

How advanced genetic techniques can unravel complex human stories

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Scholars from all over the world are gathering at the University of Cambridge today for a workshop entitled *Studia Stemmatologica*. They will be looking at novel ways of applying advanced genetic-mapping techniques to the study of cultural traditions as diverse as music and dance, languages and folk lore, tribal rugs and even tattoos.

The common strand running through all these spheres is what is known as 'descent with modification' - the evolution of traditions that are handed down from person to person.

We try our best to avoid them - but mistakes, or what we think of as mistakes, are part of life. Errors and variations in DNA give us

mutations that lead on the one hand to the variation that makes evolution possible and on the other hand to cancers and genetic diseases. Mistakes and changes in texts, languages and other cultural items can alter or even completely corrupt their meaning. The Biblical text 'Thou shalt not commit adultery' famously became 'Thou shalt commit adultery' in the so-called Wicked Bible published in 1631. In another example, the folk song Old Macdonald, which has had many variants in its long history, was adapted by American World War I servicemen to 'had a farm - in Ohio-io-o', which morphed into the 'ee-ay-ee-ay-yo' we know today.

Just as DNA shapes us, so does our cultural history. The stories we tell and pass down through generations, the traditions we observe, the things we make with our hands, are what sustains our identity and help us make sense of a bewildering world. Our art forms - whether literature, art, music or dance - are closely tuned to our environment, responsive to change, never standing still. They enter our thinking. By tracing their history, and following their twisting and merging narratives, we understand ourselves. If science is the nature in the age-old nature-nurture debate, human culture is the nurture, each one inextricably connected to the other.

Now academics working throughout the arts and humanities are borrowing the latest techniques employed in science as tools to help us understand the evolving story, and vital importance, of human creativity.

The potential for a cross-over between phylogenetics (the study of evolutionary relationships in genetics) and stemmatology (the study of historical texts by examining similarities and differences) was first explored in depth when Christopher Howe, Professor of Plant and Microbial Biochemistry at Cambridge University, began working with Professor Peter Robinson, from the Department of English at the University of Saskatchewan, on textual traditions. Their collaboration

showed that applying phylogenetics to the Prologue of the Chaucer's Wife of Bath's Tale led to conclusions about the copying history of different versions of the text very close to those from conventional studies - but much more quickly.

Among those coming to Cambridge is Jamie Tehrani, an anthropologist at Durham University, who is developing ways of applying phylogenetic analysis to crafts - such as rug-weaving and tattooing. "Because they belong to everyone and no-one, folk traditions are open to reinterpretation and experimentation. Most new variants soon go extinct, but some catch on and become incorporated into tradition. These developments are impossible to trace using standard art history methods but they can be reconstructed using phylogenetic methods that were developed by biologists from Darwin onwards to investigate the evolution of organisms," he said.

"One area that offers exciting potential is tribal rugs. Because, like other textiles, rugs preserve very badly, precious little is known about the historical development of this art form. However, using phylogenetic analysis of variation in contemporary tribal traditions, it's possible to trace some styles and techniques back to ancestral cultures that existed hundreds, and maybe thousands, of years ago. This shows that the craft has been transmitted faithfully from mother to daughter over many generations."

Historian Tuomas Heikkilä and computer scientist Teemu Roos, both from the University of Helsinki, will talk about the methods they have developed for studying written texts - such as those relating to Bishop Henrik, an evangelical Englishman murdered by a Finn called Lalli in the 12th century as revenge for drinking his beer - and medieval calendars produced to chart the passing of the ecclesiastical and agricultural year. Roos compares the way in which different versions of the Henrik story branch out in a tree-like pattern of copying

relationships to the children's game 'Chinese whispers'. He said: "By applying techniques based on statistical machine learning we have been able to find gaps in the material that can only be explained by versions that we haven't discovered. The same methods can even be used to reconstruct the missing versions."

Also an expert on texts, Giles Bergel of Oxford University is working on the impact of printing on the representation of royal and other genealogies in early-modern England. He will be discussing 'The Wandering Jew's Chronicle', a printed ballad tradition handed-down in numerous cheap editions published between 1634 and 1830. He said: "My research compares the chronicle's representations of the royal genealogy with its own genealogies - the descent of its text, woodcut images, and tune information through dynasties of printers. I'm interested in combining phylogenetic methods of tracing 'family trees' of texts with traditional research methods. Scientific and humanistic approaches to the history of culture and media enrich each other and may not be as far apart as we think."

Music represents particular challenges for scholars seeking to understand the back stories of extant texts as its written form may reflect only some aspects of the way in which it was performed. Heather Windram from the University of Cambridge and Terence Charlston from the Royal College of Music are embarking on a research project focusing on the transmission of variant readings in musical texts and their performance implications, looking in particular at 17th century keyboard music and earlier repertoires.

"Music notation has evolved over at least the last thousand years into a relatively sophisticated form which is widely used and understood today. As a means of conveying the more subtle nuances of performance, however, music notation is imprecise and often misleading," said Windram. "Each manuscript is a snapshot not only of the copying history

of the musical text, but also of the performance possibilities associated with the text. Performance adds another dimension to the transmission of the music, and can itself also trigger further variation which may then be incorporated into the text."

The changing face of dance is perhaps even harder to track. Wendy Phillips-Rodriguez, a Research Fellow at the National Autonomous University of Mexico, has been using phylogenetic techniques to look at the ancient cultures of India. Her focus is now shifting away from script systems and literary texts to Indian classical dances which show similar patterns of evolution. She said: "Adapting our knowledge of textual variation, our approach to Indian classical dances is to find that golden thread of continuity from the remote past to the present. What may have been subtle variations in the performance of ritual dances (as recorded by sculptural and literary evidence) in the course of time gave place to distinctively different dance styles. It's fascinating to see how cultural processes adapt to different ideological, political and even economical circumstances to keep themselves alive, just as organisms do."

Daniel Apollon, a specialist in digital culture at the University of Bergen argues that - given the ingenuity and fickleness of the human mind in adapting, correcting, censoring, mixing and reinterpreting texts - scholars researching their complex journeys through time and space face an even harder task than scientists tracking biological [evolution](#). He said: "The total variation of old texts, for example biblical texts, may be staggeringly huge, blending and borrowing from thousands of manuscripts and allowing millions, if not billions, of combinations of possible genealogical links competing for a common ancestor - the elusive archetype."

In helping to make sense of this maze of possibilities, the application of advanced computer programmes used in evolutionary biology by

scholars in the arts and humanities is opening up a rich strand of research possibilities. "We now know that programmes used in evolutionary biology can be used, unaltered, to analyse the data collected in a wide range of disciplines to map out evolutionary-style relationships," said Howe. "It's really encouraging to see that these principles are being used to extend our knowledge of expressive arts such as stories, music and songs. The area where science, arts and humanities interact is very exciting and we need to foster it."

Provided by University of Cambridge

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