

# Special Issue: Niche Construction, Plasticity, and Inclusive Inheritance: Rethinking Human Origins with the Extended Evolutionary Synthesis, Part 1

## Introduction to the Special Issue

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*submitted: 6 October 2023; accepted: 7 October 2023*

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### ABSTRACT

This is the first part of a special issue on niche construction, plasticity, and inclusive inheritance in the context of the extended evolutionary synthesis. In this part there are seven contributions:

- Benitez, R.A., Murray, J.K., Anton, S.C.: Introduction to the special issue: niche construction, plasticity, and inclusive inheritance: rethinking human origins with the extended evolutionary synthesis, part 1
- Lala, K.N., O'Brien, M.J.: The cultural contribution to evolvability
- Smail, I.E.: Community niches and evolution of generalist primates: a preliminary assessment of Plio-Pleistocene Cercopithecidae
- Stock, J.T., Will, M., Wells, J.C.K.: The extended evolutionary synthesis and distributed adaptation in the genus *Homo*: phenotypic plasticity and behavioral adaptability
- Sterelny, K.: Niche construction, cumulative culture, and the social transmission of expertise
- Goodrum, M.R.: Reconceiving paleoanthropology in the era of the modern evolutionary synthesis
- Tattersall, I.: Let sleeping syntheses lie

### INTRODUCTION: CAN THE EES PROVIDE NOVEL INSIGHTS INTO HUMAN ORIGINS?

For scholars examining the origins of humankind, the interpretive structures that have historically guided inquiry are analogies to ethnographic and animal behavior studies and reference to various forms of ecological theory. More recently, a turn to neo-Darwinian evolutionary processes has led to the use of predictive models rooted in the modern synthesis (e.g., human behavioral ecology [HBE]). However, researchers in several disciplines have found the modern synthesis to be lacking in its explanatory power,

particularly with relevance to the emergence and evolution of human culture (Fuentes 2017). Proponents of the aforementioned theoretical revision, known as the extended evolutionary synthesis (EES), argue for a broader framework of contemporary theory that emphasizes the role of diverse and reciprocally interacting forces (e.g., phenotypic plasticity, niche construction) and inheritance systems (e.g., genetic, ecological, cultural) (Pigliucci and Mueller 2010).

The EES offers an expanded theoretical model for considering how the phenotypic and behavioral outcomes we find in the fossil record came to be. The EES describes a

reciprocal process that, like the modern synthesis, requires heritability and selection, but expands the processes recognized to generate novel variation and emphasizes the centrality of reciprocal causation and developmental processes to constructing these new phenotypes (Laland et al. 2015). The EES centers the importance of processes such as niche differentiation and developmental plasticity that act to bias (influence) the kinds of variation available for selection. The frequency of that heritable variation is then modified by selectors (e.g., gene flow, selection, etc.) resulting in phenotypic evolution. Importantly, while the aggregate of these processes (those that generate novel variation, those that bias selection, those that hone frequency) all influence phenotypic evolution, they also all participate in a reciprocal system that need not start with mutation and lead toward phenotype, but which may be modified and tinkered with at any point. Indeed, the EES argues that phenotypic outcomes also influence (in a variety of ways) what drives/generates novel variation. That is, in the EES reciprocal causation is central to evolving systems. Development and constructed development are key to both proximate *and* ultimate evolutionary change. The EES thus puts the focus on phenotype and its variation and makes fossil phenotype and behavioral niches key to untangling human evolution.

In this special issue, we expand on previous work aiming to address what an “evolutionary rethink” along the lines of the EES may mean for framing paleoanthropological inquiry (e.g., Murray et al. 2021 and papers within the same issue). While the usefulness of the EES is debated, we argue that one measure of that usefulness should be the extent to which the new framework opens new perspectives and questions (e.g., Antón and Kuzawa 2017). Although aspects of the EES may be particularly difficult to assess in the realm of human origins research due to issues of scale, taphonomic bias, archaeological palimpsests, and temporal resolution, our objective here is to demonstrate how concepts emphasized by the EES, such as niche construction, developmental/phenotypic plasticity, and inclusive inheritance, can elicit novel insights into hominin evolution and alternative (re-) interpretation of the paleoanthropological record. The papers in the issue consider these four major themes—evolvability and niche construction, phenotypic plasticity, inclusive inheritance, and the relevance and implications of EES to paleoanthropological inquiry.

### CULTURE, EVOLVABILITY AND NICHE CONSTRUCTION

Niche construction theory (NCT) is an interpretive framework that emphasizes the ability of organisms to modify their selective environments and direct their and other organisms’ evolutionary trajectories. Humans are an incredibly effective niche constructing species; so much so that the proposed name of the current geological epoch, Anthropocene, reflects this potency. **Kevin Lala and Michael O’Brien** in their well cited 2010 article titled the “Archaeology and Niche Construction Theory” (2010) laid out the case for how the archaeological record could be differently viewed in light of NCT. Here, these same authors consid-

er a key element that drives much of human niche modification, our capacity for cumulative culture, and explore the contribution that culture makes to human capacity to evolve (2023). They argue that the primary role of culture is adjustment to rapid environmental change, and that this human capacity is in a feedback loop with, and may in fact lead the way for, biological change and enhanced human evolvability in a way that genetic inheritance cannot.

