with malnutrition and immune function (Knight et al., 2017) as well as metabolic disease (Kerr et al., 2015).

### 3.2 | Situated biologies

An earlier and important conceptual shift that aligns well with new work in epigenetics and the microbiome, and a biocultural anthropology of embodiment, is Margaret Lock's notions of "local biologies" (Lock, 1993, 2001), "situated biologies," (Lock, 2017), and "biosocial differentiation" (Lock & Nguyen, 2010). Lock proposes that biologies are entangled with local ecologies and social conditions. She summarizes that:

"...anthropologists of embodiment should, I believe, seek to situate bodies in time and space, thus bringing to the fore the inevitable coalescence of material bodies in environments, histories, social/political variables, and medical knowledge of all kinds.... part of our task is to recognize "local biologies," that is, biological difference among people that results from bodily responses to differing environments over time and across space. Such differences are not genetically determined, and a great number are of no consequence, although some bear profoundly on health and illness." (Lock, 2017, p. 5)

The notion of local or situated biologies and "unstable bodies" (Palsson, 2016) are counterpoised to the standardized, universal, body proper that has been so important to biomedical sciences. Such notions consider bodies and biology as the constant and total interactions of social, cultural and biological—where social and biological are mutually constitutive—that is, in a dialectical relationship where neither can be understood in

isolation. These "continual interactions of biological and social processes across time and space that sediment into local biologies" underlie what Lock and Nguyen (2010, p. 90) call "biosocial differentiation." Palsson (2016, p. 100) has argued, "If the material and social body are fundamentally conflated through continuous processes of relationality and embodiment...the issue of human variation needs to be revised and expanded." That is what indeed has been happening in recent decades.

As the potential for epigenetic change and the realization that very little of the human genome actually codes for proteins and yet is conserved (likely for regulatory function) one of the other common phrases that is circulating is "the reactive genome" (Gilbert, 2003), a term that recognizes both plasticity and contingency, and also serves to counter emphasis on a directive and relatively fixed genome. Fox-Keller (2014, p. 2425) states that genomic science "...has turned conventional understanding of the basic role of the genome on its head, transforming it from an executive suite of directorial instructions into an exquisitely sensitive and reactive system that enables cells to regulate gene expression in response to their immediate environment..."

So, now we have notions of "situated bodies" and "reactive genomes," but a genome far outnumbered by the number of genes in the microbial community that inhabits our external and internal environments and may shape many biological processes. This is a profoundly different view of bodies and biology that has emerged since the publication of the *Biocultural Synthesis* in 1998.

## 4 | EXPLORING THE CONTEXT AND CONTINGENCIES OF SITUATED BIOLOGIES

As we consider transgenerational transfers of epigenetic information, changing microbiomes, and a greater focus on local bodies and biology, getting contexts right is important. This includes being attentive to and working against naturalizing, making to seem real or natural challenges to health and well-being that stem from sociopolitical conditions (Blakey, 1996, 1998). If not, we risk blaming individuals for their own disrupted biology, for example, that peoples "bad behaviors" are the root cause of their poor health, or that mothers' unhealthy behaviors are to blame for epigenetic changes and compromised biologies in their children. It is important to maintain a healthy skepticism and acknowledge the limitations and potential pitfalls of the study of epigenetics and similar processes as we incorporate them into critical biocultural inquiry (Lock, 2013, 2015; Meloni, 2014a; Meloni, 2014b; Meloni & Testa, 2014; Non & Thayer, 2015; Thayer &



Non, 2015). In this time of an emerging science, with much still unknown, it is common to conflate potential for effects with real effects. There is the ever-present risk of overreliance or overinterpretation of epigenetic findings (Non & Thayer, 2015; Thayer & Non, 2015), which may reduce attention to other potential mechanisms of plasticity and inheritance, both biological and social. Moreover, the risk of somatic reductionism and neoreductionism, can mask or ignore those social, economic, and political forces that shape the environment (Lock, 2013, 2015).

