Is art exclusively ours?

Remains of archaic humans discovered in Spain suggest that it is not

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Homo sapiens (modern man) are considered to be a distinct species that first appeared in the African continent, from which it migrated to Asia and Europe. "Homo" is the genus, or group of species, and "sapiens", which means wise, denotes the only human species that has survived. Older or other extinct species are known as "archaic humans". Modern man is believed to have separated from the ancestral species, *Homo erectus*, over a quarter of a million years ago and all related species disappeared some 30,000 years ago.

While there is evidence of a progression in the kinds of tools used by ancient humans and some related species, symbolic representation, in the form of cave art, has been discovered only where there were human settlements. Art and ornament use has hence been considered a distinguishing attainment. A discovery reported in the journal, *Science*, however, re-examines this position. DL Hoffmann, CD Standish, M García-Diez, PB Pettitt, JA Milton, J Zilhão, JJ Alcolea-González, P Cantalejo-Duarte, H Collado, R de Balbín, M Lorblanchet, J Ramos-Muñoz, G-Ch Weniger and AWG Pike, from institutes in Germany, Spain, UK, Portugal and France report that they have dated samples of cave art in three sites in Spain to be 65,000 years old, which is earlier than humans are known to have appeared in Europe.

This dating of the cave art suggests that it was the work of *Homo neanderthalensis*, an archaic human species, which went extinct 40,000 years ago. Neanderthals, so named because of fossils first discovered in the 19th century in Neandertal, in Germany, are generally considered a separate species and may have descended from a separate branch of *Homo erectus* that migrated to Europe. Neanderthals share 99.7 per cent of their DNA with humans, compared to the 98.8 per cent by chimpanzees. Neanderthals, however, are not considered ancestors of humans, though they may have contributed to the human DNA through interbreeding.

The 400 or so Neanderthal remains discovered suggest that they had a more robust build and distinctive head and facial features, a reduced chin, and a large nose, shorter limb proportions and a wider, barrel-shaped rib cage. It is believed that they were furry. This belief arises from the ridges found in the bones of their fingers, which are like those of chimpanzees, whose young clutch their mothers' fur.

Handprints from the El Castillo cave in Spain

The ladder shapes are attributed to Neanderthals, although the animal figures may have been added later Pic: P Saura

Reasonably good remains of the Neanderthals have been found, including hundreds of stone tools. There is evidence that they used wooden spears, which suggests that they were hunters. They had also discovered the use of manganese dioxide to help ignite wood and were familiar with fire. For all this, however, there has been an ongoing debate about whether they produced any form of art or ornamentation.

The earliest cave art that we know of is the Chauvet cave, in central France, whose impressive drawings of animals are dated at over 32,000 or even 39,000 years old. These are clearly the work of modern humans, as the Neanderthals were extinct by then. A more ancient discovery, by Alistair Pike, the leader of the present study, is a smudged red disc in the El Castillo cave in northern Spain, dated to more than 40,800 years. Whether this is in fact a Neanderthal creation, however, is not certain as the date could overlap with the arrival of humans. Ancient cave art has also been found in the East but the antiquity of 40,000 years has not been bettered. A notable instance is the Indonesian hand prints, similar to those found in European caves, apart from drawings of local animals. But those have been dated to 39,900 years ago.

Neanderthals compared to Homo sapiens

In contrast, the discovery now reported is of ladder-like markings, dots and handprints deep in caves in three sites in Spain and dated at 65,000 years ago. As humans are thought to have come to Europe from Africa only 40-45,000 years ago, this would be an instance of art that predates humans — and hence questions the notion that symbolic representation is a human feature. Clarity on this question is of importance, as art implies the ability for thinking in symbols, a capacity we need for language and some forms of social organisation or for religion, to arise.

The usual method of dating archeological artifacts or material is by carbon dating of organic matter in the samples. Living tissue contains two forms of carbon, one the normal carbon and another, a radioactive form, in a fixed ratio. But when an organism dies and as it is fossilised, the radioactive carbon decays and the ratio of the two forms of carbon changes. How far the change has gone then reveals how long ago it was that the organism died.

This method does not work with cave art because cave art does not have associated organic matter. Dating of cave art is hence done by an indirect method, of dating the limestone-rich coating that forms on the paintings, as a result of mineral-rich water dripping over them. The mineral content has traces of radioactive uranium, but not of thorium, into which uranium decays. A fresh mineral coat would thus contain uranium but very little thorium. An older layer, on the other hand, would lose its uranium content, while thorium accumulates.

An objection to dating a sample in this way is that the ratio of uranium to thorium could be affected by water washing some of the water-soluble uranium away. The sample would thus show a higher thorium component and suggest that it was older. Pike and his team dealt with this problem by carefully scraping away the mineral layer on the paintings and collecting the material in three lots, from the exposed surface, from a little below and from nearest the painting itself.

