

EAORC BULLETIN 1,170 – 16 November 2025

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NOTICES

FORMATTED VERSION OF THIS BULLETIN

A pdf formatted version of this Bulletin is available for download at martinedwardes.me.uk/eaorc/eaorc_bulletins.htm.

PUBLICATION ALERTS

If you have had a paper or book published, or you see something which would be of interest to the group, please send me a publication alert so that I can include it in the newsletter. Many thanks to those who have already sent in alerts.

If there is a journal you feel I should be tracking on a regular basis, let me know.

And if you have any other ideas for extending the “EAORC experience”, please contact me.

EDITORIAL INTERJECTIONS

Comments in curly brackets are editorial interjections. The Editor reserves the right to be wrong, and doesn’t object to being called out on it.

NEWS

NATURE BRIEFING – DNA pioneer James Watson dead at 97

James Watson, who won a Nobel Prize for his role in discovering the double-helix structure of DNA, has died aged 97. “The elucidation of the structure of the double helix goes down, along with Mendel and Darwin, as the three greatest discoveries in biology,” says Bruce Stillman, president of Cold Spring Harbor Laboratory — which Watson led for decades and helped transform into a biology powerhouse. Watson was also instrumental in initiating and propelling the Human Genome Project. He was “a superlative teacher”, says historian Matthew Cobb, and at the peak of his career Watson trained and supported many female scientists.

But the DNA discovery was tarnished by Watson and Francis Crick using data from X-ray crystallographer Rosalind Franklin without her permission and without due credit. And Watson later turned himself into a scientific pariah by tenaciously expressing racist and sexist opinions — for example, that Black people are less intelligent than white people. Cold Spring cut ties with him and Watson sold his Nobel medal.

<https://www.nature.com/articles/d41586-025-03380-2>

NATURE BRIEFING – What happened to James Watson?

“He built the field of modern biology, but he didn’t know when to get off the stage,” says molecular biologist Nancy Hopkins, a former friend and mentee of Watson and a pioneering advocate for equality in science. She is among the scientists who wrestle with Watson’s legacy in an obituary pre-written by renowned science journalist Sharon Begley before her own death in 2021. “I really don’t know what happened to Jim,” says Hopkins. “At a time when almost no men supported women, he insisted I get a PhD and made it possible for me to do so.” But later, he held the view “that women can’t be great at anything”. Some of those who knew him posit that as his biggest achievements faded into the past — he did his Nobel prizewinning work when he was barely 25 — Watson developed an inflated sense of his own genius and a belief that his intuition was a better gauge of truth than logic or empirical research.

<https://www.statnews.com/2025/11/07/james-watson-remembrance-from-dna-pioneer-to-pariah/>

NATURE BRIEFING – People bred dogs thousands of years ago

The diversity of modern-day dog breeds might have emerged thousands of years ago. An analysis of ancient skulls reveals a distinctive dog skull shape — a shortened snout and widened face, compared to wolves — first seen in nearly 11,000-year-old fossils. Not long after, researchers say, there was a boom in the variety of dog skull shapes and sizes, capturing more than half of the diversity in today’s breeds. An analysis of the genomes of ancient dogs also suggests that ancient humans valued distinctive features, took their canine companions with them when they moved around and traded dogs with useful characteristics.

<https://www.nature.com/articles/d41586-025-03755-5>

NEW SCIENTIST HUMAN STORY – People of the Karo tribe looking down on the Omo River Valley

Near the eastern shore of Lake Turkana in Kenya, there is a hill called Namorotukunan. A river once flowed past it, but it has long since dried up. The undulating landscape is dry, dotted with scrubby vegetation. Between 2013 and 2022, researchers led by David Braun at George Washington University in Washington DC excavated the layers of clay left behind by the river. There they found 1290 stone tools made by ancient humans between 2.44 and 2.75 million years ago. They reported their finds in Nature Communications last week. The tools were of a type known as Oldowan, which have been found in many sites across Africa and Eurasia. They are some of the earliest and simplest stone tools. Furthermore, the ones from Namorotukunan are some of the oldest Oldowan tools yet found. The thing that leapt out to Braun and his colleagues was

the consistency of the objects. Despite these items spanning 300,000 years, the hominins that were making them created pretty much the same kinds of tools, and they were systematically choosing the best rocks for their purposes. This suggests these early uses of tools were not short-lived one-offs, invented and then quickly forgotten. Instead, tool-making was something early hominins did habitually. The Namorotukunan tools are just the latest discovery to come out of one of the most important places on Earth for understanding our origins: the Omo-Turkana basin.

<https://www.nature.com/articles/s41467-025-64244-x>

NEW SCIENTIST HUMAN STORY – Basin, cradle and rift

Beginning in the 1960s, the Omo-Turkana basin has been at the heart of studies of human evolution. It begins in the white sands of southern Ethiopia, where the Omo River flows south into Lake Turkana. One of the largest lakes in the world, Lake Turkana is long and thin, extending far to the south into Kenya. Two other rivers, the Turkwel and Kerio, drain into its southern reaches. There are fossil-bearing regions dotted all over the basin. On the lake's west side is the Nachukui Formation, while to the east lies Koobi Fora. There are also sites along the rivers, including the Usno Formation near the Omo in the north, and Kanapoi near the Kerio in the south.