This reinforces the critical importance of examining *local biologies* through grounded ethnographic research in varied and interacting contexts (historical, political-economic, social, cultural, and ecological). Despite greater attention to linking biology to social problems, and despite employing new methods to better elucidate dimensions of biological plasticity as embodied lived experience, we continue to grapple with context and particularly historical and political-economic context. For example, relatively few of the articles in a recent review of biocultural work by Wiley and Cullin (2016) explicitly employed political economic analyses. Grappling with these contexts is important to avoid naturalizing local ecologies, and making our analyses more relevant to wider arenas of scholarship and practice. It remains a challenge to all biocultural research.

What then are some of the roadblocks and challenges faced by biocultural anthropologists seeking to delve more deeply into these broader and deeper political economic contexts, and make them central to their research and analyses? Here, we note three among other possibilities: (a) a reluctance to stray too far from core issues of evolution, adaptation, and stress, and thus maintain sub-disciplinary boundaries; (b) this work takes us outside of a comfort zone of perceived methodological certainty; and (c) the limitations of subdisciplinary specialization and training. These are all interrelated and reflect upon the limitations of the subfield structure in anthropology.

#### 4.1 | Expanding theoretical reach

We are generally trained with a limited theoretical tool kit and it is not easy to embrace new, foreign approaches, and yet our ability to address many questions of social relevance and with relevant to human biology, health and well-being demand that we learn from and draw on perspectives appropriate to the questions we ask. Evolutionary processes are quite obviously central to any consideration of humankind, as are linguistic and cognitive processes, political and economic processes, and so on. To us, it seems both obvious and logical that if one's

research questions address the human biology of poverty, inequality, or of any social process (ie, arguably many research questions), drawing on theoretical insights from the study of inequalities is at least as important as those directing inquiry into the inner workings of bodies and biologies. We do not have to limit ourselves to one perspective, or for example adopt the view that emphasizing social explanations of biological variation over an evolutionary explanation is an affront to either evolutionary theory or the study of human biology. Nor is emphasizing evolutionary explanations a sign of ignoring social and cultural context. We need no litmus tests of disciplinary membership. And it follows that drawing on multiple perspectives in unison may be all the more powerful.

Equally important is convincing our colleagues who are more firmly entrenched in social and cultural worlds of the relevance of paying attention to biology and bodies. This may first entail confronting suspicions of biology stemming from historical legacies of scientific racism and other reductionisms. We hope that by adding rich context, combatting naturalizing and reductionist thinking, and demonstrating relevance helps to bridge these chasms. The path we advocate is one where disciplinary boundaries become so blurred as to be illegible and work across the biocultural divide is recognized as sensible, necessary, and cutting-edge interdisciplinary research.

An ever-expanding range of approaches from biocultural scholars is evidence of the power of integration and blurring subdisciplinary boundaries. Bringing plasticity to the forefront of evolutionary models (Hicks & Leonard, 2014), advancing new notions of biosocial inheritance (Hoke & McDade, 2015), of embodied heritage (Jernigan, 2018), of syndemics (Mendenhall, 2012; Singer, 2011), of situated biologies and reactive genomes (Fox-Keller, 2014; Gilbert, 2003; Lock, 2017), and bringing forward the increasing diversity of voices in biocultural anthropology (Smith & Bolnick, 2019) all attest to recent strides in biocultural anthropology and an expanding biocultural synthesis. In their introduction to a "Vital Topics Forum" in the *American Anthropologist*, Smith and Bolnick reflect on how science has always been a view from somewhere, and how historically biological anthropology has produced knowledge "framed by classist, patriarchal, heterosexist, white supremacist, and settler colonial agendas (2019: 465)." We are at a moment where new and diverse voices and perspectives are welcome and necessary, and where new notions of culture-nature dialectics and new possibilities for biocultural syntheses are envisioned. Adherence to one or a few theoretical dogmas can only stifle not promote these potentials. We need to maintain and nurture spaces for interdisciplinary and intradisciplinary practice. As Eldridge and Gould (1972) famously stated almost

50 years ago—theory colors perception and shapes what sorts of questions are asked—so we need to expand our theoretical toolkit. Our long-term goal is for there to be no need to speak of a “critical” biocultural approach, because all biocultural would be critical. This is largely the case now in medical anthropology, but not yet in most approaches contained under the umbrella of biocultural anthropology.