The three layers showed that the outer layer, which would be the most recent, was the youngest and the age increased as one went deeper, or closer to the painting. If it is washing by water that is making the mineral coat appear older than it is, then it is the outermost layer that should appear to be the oldest. As it is the innermost layer that shows the greatest age, this would be the correct age of the painting, the team concludes.

The finding represents an important resolution of the question of symbolic representation, in the form of art, having been practiced by a pre-human species. The discovery has implications in anthropology, psychology and theories of language and communication. Taken along with other discoveries of ancient cave art in Africa and of ornaments fashioned and used by Neanderthals in other locations, the discovery would bring about a reassessment of the idea that there is something essentially special about being human.

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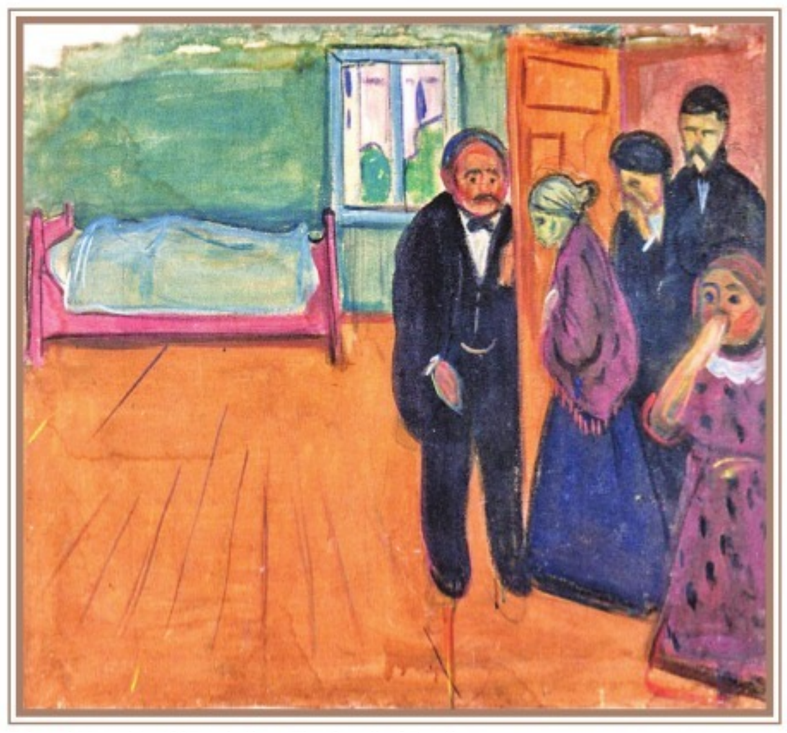
When death is a saviour



Edvard Munch's 1895 painting, *The Smell of Death*

JEAN-CHRISTOPHE NEBEL

Genetic research into the 'rotting flesh' smell after one dies could help us produce new ways of diagnosing and treating depression and suicidal ideation

And the sky was watching that
superb cadaver
Blossom like a flower.
So frightful was the stench
that you believed
You'd faint away upon the grass.
The blow-flies were buzzing
round that putrid belly,
From which came forth
black battalions
Of maggots, which oozed out
like a heavy liquid
All along those living tatters.

This poem was written by Charles Baudelaire in 1857, when scientists didn't really know what the smell of death was. Perhaps Baudelaire's morbid curiosity inspired the work of the German physician Ludwig Brieger, who a couple of decades later, for the first time, described the main chemical compounds responsible for the "rotting flesh" smell — a mix the organic compounds putrescine and cadaverine.

But how do humans actually sense this terrifying smell? A new study, published in *PLOS Computational Biology*, has now uncovered the biochemical details. Bizarrely, the findings may be able to help treat major mood disorders such as depression.

In recent years, the smell of death has become an important topic of investigation due to its potential of being used as a forensic tool. Its exact composition and intensity could help in distinguishing human from animal remains, and even determining the time of death. Such information could be used when training human remains detection dogs.

Our sense of smell relies on the detection of airborne molecules. Proteins belonging to a large family — G protein-coupled receptors — do this by sensing molecules outside the cell and activating physiological responses. This includes not only smell, but also vision, taste and the regulation of behaviour and mood.

The interaction these proteins have with the outside world makes them major targets for drug development — around one-third of currently available drugs were designed to interact with them. Among the 800 human GPCRs, more than 100 are classified as "orphans" — meaning we don't know which molecules they are able to sense and how they would interact with them. As a consequence, their potential for developing new drugs is particularly difficult to exploit.

But our new research has recently established that two of these orphans — the human TAAR6 and TAAR8 receptors — are able to detect putrescine and cadaverine molecules. Using computational strategies including modelling of the three-dimensional structure of the receptors, we revealed exactly how they interact with the chemicals of death.