<https://www.newscientist.com/article/mg22229740-900-this-vast-lake-will-die-so-millions-can-live-better/>

NEW SCIENTIST HUMAN STORY – Omo-Turkana basin sites

Researchers led by François Marchal at Aix-Marseille University in France have drawn together all the known hominin fossils from the Omo-Turkana basin. They're developing a database to showcase them all, and in the meantime they have described the overall patterns in the *Journal of Human Evolution*. The compilation is both a time capsule of research into palaeoanthropology and a goldmine of information about human evolution. Research in the Omo-Turkana basin began with "early expeditions to the Omo Group deposits by a joint French, American, and Kenyan team led by Camille Arambourg, Yves Coppens, F. Clark Howell, and Richard Leakey". Leakey also led a team that explored Koobi Fora in the east, and then western areas like Nachukui. Richard Leakey might ring a bell – he was a big figure in human evolution research in the 1960s, 70s and 80s. He was the son of Louis and Mary Leakey, who did pioneering research in Oldupai (formerly Olduvai) gorge in Tanzania – and his daughter Louise is still a palaeoanthropologist today. However, the study of the Omo-Turkana basin is much bigger than one man or even one family. From the sites in the region, Marchal and his colleagues totted up 1231 hominin specimens from an estimated 658 individuals, which they say is about one-third of all the hominin remains known from Africa. Along with the Great Rift valley in East Africa (which includes Oldupai gorge and many other sites) and the Cradle of Humankind in South Africa, the Omo-Turkana basin is one of the three most productive hominin fossil localities in Africa.

<https://www.sciencedirect.com/science/article/pii/S0047248425000843>

NEW SCIENTIST HUMAN STORY – A jaw bone discovered at Jebel Irhoud

In the north, near the Omo River, researchers found some of the oldest remains of our species (*Homo sapiens*) on the planet. At Omo Kibish, researchers found two partial skulls and various other bones, plus hundreds of teeth. The more we study these remains, the older they seem to be. Originally claimed to be 130,000 years old, a 2005 study pushed them back to 195,000 years ago – and a 2022 follow-up indicated they were at least 233,000 years old. Of all the remains of *Homo sapiens*, only the Jebel Irhoud fossils from Morocco, which are around 300,000 years old, are more ancient. The Omo Kibish and Jebel Irhoud fossils are some of the key evidence our species is significantly older than we once thought. Instead of evolving around 200,000 years ago, we may have been evolving independently for several hundred thousand years. Something similar appears to be true of the *Homo* genus, which includes us as well as other groups like *Homo erectus* and the Neanderthals. Precisely when *Homo* first evolved is tricky to nail down. There are definitely *Homo* by 2 million years ago, but as we go further back in time the record becomes murkier. By drawing together all the fossils from the Omo-Turkana basin, Marchal and his colleagues found *Homo* is well-represented in the region from 2.7 to 2 million years ago. The oldest-known *Homo* specimens from the basin are from the Shungura Formation and are 2.74 million to 2.58 million years old. However, despite having been announced in 2008, they have still not been described in detail. Despite such frustrating gaps, Marchal's team found "no fewer than 45 individuals of early *Homo* arising from 2.7 to 2.0". If they were to add in the undescribed material, they suggest, "there are likely to be 75 individuals of early *Homo*, making this a substantial and significant assemblage" – or, as they say, "more than a smattering of fossils". The implication is the *Homo* genus was pretty well-established in the Omo-Turkana basin between 2.7 and 2 million years ago. They weren't dominant – another genus called *Paranthropus*, which had smaller brains and bigger teeth, was twice as common. There were also a lot of *Australopithecus*, though their time was drawing to a close. The basin was a place where many hominin species lived side by side. But *Homo* were there, and they may have made some of those Oldowan tools. Findings like these are only possible through this sort of sustained study over decades. I expect the Omo-Turkana basin will keep telling us more about our origins for many years.

<https://www.nationalgeographic.com/culture/article/oldest-human-outside-africa-discovered-fossil-jaw-israel-science>

NEW SCIENTIST HUMAN STORY – Neanderthal-human hybrids may have suffered a genetic mismatch

When *Homo sapiens* and Neanderthals interbred, a genetic variation affecting red blood cells may have hindered reproduction in women who were hybrids, and this might have played a part in Neanderthals' demise. Read more

<https://www.newscientist.com/article/2500492-neanderthal-human-hybrids-may-have-been-scourged-by-a-genetic-mismatch/>

NEW SCIENTIST HUMAN STORY – How a surge in ancient plagues 5000 years ago shaped humanity

Plague, leprosy, smallpox and other diseases didn't jump from animals to humans when we thought. Ancient DNA is revealing where they come from and how they changed history. Read more

<https://www.newscientist.com/article/2500060-how-a-surge-in-ancient-plagues-5000-years-ago-shaped-humanity/>

NEW SCIENTIST HUMAN STORY – Denisovans may have interbred with mysterious ancient human group

We now have only the second high-quality genome from an ancient Denisovan human, which reveals there were more populations of this species than we thought. Read more

<https://www.newscientist.com/article/2502409-denisovans-may-have-interbred-with-mysterious-group-of-ancient-humans/>

NEW SCIENTIST HUMAN STORY – Do we need to revisit the Homo taxonomy?

I interviewed Christopher Bae, an anthropologist who studies the ancient humans that lived in Asia. Bae has been instrumental in the naming of two species, Homo bodoensis and Homo juluensis. Both caused ructions in the scientific community, partly because they defied the standard rules of species naming, and partly because not everyone agrees they represent truly distinct populations. He talked me through his reasoning and also explained how his personal background shaped his fascination with human origins.

<https://www.newscientist.com/article/2500833-does-the-family-tree-of-ancient-humans-need-a-drastic-rewrite/>

NEWS FROM SCIENCE – James Watson: Titan of science with tragic flaws

Science historian Nathaniel Comfort reflects on the “most famous scientist of the 20th century, and the most infamous of the 21st”.