## 4.2 | Moving out of comfort zones

Too often we “retreat into the laboratory” and the false premise of methodological objectivity and certainty, a point made by Martin (1998) for skeletal biologists 20 years ago. For some, the only facts are those that are measurable and quantifiable; the only truths are universal. The inability to see a way into the opaqueness of social worlds, and specifically the absence of a standardized and universal measure of “political economy,” and the lack of clarity in biological pathways of embodiment through which social worlds “get under the skin,” make the analysis of local biologies in broad social and political-economic contexts overwhelming. Indeed, more biocultural anthropologists have embraced an examination of inequalities and biology only as methodologies for better elucidating pathways to embodiment have emerged. So there is comfort in the biology and biological methods for its apparent clarity, and discomfort with historically and ethnographically driven political-economic analyses, which appear to be less clear and more ambiguous.

To be sure, the sort of explorations we are advocating go beyond standard measures of SES or GINI coefficients of economic inequality, to inquire into the historic roots of inequalities and their current expressions in local environments and biologies. The key to identifying the most important and relevant dimensions of political economy and local environments in studies of local biologies depends on historical and ethnographic analysis; there is no escaping ethnography in critical biocultural/biosocial approaches.

So what to measure and how to measure it? For example, in the Andes where one of us worked, the most critical dimensions of local political economy were relations of power that shaped access to land and labor for agropastoral production. In other research contexts, it might be about access to equal pay and benefits, political and economic policies and structures that limit where someone can live (eg, redlining) or access to healthy foods (eg, food deserts) and health care. Wilkinson and Pickett (2011) in *The Spirit Level: Why Greater Equality Makes Societies Stronger* argue that for more

economically developed nations income inequality drives disparities in both health and social well-being. What is relevant depends on the local contexts but it is always important to be attentive to the historical roots of these inequalities or they become naturalized and “taken for granted” parts of the environment. Examining who benefits and who pays the price (Krieger, 2001; Leatherman, 1998; Singer, 1998) is another way to hone in on relations of power that shape people’s biology. There is obviously no single instrument through which one can measure inequality or “political economy.” There are multiple measures of economic status and inequality, from GINI coefficients of income inequality, to any numbers of ways to quantify SES, to the UN Human Development Index, and so forth. These provide variables for quantitative analyses but not broader conceptualization of macro/political-economic forces that shape the realities these numerical indices depict. For that, we need broader analyses that include historical analysis of global–local interactions and are rooted in ethnographic observation of local environments and local biologies. These are approaches that focus on institutions and structures that do harm by denying access to resources and limiting life’s choices and possibilities (Roseberry, 1989; Sen, 1981; Wolf, 1982).

## 4.3 | Disciplinary specialization and training

While we are suggesting broadening our theoretical and methodological approaches, this poses a conundrum. In the ever-specialized world of science, interdisciplinary training is ever narrower, and even when not, imposter syndrome looms large. So will we biocultural anthropologists use embodiment in its fullest and most theoretically sophisticated form? Probably not. Will we match the sophistication of Marxian scholars in our political-economic analyses? Almost certainly none of us will. We, the coauthors, most certainly have not.

We conducted research and published on the *Coca-Colonization* of diets in the Yucatan (Leatherman & Goodman, 2005a, 2005b). While we tried to frame our community study in the political economy of tourism, we never really managed to properly “study up” in Nader’s (1972) terms or “march upstream” in McKinley’s (1986) terms to look at the structures of *Coca-Cola* or *Pepsi* corporations fighting for the “stomach share” of the Mexican population (Leatherman & Goodman, 2005a, 2005b, p. 839) We might have, and perhaps should have, talked more to company executives and studied the structure and culture of their respective organizations. However, the point is not to do everything or dismiss work that

does not. Rather, at least acknowledging these larger frames of reference keep pathways of analysis open. Perhaps in the next decade, we might see more biocultural anthropologists joining with others or themselves walking upstream to see who is throwing the bodies in the river (McKinley, 1986); or in this example, marketing “killer commodities” (Singer & Baer, 2008) to the Maya and others.