There are many direct applications of this work. For example, we could design drugs to reduce the sensitivity to those odours for people either suffering from increased smell perception (hyperosmia) or working in environments where those compounds are present. They may also be useful for developing a new form of "tear gas" for riot control by creating artificial compounds activating those receptors.

In the longer term, the findings could also help us tackle major mood disorders. Several specific variations in TAAR6 have previously been associated with conditions, which affect a sizeable proportion of the world population — depression, bipolar and schizophrenic disorders. For example, one variant was found to affect how people respond to antidepressants, while another was linked to higher suicide risk.

The research could therefore help us develop a new non-invasive method to support diagnosis. Patients with major mood disorders could be offered a "death smell test", where an abnormal response (experiencing it either more or less strongly than normal) to those odour stimuli could indicate that they carry one of the TAAR6 variants that increases susceptibility to specific mental conditions.

Once diagnosed, sufferers of these conditions could also get specific help from new drugs — the detected genetic variant could be targeted to alleviate symptoms of the psychiatric disorder. While we currently don't know the exact biochemical mechanisms by which a given variant causes a specific mental health condition, our study is a very useful starting point for uncovering that since it explains the biochemical mechanism involved in the interaction of TAAR6 with external compounds.

It would then be easy to estimate how the presence of a certain variant would affect that interaction. Establishing the link to its physiological response — helping us understand what compounds alter the mental state — would be more challenging. However, even if the detailed pathway between the drug and the final outcome remains unknown, simply testing them in animals and human clinical trials can often be sufficient to demonstrate that they work.

Baudelaire himself was affected by bipolar disorder — the great and troubled poet wrote of his thoughts of suicide and even attempted to kill himself when his mistress and muse, Jeanne Duval, was rejected by his family. Could the poet have ever imagined that inside the rotting carcass that he described so vividly may have resided a remedy to his mental condition?

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The independent

PLUS POINTS

Abhorring alcohol?

Humans may be developing a gene that results in an "adverse physical response" to drinking alcohol, according to new research. Scientists believe people have begun evolving so they find it so unpleasant it could stop our species from drinking in the future.

Examining recent trends in the positive selection of genes across human populations they discovered that a variant of a gene that results in an "adverse physical response" to alcohol had simultaneously emerged in various populations without direct genetic inheritance. Authored by two researchers at the University of Pennsylvania, the study has been published in the journal *Nature, Ecology & Evolution*.

They came to the conclusion after filtering the findings of the 1000 Genomes Project (a seven-year study, which catalogued human variation and genetic data) to analyse data from 2,500 people from 20 population groups across four continents.

They discovered that a group of enzymes known as alcohol dehydrogenase, which are normally present in humans to help break down alcohols, have seen genetic variation that increases enzyme activity and instead results in an "adverse physical response to alcohol consumption" The alcohol is less effectively broken down, the result being that those who then drink it then feel so sick they are highly unlikely to develop a taste for it or drink enough to become alcoholic.

The genetic variations were not just found in one population, but were observed in five populations in different continents, making the changes unlikely to be solely the product of genetic inheritance. The authors said, "Taken collectively, these patterns suggest that alcohol oxidation pathways broadly have been subject to recent positive selection in humans. Genes in this pathway have been repeatedly targeted, with multiple events segregating at these sites, (and) the selective pressure appears to operate across the major continental groups included in this study."

The research follows new evidence that alcohol abuse is linked to an increased risk of dementia. Those with drinking disorders are associated with a three-time greater risk of all types of the disease, a study published in the *Lancet Public Health* journal says.

The independent

Glowingly unique

University of Otago researchers have helped uncover how New Zealand glowworms produce their glow. A multi-year study of the bioluminescence produced by glowworms was published recently in the online science journal, *Scientific Reports*.

The bioluminescence is not produced by a firefly-like luciferase but an entirely new luciferin and the study was a collaborative effort between Otago's chemistry and biochemistry departments. Lead authors doctors Oliver Watkins and Miriam Sharpe, working with professors Nigel Perry (chemistry) and Kurt Krause (biochemistry), have discovered that the New Zealand glowworms produce their light using a chemical reaction that is different to all other glowing creatures like fireflies.

All light made by living creatures comes from chemical reactions that take place in enzymes called luciferases. "What we have discovered is that the chemical, called a luciferin, which makes light in New Zealand glowworms is unique, not used by any other glowing organism. However, the glowworm luciferase is related to enzymes already found in other bioluminescent organisms like fireflies," said Sharpe, "No one expected that this type of luciferase could make light with more than one kind of luciferin chemical."

Perry says for the full potential of glowworm's new chemistry to be exploited the next step is to synthesise the chemical compound — luciferin —that makes the light, in the laboratory. This is a key step to enable utilisation of the glowworm chemistry in any laboratory application.