<https://www.science.org/content/article/james-watson-titan-science-tragic-flaws>

NEWS FROM SCIENCE – To unearth their past, Amazonian people use ‘a language white men understand’

A model partnership between archaeologists and the Kuikuro people has helped rewrite the history of early Amazonian societies

<https://www.science.org/content/article/unearth-their-past-amazonian-people-turn-language-white-men-understand>

SAPIENS – 90 Years Since Its Discovery, a Stone Age Human Still Holds Lessons

A paleoanthropologist reflects on England’s oldest human cranium—and what its changing interpretations say about science.

<https://www.sapiens.org/biology/paleontology-swanscombe-fossil-england-politics-science/>

SCIENCEADVISER – Watson: famous and infamous

James Watson, a controversial biologist who shared a Nobel Prize for the discovery of the structure of DNA, died last week at 97. “Watson was the most important and most famous scientist of the 20th century, and the most infamous of the 21st,” said one of his biographers. “And in both cases, the reason is due to his genetic determinism.”

<https://www.science.org/content/article/james-watson-titan-science-tragic-flaws>

SCIENCEADVISER – dogs’ skulls were already distinctly different from wolves’ skulls by 11,000 years ago

Today, dogs come in all shapes and sizes. People often point to a breeding frenzy in the Victorian era, around 200 years ago, as the source of all that variety. But an analysis of 643 dog skulls published this week in Science finds otherwise—even thousands of years ago, our besties had many different looks.

“The earliest skulls with clearly domestic skull shapes in our dataset date to around 11,000 years ago,” researchers Carly Ameen and Allowen Evin explained in an article for The Conversation. While today’s most extreme shapes—like the squashed faces of pugs—were absent, the team found that thousands of years ago, dogs already had half the total variation in skull shape seen today. “In fact, some early dogs exhibit skull forms not found in any modern breeds, hinting at lineages and morphologies that may have since vanished,” Ameen and Evin wrote. Another new Science paper by different researchers examined 73 modern and ancient dog genomes. The team found that dogs were already traveling with people back then, too. As Kylie Cairns and Melanie Fillios, who were not involved in the new studies, put it: “Dogs played an indispensable role in human societies as crucial ‘biocultural packages’ that moved with humans.”

The findings call into question just how much of dog diversity comes from our selective breeding. “If early dogs were already diverse, humans might have had less influence on their evolution than previously thought,” Fillios wrote in a related Perspective. “Could climate, geography, or resource availability have contributed more than people to the diversification of early domesticated canids?”

<https://www.science.org/doi/10.1126/science.adt0995>

<https://www.science.org/doi/10.1126/science.adu2836>

THE CONVERSATION – It's a myth that the Victorians created modern dog breeds

Dogs were already remarkably diverse more than 10,000 years ago, long before kennel clubs and pedigrees.

<https://theconversation.com/its-a-myth-that-the-victorians-created-modern-dog-breeds-weve-uncovered-their-prehistoric-roots-269534>

PUBLICATIONS

American Journal of Biological Anthropology

PAPERS

GUILLERMO ZORRILLA-REVILLA et al – Morphological Influences and Energetic Walking Flexibility in Determining Preferred vs. Optimal Speeds: An Evolutionary Human Ecology Perspective on Children and Adolescents

Locomotion is fundamental to the survival of our species. The most comfortable walking speed may be the most efficient for allocating conserved energy for other functions. However, whether preferred (PLS) and optimal (OLS) speeds align in children and adolescents remains unclear. This study aimed to determine whether OLS and PLS are similar in children and adolescents and how anthropometry influences both speeds and their differences.

Eleven females and 17 males (8–17 years of age) were anthropometrically characterized. Five treadmill walking pace tests were used to identify the OLS and U-shaped relationship between energy expenditure and speed (χ^2 CoT), indicating walking flexibility. Additionally, PLS was self-selected using the same protocol. Differences between OLS and PLS were calculated (mean difference [MD]).

No significant sex differences in anthropometry and speed-related variables were found. OLS, PLS, and their MD in the pooled sample were 3.05 ± 0.13 , 2.46 ± 0.51 , and 0.60 ± 0.46 , respectively, with significant differences between OLS and PLS ($p < 0.0001$). Femur length (FL), Bi-iliac breadth (BIL), and χ^2 CoT explained variance in OLS, PLS, and MD, respectively, in the forward stepwise regression models.

Unlike adults, OLS and PLS are not interchangeable in children and adolescents. Participants with lower χ^2 CoT (greater flexibility) can select comfortable speeds farther from OLS without energetic penalty. Taller individuals with longer femurs and wider hips might have biomechanical advantages in reaching higher OLS and PLS, but this reduces flexibility. These traits, along with the growth and development pattern of *Homo sapiens*, may reflect evolutionary advantages relevant to interspecies competition.

<https://onlinelibrary.wiley.com/doi/full/10.1002/ajpa.70152>

Evolutionary Anthropology

PAPERS

ZE HONG – When Rituals Fail: Rationalization, Bayesianism, and Predictive Processing

Why do rituals persist in human societies despite their frequent and observable failures to produce intended outcomes? This paper advances a two-part argument to explain this resilience. First, at the individual level, I argue that belief in ritual efficacy is maintained through Bayesian-rational processes, where the invocation of auxiliary hypotheses absorbs disconfirming evidence and shields central beliefs from significant revision. Importantly, such protection is not complete. Each failure produces a small but non-zero erosion of individual confidence. Second, I address the resulting population-level puzzle: why does such incremental doubt not accumulate into widespread skepticism and the eventual collapse of ritual systems? I argue that social features and informational dynamics (e.g., memory biases, the underreporting of failure, pluralistic ignorance) as well as the protective “design” of rituals themselves systematically inhibit the aggregation of doubt across individuals and generations. By linking individual cognition with population dynamics, this account explains the remarkable resilience of ritual systems in the face of persistent empirical failure.