The larger point is that any perceived shortcomings should not lead us to ignore context, downplay its importance, keep us from grounding local biologies in ethnography to the best of our abilities, and to share the results broadly. We can all read history, can attempt to frame our work in larger political economic forces, and seek collaborations. And more importantly, biocultural analyses bring a level of integration and synthesis to the analysis of the human condition largely absent from much anthropology. Bodies matter, biology matters and braiding them together with social, cultural, and political-economic perspectives on the human experience makes a critical contribution to anthropology.

Currently, most large departments make hiring and promotion decisions within subfields. However, one could envision new programs that cut across subfields, for example, program in applied human biology. Such programs may be key to a reintegration across theory and application as well as across biological and cultural perspectives. We can cite two examples in the applied anthropology program at the University of South Florida or the School of Evolution and Social Change at Arizona State University. There are others, but the point is that these programs promote a strong interdisciplinary focus and training often in search of practical solutions for challenges to health, society and the environment.

## 5 | SUMMARY: PAST AND FUTURE

When the *Biocultural Synthesis* volume was published in 1998, it was intended both as a critique and way forward. We pointed out that overreliance on evolutionary explanations of human biological variation and the dominance of an “adaptationist program” within evolutionary theory limited the sort of research questions, methods, analyses, and interpretations possible. Theory colors perception (Eldridge & Gould, 1972) and evolutionary theory colored a perception of human biological variation as incremental adaptations to environmental stressors produced predominantly by natural selection—where stressors were a component of the natural environment rather than a product of human action. Ironically, the practice of the evolutionary program that looked back in time through

an inverted looking glass all but erased history by treating it as one long continuous and homogenous flow of constant selective pressures (a necessary assumption). Focusing on humans as constructing niches added an element of agency not seen in earlier models (Fuentes, 2016; Levins & Lewontin, 1985; Smith & Thomas, 1998). Gould in his many books, notably “*A Wonderful Life: The Burgess Shape and the Nature of History*,” advanced the importance of historical contingency, and this provided a more nuanced history to evolutionary change.

As we have noted, the landscape of human biology, evolutionary theory, and the potential for linking macrosocial forces and structural inequalities to human biology and health through multiple pathways of embodiment has changed dramatically over the past two decades. Linkages such as these require a fuller engagement with theory and method across a range of disciplines, rooted in ethnography, and attentive to the relations of power producing social inequalities. Yet, barriers remain and we have tried to note a few of a number of barriers to fully engaging the social and biological in biocultural research. Subfield silos and specialization within anthropology work against such integration, and more applied multidisciplinary programs oriented toward addressing practical issues of human biology and health provide antidotes.

If there is a single dominant theme of human evolutionary history, it is tremendous adaptability that humans possess as a result of culture and biological plasticity. Because both culture and plasticity occur within human-constructed niches, and include not just physical environments but social worlds, a challenge was and is to define the social world. Social inequalities of all sorts are major elements of this definition. Social inequalities are products of larger macrosocial political economic forces, and hence an approach that can weave together evolution, adaptability/plasticity, and political economy to explain human biological variation is needed. A variety of theoretical models have developed such approaches, including structural violence, ecosocial perspectives, political ecology, and historical trauma. We advocate and encourage a stronger engagement with a full range of these and other similar approaches to continue to build and expand on a critical biocultural anthropology.

Key elements of a critical biocultural anthropology, like these other perspectives, is to bring history, political economy, and biology into articulation in grounded ethnography. One of the signs of a vibrant discipline are the ways new generations of scholars have advanced efforts to articulate biology and social process through rich ethnographic observation, and have produced interesting results and exciting new frameworks. To cite but a few, and there are many others, we note new frameworks of

“biosocial inheritance” in Hoke's work in the Andes (Hoke & McDade, 2015), “embodied neoliberalism” in Elizabeth Sweet and colleagues' research on debt and the financial crisis” (Sweet, Dubois, & Stanley, 2018), and “embodied heritage” in Kasey Jernigan's work on food commodity programs and obesity among the Choctaw (Jernigan, 2018).

These different and exciting projects share in common a deeper interrogation of historical inequalities paired with rich field ethnography. They stand as beacons to potential new directions in critical biocultural anthropology.

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## CONFLICT OF INTEREST

Both the authors declare no conflict of interest.

## AUTHOR CONTRIBUTIONS

T.L. drafted the manuscript and A.G. edited the manuscript for content and provided critical comments on the manuscript.

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