

Preface



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Bridging cultural gaps: interdisciplinary studies in human cultural evolution

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Within the blink of an eye on a geological timescale, humans advanced from using basic stone tools to examining the rocks on Mars; however, our exact evolutionary path and the relative importance of genetic and cultural evolution in directing it remain a mystery. Our cultural capacities—to generate new ideas, to communicate and learn from one another, and to form vast social networks—together make us uniquely human, but the origins, the mechanisms and the evolutionary impact of these capacities are not well understood.

This special issue comprises studies that bring together perspectives from anthropology, archaeology, biology, computer science, ecology and psychology to help elucidate the cultural forces affecting human evolution. These studies explore avenues in which approaches and insights from different fields may inform one another or be brought together to generate novel interdisciplinary research agendas, with the goal of advancing the study of human uniqueness and its pre-hominid origins. The aim of this issue is to advance interdisciplinary discussion of the roles that culture plays in shaping the course of human evolution, exploring the mechanisms of cultural evolution from their cognitive underpinnings in individuals, through the behavioural ecology of learning from others, to the dynamics of transmission at the level of individuals and populations. The articles in this issue bring insights from disparate disciplines to bear on major questions in cultural evolution [1–11] and suggest broad-scale ways in which the study of cultural evolution can be synthesized with other disciplines [12–14].

In the introduction to this issue [15], we outline how integrative studies are poised to move the field of cultural evolution forward; we demonstrate the utility of this approach by reviewing a number of interdisciplinary studies in cultural evolution and related fields that encompass behavioural ecology, population dynamics, cognition and genetics. Next, in the special issue's first article, Truskanov & Prat [1] bring insights from the behavioural ecology of social learning in non-human animals to bear on the underlying mechanisms of cultural transmission. They address the widespread misconception that high fidelity of transmission depends on precise copying of cultural information and suggest the opposite: fidelity of transmission might depend on *inexact* copying, coupled with trial-and-error exploration, which together allow flexibility in applying a learned behaviour and tailoring it to the current environment. Stressing the importance of mechanisms of social learning in a broader perspective, Heyes [12] proposes that insights from the cognitive sciences must inform cultural evolution and vice versa: the two fields need one another. Applying this approach to a topic at the heart of cultural evolution, she outlines the possible cognitive processes that may underlie cultural transmission, asking whether a Darwinian view of selection dynamics is a correct description of these processes. Kolodny & Edelman [2] combine a cognitive approach with the thought paradigm of evolutionary biology to tackle the question of the evolution of the capacity for language. The authors bring together ideas and insights from anthropology, archaeology and behavioural ecology to suggest an explicit scenario for the ecological context in which language may have evolved, and they build on current knowledge of neural anatomy and function to outline a computational level model of the underpinnings of this adaptation.

Next, Arbilly [4] incorporates fundamental concepts in behavioural ecology into a new perspective on dynamics of cultural transmission in which key individuals play a cultural role reminiscent of that of keystone species in an ecosystem. She demonstrates possible outcomes of such dynamics with an explicit model and its simulation-based implementation. In the following study, von Cramon-Taubadel & Lycett [5] adapt a statistical framework from evolutionary ecology to study cultural transmission at the population level, attempting to tease apart the signals left by historical dynamics of population divergence from those of repeated cultural transmission of traits. They demonstrate the use of this framework in the analysis of empirical data from the material culture of New Guinea. In a complementary data-driven approach to population-level signals of cultural evolution, Sherriah *et al.* [3] compare features of a creole language to those of its potential source languages, synthesizing the study of linguistics with cultural evolution to (i) retrace the evolutionary history of a modern human migration and (ii) evaluate existing hypotheses about the dynamics of language formation. Approaching the question of cultural transmission by merging theory and data, Kandler & Powell [6] focus on deciphering which learning strategies are employed by humans. First, they modify a powerful framework for reconstructing human demographic history based on genetic data and apply it to prehistoric cultural artefacts. This approach enables them to determine whether the existing data are consistent with different evolutionary hypotheses without requiring the assumption that the system is at equilibrium. They also address the inherent challenges of data sparseness in the archaeological record and discuss related approaches that have proved helpful in this regard.

To cope with a similar challenge of data sparseness and to answer questions about human history and culture, Garvey [7] reviews the unique characteristics of the archaeological record of cultural artefacts and suggests a method of big-picture learning about social dynamics, cultural transmission and selective forces from the fine-scale analysis of projectile points produced in prehistoric villages in southeastern New Mexico. Then, Kline *et al.* [8] discuss the implicit assumptions in many studies of human culture by anthropologists and developmental psychologists and suggest that a principled reconsideration of these is necessary. They highlight the importance of making informed choices regarding study design and very careful interpretation of and inference from empirical observations, stressing the prominent role that conceptual models of cultural evolution should play. Mattison *et al.* [13], in a study that embodies many of these suggestions, point out the extent to which the fields of cultural

evolution and human behavioural ecology have studied similar questions for decades, yet with little cross-talk between them. They suggest that this stems from differences in both the underlying assumptions and the typical focus of the questions asked. Mattison *et al.* [13] aim to reconcile these two fields, making their case with analysis of the cultural underpinnings of the age of women at last birth in the Mosuo population in China.

In what follows, three studies use methods from neighbouring fields and combine theoretical considerations with empirical data to provide new perspectives on long-standing debates in cultural evolution, namely the roles of population size, connectivity and environmental factors in determining a population's cultural complexity. Aoki [11] provides an in-depth review of the theory and modelling approaches to this topic within the field of cultural evolution and in the anthropological literature, highlighting alternative mechanisms that may lead to overlapping qualitative patterns. Derex *et al.* [9] use ideas about diversity from economics, management, genetics and behavioural ecology to inspire a model of cultural dynamics that simulates learning at the individual, population and meta-population levels. They demonstrate that limited connectivity may be conducive to cultural complexity, which opposes the common assertion that reduced connectivity would hinder the accumulation of culture. Next, Fogarty [10] applies a model that was developed to study the dynamics of genetic modifiers to cultural traits in order to incorporate environmental fluctuations in a simulation framework that considers demographic processes and innovation. She proposes interpretation and generalizations from comparing these results with data on toolkit complexity in different hunter-gatherer groups. Last, Feldman & Ramachandran [14] bring cultural evolution to bear on modern genetic analysis, highlighting potentially misleading interpretations of genome-wide association studies that aim to assess the genetic underpinnings of behavioural traits such as IQ without considering potential processes of cultural transmission that may have profound effects on these traits.

The papers in this theme issue demonstrate that the study of cultural evolution is broadly relevant across many disciplines and that numerous fields can also shed new light on cultural evolution. Each article integrates the study of cultural evolution with the perspective of one or more other disciplines, bridging gaps between fields in ways that yield new insights. We hope that this issue encourages interdisciplinary discourse and novel approaches to fundamental questions in the study of behaviour and evolution.

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