<https://onlinelibrary.wiley.com/doi/abs/10.1002/evan.70020>

Frontiers in Artificial Intelligence

PAPERS

KIRAN PALA et al – A geometric semantic model and Parts-of-Sense Inference annotation framework

We introduce a geometric semantic model designed to capture fine-grained semantic representations in a multidimensional space. Building on this model, we develop a novel annotation framework that facilitates detailed semantic analysis across languages. Central to our approach is a set of Parts-of-Sense Inference (POSI) tags: 135 interpretable four-letter codes that annotate subtle semantic attributes often overlooked by traditional models. To evaluate the cross-linguistic and cross-structural applicability of this framework, we annotate expressions in four typologically diverse languages. Our results demonstrate that the proposed model provides an interpretable, cognitively plausible approach to semantic representation and can serve as a robust tool for investigating language processing and meaning inference across linguistic contexts.

<https://www.frontiersin.org/journals/artificial-intelligence/articles/10.3389/frai.2025.1666074/full>

iScience**PAPERS****ROBERT BÖHM et al – Untangling altruism and parochialism in human intergroup conflict**

Human intergroup conflict occurs on a scale unmatched in other mammals. Paradoxically, this capacity for war is closely linked to our exceptionally cooperative abilities. Models of ‘parochial altruism’ describe how within-group cooperation and between-group competition may co-evolve, but it is unclear whether these models reflect human preference adaptation in real-world conflicts. Across five studies (total N=1,121), we develop and validate a psychometric toolkit to test the core assumptions and predictions of parochial altruism models in groups involved in real conflicts of varying intensities. Our measures clearly distinguish interindividual altruism from intergroup parochialism, outperform prior metrics in capturing social preferences related to intergroup conflict, and improve predictions of individuals’ conflict contributions. Notably, we find that parochialism varies for different outgroups—an unanticipated result that challenges existing theoretical models. Our work provides new tools for studying individual- and group-level social preferences in intergroup relations and presents novel evidence to inform substantive theoretical improvement.

[https://www.cell.com/iscience/fulltext/S2589-0042\(25\)02239-4](https://www.cell.com/iscience/fulltext/S2589-0042(25)02239-4)

Journal of the Royal Society Interface**PAPERS****RUARIDH CLARK et al – Motor organisation of social play in children with autism**

Play is a quintessential human behaviour, underpinned by motor organisation and fundamental for learning and development. However, the motor patterns underlying play have not been computationally characterised in children with autism, despite known play pattern differences, including reduced social and pretend play. Recent evidence of fundamental neuromotor disruption in autism suggests neuromotor organisation differences may underpin play differences. We employed a digital game to examine play patterns in 878 children aged 2.5–6 years old, including 372 diagnosed with autism spectrum disorders (ASD), 64 diagnosed with other neurodevelopmental disorders and 441 without known neurodevelopmental problems (WP). Computational characterisation of play patterns by network analysis revealed significant differences between groups in the motor organisation of its sequential steps. Children with ASD developed an indirect, two-step pattern during the social food-sharing aspect of the game, in contrast to a direct, single-step pattern by WP children. These findings provide new variables for the digital characterisation of ASD. They reveal differences in the sequential nature of goal-directed motor organisation made in play in autism that precede higher-order differences in social cognition and emotional regulation reported in the literature, giving important insight into the psychomotor nature of autism for its education, care and support.

<https://royalsocietypublishing.org/doi/10.1098/rsif.2025.0302>

Nature**ARTICLES****MARY ABRAHAM – Be rational: chimp decision-making is guided by the strongest evidence**

The ability to change your mind in response to better evidence is a hallmark of human cognition. Experiments now show that chimps are capable of rational thought too.

<https://www.nature.com/articles/d41586-025-03584-6>

Nature Human Behaviour**PAPERS****QIHUI XU et al – Large language models without grounding recover non-sensorimotor but not sensorimotor features of human concepts**

To what extent can language give rise to complex conceptual representation? Is multisensory experience essential? Recent large language models (LLMs) challenge the necessity of grounding for concept formation: whether LLMs without grounding nevertheless exhibit human-like representations. Here we compare multidimensional representations of ~4,442 lexical concepts between humans (the Glasgow Norms¹, N = 829; and the Lancaster Norms², N = 3,500) and state-of-the-art LLMs with and without visual learning, across non-sensorimotor, sensory and motor domains. We found that (1) the similarity between model and human representations decreases from non-sensorimotor to sensory domains and is minimal in motor domains, indicating a systematic divergence, and (2) models with visual learning exhibit enhanced similarity with human representations in visual-related dimensions. These results highlight the potential limitations of language in isolation for LLMs and that the integration of diverse modalities can potentially enhance alignment with human conceptual representation.

<https://www.nature.com/articles/s41562-025-02203-8>

Nature NPJ Heritage Science

PAPERS

XIANGLI WANG et al – New evidence for the terminal pleistocene funerary-associated ochre use in southwestern China

Although archeological findings have suggested the long history of ochre exploitation by humans, the cultural implications of prehistoric funerary ochre remain unclear due to a lack of in-situ preservation consisting of ochre, artifacts, and human skeletons. This paper aims to investigate how humans in southwestern China interacted with ochre minerals in the terminal Pleistocene. We collected a set of red remains from the Qingshuiyuan Dadong site, dating to ca. 11 cal ka BP, which have been identified as hematite using multiple geochemistry techniques. Combined with microscopic observation of grave goods and ethnographic investigations, our study suggests that the ochre was consciously applied to stone artifacts and placed in burials as a possible component of funerary rituals at that time. By further integrating their archeological context, we inferred the use of ochre could be a cultural link in a broader regions.

