Culture evolves

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Culture, broadly defined as all we learn from others that endures for long enough to generate customs and traditions, shapes vast swathes of our lives and has allowed the human species to dominate the planet. Indeed, our 'capacity for culture' appears so distinctive among animals it is often thought to separate we cultural beings from the rest of nature, and the Darwinian forces that shape it.

However, a contrary conclusion has arisen in the recent discoveries of a hitherto disparate range of scientific disciplines.

The 'discontinuity' view of human culture has been challenged in two ways. One is that the roots of social learning, tradition and culture are increasingly being traced in a widening array of non-human species. The other is that the ways in which culture itself evolves are being elucidated, extending and enriching our understanding of the Darwinian and other processes that shape the biosphere and our place in it. Culture, long the almost exclusive province of social scientists, has become a topic increasingly tackled by scientific methodologies, from sophisticated numerical and modelling techniques to field and laboratory experiments.

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Accumulating data representing decades of study of a number of mammals including dolphins, meerkats, monkeys and apes, have charted the existence of sometimes dozens of putative local traditions at different field sites. In chimpanzees and orangutans these encompass behaviour patterns including foraging techniques, tool use, courtship ploys and social customs that suggest ancient origins for the capacity to sustain complex, multi-tradition cultures once thought unique to humans. These long-term observations have recently been strengthened by experimental studies demonstrating the spread and maintenance of seeded artificial foraging techniques in both captive and wild mammals, from mongooses to chimpanzees.

More generally, social learning has been shown to be widespread in the animal kingdom, extending to insects and other invertebrates. Some of the most robust evidence for traditions is now available in birds, where the relative ease of cross-fostering through egg transfer has demonstrated the role of learning from parents, and in fish, where a variety of experimental manipulations has established phenomena like the power of social learning to maintain travel route traditions. An 'ecology of culture' is also emerging. For example, teaching-like behaviour is now recorded among diverse predatory species where young need to make the difficult leap from incompetence to competent prey-capture, yet is minimal at best in our closest primate relatives, where a largely vegetarian diet can be more gradually acquired even when it requires skilled tool use.

New discoveries have pushed the roots of humanity's capacity for cumulative culture into ever more ancient timeframes. The record of stone tool manufacture now extends back to 2.6 million years. A similar trend now emerges in relation to the classical view of a cultural 'revolution' 30-40 thousand years ago, with evidence for such aesthetic achievements as cave paintings. An exciting range of new evidence has revealed more ancient origins of this aspect of human culture, including shell beads and large quantities of ochre, dating back at least 100,000 years in Africa.

The subsequent spread and diversification of culture have been investigated using tools developed to study biological evolution. Language evolution has proved a particularly productive topic for the application of these numerical approaches to constructing (cultural) phylogenetic trees. A remarkable parallel has been demonstrated between the

Main image - Shell beads from Morocco, recently dated to 70-80 thousand years ago. © Professor Francesco d'Errico, University of Bordeaux.

Archive image - Images of flints from a paper by Joseph Prestwich, 1860. From the Royal Society archive.

From the archive

1859 was a watershed year in human understanding of biological systems. The publication of Charles Darwin's *On the origin of species*[3] outlined the evolutionary mechanism of natural selection to a general audience. But it was also the year for a seminal study by two Royal Society Fellows, Joseph Prestwich and John Evans, in which they reviewed archaeological remains to determine the possible length and depth of human history.

Their evidence lay in the flint tools which were steadily accumulating in the collections of learned societies such as the Royal Society. Such cultural artefacts came to be used to denote intelligence and then levels of cognition and design ability. The more systematic and Darwinian organisational approach used by Augustus Pitt-Rivers FRS in dealing with his formidable collections of human weaponry and tools led to the 1906 book *The evolution of culture and other essays*[4]. In this, Pitt-Rivers grouped objects into technological families in which a cumulative evolution of thought and creativity might be discerned.

Darwin himself drew parallels between biological evolution and the development of language in the *Origin* and by the time of *The descent of man*[5] he had explored the relationship more deeply: "We find in distinct languages striking homologies due to community of descent, and analogies due to a similar process of formation. The manner in which certain letters or sounds change when others change is very like correlated growth. We have in both cases the reduplication of parts, the effects of long-continued use, and so forth. The frequent presence of rudiments, both in languages and in species, is still more remarkable."

picture of language evolution coupled to the peopling of the Pacific islands and independent evidence on the latter derived from the distribution of the gut bacteria *Heliobacter pylori*. These kinds of phylogenetic analyses are being increasingly extended to other domains of culture, from technologies to political structures.

How evolution had shaped mental ontogenetic processes to facilitate the assimilation of culture adds developmental psychology to the eclectic mix of ethology, psychology, archaeology, anthropology and other disciplines brought together in the current discussion in this field. Given how well we might assume we know the young of our species, it is remarkable that revolutions in our understanding are emerging. Ingenious new experimental approaches have revealed what appears to be an intriguing cognitive mosaic, encompassing both sophisticated rules guiding optimal learning from others in infancy, alongside striking tendencies for conformity and 'over-imitation' so powerful they can lead children into radical, although recoverable, lapses into false beliefs.

Bringing together a wide range of perspectives on cultural evolution is a productive step forward in building a modern science of culture. Cultural transmission has been shown to be a much more widespread phenomenon in the animal kingdom than could have been suspected a few decades ago, and as a 'second inheritance system' accordingly has important implications for evolutionary biology generally, extending to gene-culture co-evolution. It has been shaping the course of human evolution for longer and in deeper ways than hitherto thought; and excitingly, it is proving amenable to rigorous, but imaginative, systematic scientific investigations, generating real progress in our understanding of how "culture evolves".