Despite the prevalence of research exploring human niche construction, few studies have applied the concept to human origins. It is true that the gaps inherent to the paleoanthropological record make it difficult to theorize the potential effects of hominin niche construction; nevertheless, an NCT approach allows for novel interpretations of the fossil and archaeological record. How niche construction in humans differs from other primates and when it arose requires a comparative framework. **Irene Smail** (2023) uses NCT to assess the significance of niche construction for considering morphological trends in a generalist primate model—fossil cercopithecines. Using dental metrics, she reconstructs the dietary ecomorphological niches of fossil cercopithecines from Plio-Pleistocene sites in eastern and southern Africa. She cautions that while her results suggest that there is little evidence of niche construction based on phenotypic indicators, there is a strong possibility that co-occurring species were competing via behavioral rather than morphological adaptations. She discusses the implications of her study to the emergence of niche construction in the hominin lineage.

### PHENOTYPIC PLASTICITY

The conceptualization of evolvability and niche construction has significant implications for research concerning phenotypic and developmental plasticity. Phenotypic plasticity involves changes in an organism’s behavior, morphology, and physiology as an evolutionary response to environmental variation (West-Eberhard 2003). An organism’s plasticity could very well be a response to conditions the organism itself created through niche construction. As such, these reciprocal interactions are a significant component of the EES. **Jay Stock, Manuel Will, and Jonathan Wells** (2023) evaluate the applicability of EES to human evolution by reviewing evidence for behavioral and phenotypic diversity in the genus *Homo*. They discuss the relationship between brain and body size variation in various environmental contexts; growth and adaptability within modern humans; and, the emergence of spatial, temporal, and environmental variation in Middle Stone Age assemblages as indicators of cognition and local adaptability. This paper builds on Wells and Stock’s well-cited 2007 paper “The biology of the colonizing ape” in which they first examined the coevolution of niche construction and plasticity.

### INCLUSIVE INHERITANCE

The EES emphasizes the interactions of multiple modes of inheritance—genetic, ecological, cultural, material. An examination of inclusive inheritance has significant impli-

cations for understanding the evolution of cultural transmission and knowledge acquisition. **Kim Sterelny** (2023) argues that cumulative culture not only requires high fidelity transmission of knowledge, but also necessitates the transmission of expertise. But expertise itself cannot be transmitted by simple observation of an expert. Instead, Sterelny suggests that the transmission of expertise (of a tool-maker, for example) requires the presence of an adaptive learning niche that allows cumulative learning beyond copying. This reveals a useful framework for creating hypotheses concerning transmission throughout hominin evolution and brings the importance of cognitive and behavioral adaptations to the fore.

## PALEOANTHROPOLOGY AND THE EES

In considering the implications of the EES for the practice of paleoanthropology, **Matthew Goodrum** (2023) provides a historical overview of how the Modern Synthesis and developing technologies shaped the discipline. His discussion frames how and why disciplinary theory changes over time. Alternatively, **Ian Tattersall** (2023) offers an opposing perspective on the EES and argues that an evolutionary rethink requires more than a simple “extension” of the Modern Synthesis. He contends that a new framework must be built—one that is free of the problems entrenched within standard neo-Darwinian theory.

## SUMMARY

This special issue fosters engagement with the EES in paleoanthropological research. The articles within the issue contribute interesting and thoughtful discussions of phenotypic plasticity, niche construction, evolvability/cumulative culture, and the usefulness of EES as a theoretical framework more broadly. Based on this first set of papers, it is clear that paleoanthropologists can address research questions related to human origins through an EES framework using empirical data across human evolution. Following the lead of Smail’s (2023) work with fossil primates, it may be interesting for paleoecologists considering the impact hominins may have had on past faunal communities and environments to implement the perspectives and emphases of the EES. Ultimately, we think that the articles here provide paleoanthropologists with an approach for addressing future questions that we hope others will expand upon.

Moving forward, using perspectives of the EES, paleoanthropologists can build a more comprehensive framework for understanding hominin-environment interactions over time and space in collaboration with modern ecologists, climatologists, and environmental scientists (Franklin et al. 2015; Marean et al. 2015). In some cases, the methods required to operationalize the EES are well established in other fields but need to be integrated into a cohesive framework for the study of human origins. Further, the framework of the EES allows paleoanthropologists to address longstanding questions from slightly different perspectives, analyzing data in different ways, building explicit hypotheses to be tested through the analysis of em-

pirical data from future discoveries, as outlined by many researchers (e.g., Antón and Kuzawa 2017; Ready and Price 2021; Stiner 2021; Stiner and Kuhn 2016). However, it is important to note that an EES perspective may not be relevant to every research question and many may agree with Tattersall (2023) that a total rework in theory is required that is entirely divorced from Mayr’s Modern Synthesis, which has a complicated past in paleoanthropology. We hope these papers may inspire those perspectives as well.

## ACKNOWLEDGEMENTS

Thanks to the editors of *PaleoAnthropology* for their work on this issue, particularly Katerina Harvati for her attention and patience and Deb Olszewski for her careful attention to detail. William Snyder produced the wonderful cover art.

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