<https://www.nature.com/articles/s40494-025-02140-9>

Nature Reviews Microbiology

ARTICLES

JESSICA A. GRIFFITHS et al – The gut microbiome shapes social behaviour across animal species

The gut microbiome has profound influences on brain activity and complex behaviours. Research across diverse animal species, in both natural environments and laboratory settings, has identified biological mechanisms that underlie gut–brain interactions. An emerging central theme is that the gut microbiome is shaped by, and actively contributes to, sociability throughout the lifespan. In this Review, we highlight recent literature revealing the effects of the microbiome on early neurodevelopment, immune modulation, stress responses and microorganism-mediated metabolism that affect social behaviour. Studies investigating the cellular and molecular pathways that underlie microbial influences on social behaviour have implicated brain regions and circuits that mediate critical aspects of animal behaviours, including bonding, mating, defence, aggression and social learning. Gut microbiome–brain research using animal models of social deficits and ecological studies in the wild, as well as investigations of human conditions comorbid with impaired social behaviour, could offer new and natural avenues for improved quality of life in individuals and social groups.

<https://www.nature.com/articles/s41579-025-01262-y>

Nature Scientific Reports

PAPERS

LOCADIA DZINGWENA et al – Climate and predation drive variation of diel activity patterns in chacma baboons (*Papio ursinus*) across Southern Africa

Understanding how animals adjust daily activity to environmental gradients reveals key drivers of behavioral plasticity. While diel activity is theorized to reflect trade-offs among thermoregulation, energy balance, and predation risk, few studies test these interactions at broad spatial scales within species. We investigated this in chacma baboons (*Papio ursinus*) using over a million camera-trap detections across 29 sites in six biomes (2016–2022) in South Africa and Zimbabwe. Activity, as measured by area under the kernel density curve (AUC), declined by about 3% with latitude, consistent with lower resource predictability, and increased with thermal stress, while latest detected movement (LDM) and earliest detected movement (EDM) times were similar across sites. Baboons avoided midday heat but increased dawn and night activity under predator pressure. These findings show how abiotic and biotic pressures shape diel schedules and highlight temporal flexibility as an adaptive strategy for generalist mammals in a changing world.

<https://www.nature.com/articles/s41598-025-23151-3>

A. T. KORZENIOWSKA et al – Sound symbolism facilitates interspecies communication between humans and domestic dogs (*Canis familiaris*)

The evolution of human communication likely centred, in part, on shared intuitions about the mapping of sound to meaning. These sound-meaning intuitions, known as sound symbolism, can be seen for example in the bouba-kiki effect, where nonsense words carry inherent meaning about their likely referents (here, rounded vs. angular objects respectively). In our paper we suggest for the first time that sound symbolism can afford successful interspecies communication between humans and animals in certain circumstances. Over four investigations, including replications, we show that humans use sound symbolism significantly and pervasively to attempt to convey meaning to domestic dogs (*Canis familiaris*), specifically, by exploiting vocal prosody to signal elevation in space. In Study 1 we analysed recordings of amateur dog owners commanding their dogs to move upwards (e.g., “stand”) or downwards (e.g., “down”), finding higher mean pitch (fundamental frequency, f0) in the former versus the latter. In Studies 2 and 3a, we replicated this in competitive dog owners, both in self-report, and in acoustic voice-analyses recorded in competition. In addition, professionals also used further sound symbolism beyond amateurs, in their commands for the dog to “sit” (using higher pitch to denote sit up vs. sit down). Finally, in Study 3b, we demonstrate that sound symbolism appears to be mutually understood by dogs in certain useful circumstances. Dogs were faster to enact “down” commands with prosodic sound symbolism, compared to without, demonstrating that sound symbolism may sometimes underlie successful inter-species communication.

<https://www.nature.com/articles/s41598-025-22923-1>

New Scientist

ARTICLES

JONATHAN R. GOODMAN – Sperm are selfish – and so are we

A new study hammers home how the "survival of the nicest" view makes no sense when it comes to evolution.

<https://www.newscientist.com/article/mg26835690-100-sperm-are-selfish-and-so-are-we/>

REVIEWS

ELLE HUNT – Smart new book takes an axe to the myth of human exceptionalism

Christine Webb's provocative and moving book *The Arrogant Ape* explores our unjustifiable sense of superiority in the living world, laying out the evidence against it.

Review of 'The Arrogant Ape: The Myth of Human Exceptionalism and Why It Matters' by Christine Webb; Abacus, UK; Avery, US (2025).

<https://www.newscientist.com/article/mg26835692-100-smart-new-book-takes-an-axe-to-the-myth-of-human-exceptionalism/>

MICHAEL LE PAGE – Surprising new biography of Francis Crick unravels the story of DNA

Francis Crick's biography is full of surprises as author Matthew Cobb reveals the life and work of the co-discoverer of DNA's structure.

Review of 'Crick: A Mind in Motion – From DNA to the brain' by Matthew Cobb; Profile Books Ltd (2025).

<https://www.newscientist.com/article/mg26835692-000-surprising-new-biography-of-francis-crick-unravels-the-story-of-dna/>

Philosophical Transactions of the Royal Society B

PAPERS

JACQUES SINGER & ANTONIO DAMASIO – The physiology of interoception and its adaptive role in consciousness

The interoceptive nervous system uses signalling mechanisms distinct from those of exteroceptive, voluntary motor, cognitive and linguistic processes. While interoception relies mainly on analogue-like processing, the other systems favour digital-like signalling. This physiological feature allows interoception to map the state of the organism's internal milieu in real time, in stark contrast to the rapid, precise and time-sensitive processing of exteroceptive, proprioceptive, cognitive and linguistic signals. This distinction arises from the unique features of the interoceptive process, namely the unmyelinated and lightly myelinated nature of afferent interoceptive neurons, which facilitates non-synaptic signalling throughout interoceptive pathways, notably in those of the vagus nerve and of neural structures devoid of a blood–brain barrier. We propose that by continuously representing the body's state, spontaneously conscious homeostatic feelings constitute the foundational substrate of subjectivity and the grounding for consciousness. This idea builds on our prior work, which grounds consciousness in core biology rather than high-level cognition. Consciousness enables adaptive and protective responses that maintain homeostasis and secure life.

<https://royalsocietypublishing.org/doi/full/10.1098/rstb.2024.0305>

ALBERT NEWEN & CARLOS MONTEMAYOR – Three types of phenomenal consciousness and their functional roles: unfolding the ALARM theory of consciousness

The evolution of consciousness is a neglected topic that plays a surprisingly insignificant role in all major theories of consciousness. Furthermore, substantial disagreements can be observed in the dominant views on the neural correlates of consciousness (NCCs), which focus too much on cortical brain regions. In order to dissolve some of the contradictions among these views and to constrain the rival theories, we propose to distinguish three core phenomena of phenomenal consciousness: basic arousal, general alertness and reflexive (self-)consciousness. The central aim is to show that we can fruitfully distinguish specific functions for each of the three phenomena. Basic arousal has the function to alarm the body and secure survival by intervening in the slow updating of homeostatic processes. General alertness fosters advanced learning and decision-making processes, enabling various new behavioural strategies to deal with challenges, and reflexive (self-)consciousness enables future-directed long-term planning, accounting for the mindset of oneself and other agents. Constraining our contemporary theories of consciousness with this evolutionary and functional approach will enable the science of consciousness to make progress by accounting for three specific functions of consciousness, thereby informing the search for distinct an NCC.

<https://royalsocietypublishing.org/doi/full/10.1098/rstb.2024.0314>

JOSEPH E. LEDOUX – What the functions of consciousness are depends on what one thinks consciousness is

The word 'consciousness' is often used as if it is a single thing, and as if everyone knows, in a general sense, what that thing is. The very notion of a theory of consciousness implies that someday this thing will be accounted for. But suppose that

multiple kinds of consciousness exist. If so, an adequate theory of consciousness would have to be multifaceted rather than unitary. And, accordingly, an account of the function or functions of consciousness would depend on the kind or kinds of consciousness one is referring to. Herein, I use a tripartite taxonomy of human consciousness and explore the relation of each kind to its underlying pre-conscious cognitive processes and their neural underpinnings. I also consider how each kind of consciousness may have evolved, and what the adaptive functions of each may have been.

<https://royalsocietypublishing.org/doi/full/10.1098/rstb.2024.0311>

MASANORI KOHDA, SHUMPEI SOGAWA & REDOUAN BSHARY – On the mirror test and the evolutionary origin of self-awareness in vertebrates

Self-awareness in animals is often documented by showing evidence for mirror self-recognition (MSR), which is confirmed by the mirror mark-test. The classic assumption about self-awareness was that it is a complex cognitive process, restricted at best to a few large-brained species. Indeed, early MSR research yielded positive results only in great apes, elephants, dolphins and magpies, while most endotherm species failed. However, recent detailed proof of MSR based on a mental representation of self, i.e. private self-awareness (PrSA), in cleaner wrasse *Labroides dimidiatus*, a small-brained ectotherm fish, indicates that the origin and cognitive complexity of self-awareness must be reconsidered. Here, we first recapitulate key concepts on the evolution of self-awareness, and then summarize the evidence that cleaner wrasse exhibit PrSA. We propose that the many negative MSR results are potentially false-negatives, and that self-awareness does not require a large brain. We posit a new hypothesis: self-awareness was already present in the early shared ancestors of modern vertebrates.

<https://royalsocietypublishing.org/doi/full/10.1098/rstb.2024.0312>

JONATHON D. CRYSTAL – Episodic memory in non-humans: an approach to understand an evolutionary function of consciousness

A fundamental question in comparative cognition concerns the evolution of consciousness. It is unlikely that consciousness appeared in humans without any precursors in other animals. Yet, the concepts that dominate our understanding of consciousness are inherently human centred, focussing on subjective experiences with a rich use of language. This understanding of consciousness is probably empirically intractable in studies of non-humans. An alternative approach focuses on adopting a functional perspective. What function does consciousness serve? What can an animal capable of such a function do via its behaviour? In this connection, I review the development of animal models of episodic memory. Episodic memory involves recalling the past and in humans is described as the phenomenological conscious experience of projecting oneself (autonoesis) in time (chronesthesia). Because there are no agreed upon empirical approaches to investigate subjective experiences in non-humans, efforts to develop animal models of episodic memory have focussed on the contents of episodic memory. I review experiments using rats which suggest that, at the moment of a memory assessment, the animal remembers back in time to an earlier event or episode. I conclude by evaluating implications of episodic memory in rats as a functional window into the evolution of consciousness.

<https://royalsocietypublishing.org/doi/abs/10.1098/rstb.2024.0304>

KRISTIN ANDREWS & NOAM MILLER – The social origins of consciousness

We present the social origins of consciousness hypothesis, according to which the ability to coordinate with group members was the original adaptive function of consciousness. We offer three arguments. The phylogenetic argument presumes that consciousness is widespread among existing animals, and that widespread capacities are probably evolutionarily old. Early animals relied on consciousness to solve a problem that arose during the Cambrian, when animals first became behaviourally flexible—how to predict others' behaviour and stay together as a group. The argument from neuroscience points to evidence that even very simple brains have the capacities for social rewards and pains, and that modern brains retain close connections between the substrates for social cognition and affect. The deep adaptive alignment between social pain and harm to animals develops an argument originally proposed by William James (1890). We provide evidence that in preference tests, bodily pain is preferred to social pain in a wide range of species. We offer two approaches to testing the hypothesis—the salience of social stimuli test and the overattribution of agency test. Working under the social origins of consciousness hypothesis could lead to significant breakthroughs in research, especially by focusing on simpler systems than are currently studied.

<https://royalsocietypublishing.org/doi/full/10.1098/rstb.2024.0300>

LÉA MONCOUCY et al with AXEL CLEEREMANS – The value of consciousness: experiences worth having

DC. Dennett (2020, personal communication) asked: 'How do we go from doing things for reasons to having reasons for doing things?'. This question targets a fundamental shift in nature: while all organisms act in the way they do for reasons that are shaped by extrinsic evolutionary cost functions, some also act for reasons of their own, even engaging in behaviour that may be detrimental to their own existence. For such organisms, we argue, phenomenal experience—what it feels like—has intrinsic value. Here, we elaborate on the perspective developed by Axel Cleeremans and Catherine Tallon-Baudry (Cleeremans, Tallon-Baudry 2022 *Neurosci. Conscious*, 2022, niac007. (doi:10.1093/nc/niac007)) and defend the claim that phenomenal experience broadens an organism's ability to act in a manner that is not merely responsive to the objective value of an extrinsic evolutionary cost function but is also shaped by the preference-driven subjective value associated with

items, situations, events or other agents. Importantly, we argue that the intrinsic value of subjective experience cannot always be reduced to other forms of extrinsic values, because subjective value can act not only as a driver of behaviour, but also as a target for behaviour.

<https://royalsocietypublishing.org/doi/full/10.1098/rstb.2024.0303>

NICHOLAS HUMPHREY – Phenomenal consciousness: Its scope and limits

In the history of life, consciousness of sensory states with ‘phenomenal properties’—the basis of ‘sentience’—is, arguably, a late evolutionary development, which occurred long after conscious access to a ‘global mental workspace’ had become widely established as a strategy for cognitive information processing. In this article, I focus on phenomenal consciousness. I propose a step-by-step sequence by which the mental representation of sensory stimulation could have acquired phenomenal content through small changes in the brain. Also—addressing the question of evolutionary function—I point to the crucial psychological benefits to an animal of having a ‘phenomenally conscious self’. A thread running through the article is the phenomenon of ‘blindsight’, which I take to be a model for the non-phenomenal cognition that characterizes the majority of insentient animal species.

<https://royalsocietypublishing.org/doi/full/10.1098/rstb.2024.0306>

EVA JABLONKA & SIMONA GINSBURG – Consciousness: Its goals, its functions and the emergence of a new category of selection

We suggest that the emergence of consciousness in living organisms entailed new goals and new functions, which gave rise to a new category of selection, which we call mental selection. Mental selection involves ontogenetic choices that are directed towards consciously perceived and affectively evaluated patterns. It expands the types, targets and regimes of natural and sexual-social selection and is a scaffold on which human artificial selection emerged. We suggest that the functional effects of consciousness and the mental selection which it affords, were driven and enabled by the evolution of an open-ended form of associative learning (unlimited associative learning (UAL)). UAL enables animals to discriminate between composite percepts and acts and permits plastic self-learning and goal-directed behaviour driven by flexibly prioritized physiological needs, which enable flexible adjustments to a huge range of conditions and events during the animal’s lifetime. We propose that UAL-based signal selection, involving for example, predator–prey, sexual and other social interactions, led to the evolution of intricate perceptual, emotional and motor patterns that could not have existed before consciousness evolved. These patterns, which can be thought of as signatures of consciousness, first appeared in the Cambrian era and scaffolded the evolution of imaginative animals and reflective humans.

<https://royalsocietypublishing.org/doi/full/10.1098/rstb.2024.0310>

YURANNY CABRAL-CALDERIN, JULIO HECHAVARRIA & LUCIA MELLONI – Towards a neuroethological approach to consciousness

Understanding consciousness remains a significant challenge in science. What distinguishes conscious beings from unconscious systems, such as organoids, artificial intelligence or other non-sentient entities? Research on consciousness often focuses on identifying brain activity associated with conscious and non-conscious states, primarily in neurotypical human adults. However, this approach is limited in scope when applied to entities with developmental or evolutionary trajectories different from our own. How do we investigate consciousness in infants, whose brains are still maturing or in non-human animals, shaped by diverse ecological and evolutionary pressures? This opinion piece encourages consciousness studies to adopt a neuroethological perspective, drawing on Tinbergen’s framework for studying behaviour. By examining the (1) mechanisms, (2) development, (3) adaptive functions and (4) evolutionary origins of consciousness, we can move beyond a human-centric focus to explore its diversity across life forms. Most investigators now accept that consciousness is not confined to humans alone but that some other animals have it, and it is a continuum shaped by evolutionary pressures. By adopting this broader approach, consciousness studies can better investigate and understand consciousness in its various forms and contexts, with significant scientific, ethical and societal implications.

<https://royalsocietypublishing.org/doi/10.1098/rstb.2024.0307>

PLoS One

PAPERS

ALFRED W. CRAMER – Intervallic Intonation: Applying the Implication-Realization model of musical melody to speech intonation and prosody

This methodological study presents the Implication-Realization (IR) model as a framework for the analysis of linguistic prosody and examines its application to English-language examples of speech. Originally developed by Eugene Narmour for music analysis, IR’s cognitively-based approach views melodies as hierarchical structures formed through processes of implication and closure. It parses melodies by comparing successive pitch intervals while also considering duration and potentially other parameters. With computational assistance from a newly developed set of Praat scripts (IRProsodyParser), the study applies an adapted version of IR’s symbology to several Modern American English examples. In this adaptation, comparisons of successive pitch intervals form the basis for a categorical classification of interval sizes. IR-generated parsings show broad correspondence with those produced within the autosegmental-metrical (AM) framework, with AM boundary

tones, phrase accents, and pitch accents manifested at progressively deeper levels in the IR hierarchy. These findings support the view that pitch intervals are central in perceiving speech intonation and that intonational features arise as the result of a complex interaction of pitch, duration, and other cues. Moreover, while AM and similar approaches often frame intonational features in terms of aural prominences within the melodic stream, IR encourages viewing them in terms of their positions within a melodic hierarchy.

<https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0336780>

THERESA RÖSSLER et al with ALICE M. I. AUERSPERG – Seizing opportunities: Object neophobia as a factor mediating technical innovation in Goffin’s cockatoos?

Most studies find substantial inter-individual differences in problem-solving performance within a species, which can drastically influence an individual’s fitness. It has been suggested that innovative behavior can be strongly affected by behavioral traits, such as exploration, persistence, neophilia, and neophobia. Individuals who are more neophobic than others may encounter fewer opportunities or favorable interactions but may also show differences in cognitive ability. We tested eleven captive Goffin’s cockatoos (*Cacatua goffiniana*), a model species for innovative problem-solving, for individual variation in object neophobia and whether it relates to motivation and performance in a problem-solving task. We found no evidence that the less neophobic cockatoos were generally better problem-solvers, nor that they were more eager to engage with the setup after familiarization. Our results suggest that object neophobia in this group of Goffin’s cockatoos may not be directly linked to either the ability to innovate or the general motivation to interact with experimental apparatuses. We discuss what these findings could imply for the emergence of innovative behavior as well as the potential limitations of individually tested animals of a highly social species.

<https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0335028>

Quarterly Review of Biology

PAPERS

WILLIAM A. SEARCY & ELEANOR M. HAY – Vocal Contextual Learning in Birds

Vocal production learning, in which the structure of vocalizations is learned, has a narrow distribution among animals in general and among birds in particular. Here we assess the generality of two other forms of vocal learning: comprehension learning, in which response to vocalizations is modified by experience with how the signals are used by others, and usage learning, in which the contexts in which vocalizations are produced is similarly modified. Evidence for vocal comprehension learning is shown to be widespread, occurring in 17 of 37 avian orders representing all of the major lineages except for the most basal one. Evidence for vocal usage learning, by contrast, is extremely limited, occurring in only four of the avian orders in two of the major lineages. Furthermore, some instances of vocal comprehension learning are more cognitively advanced than what is found in vocal usage learning. Although the distribution of evidence for comprehension and usage learning may in part result from the distribution of research effort, these results suggest that the ability to extract information from sounds is better developed in birds than is their ability to encode information in sound. These patterns have implications for the evolution of language.

<https://www.journals.uchicago.edu/doi/abs/10.1086/738800>

Royal Society Open Science

PAPERS

SARAH BROCARD et al with KLAUS ZUBERBÜHLER – The perception of prosocial agents by chimpanzees and humans

The human propensity for prosocial behaviour has no equal, not even in our closest living relatives, the chimpanzees. However, it remains unclear whether this difference is grounded in the sheer perception and cognitive evaluation of prosociality. We investigated how two hominid species, chimpanzees and humans, perceive third-party social interactions with prosocial, neutral and antisocial agents. Using a touchscreen paradigm, human and chimpanzee participants freely selected between two actors after viewing their interactions, ranging from pro- to antisocial. Contrary to current thinking, we found no evidence for species differences in their choices for agents, regardless of whether interactions were between conspecifics or not. Both humans and chimpanzees demonstrated comparable sensitivity to prosociality, challenging existing views of a profound chimpanzee-human difference in prosociality. Instead, our results indicate that the perception of social interactions is similar across hominids, but that humans have evolutionarily diverged in how they act upon such perceptions.

<https://royalsocietypublishing.org/doi/10.1098/rsos.250916>

Science

ARTICLES

MELANIE FILLIOS – Dog domestication, from the fierce to the felsty

Quantitative analysis of canid skulls points to an earlier origin of dog diversity

<https://www.science.org/doi/10.1126/science.aec3775>

PAPERS

ALLOWEN EVIN et mul – The emergence and diversification of dog morphology

Dogs exhibit an exceptional range of morphological diversity as a result of their long-term association with humans. Attempts to identify when dog morphological variation began to expand have been constrained by the limited number of Pleistocene specimens, the fragmentary nature of remains, and difficulties in distinguishing early dogs from wolves on the basis of skeletal morphology. In this study, we used three-dimensional geometric morphometrics to analyze the size and shape of 643 canid crania spanning the past 50,000 years. Our analyses show that a distinctive dog morphology first appeared at about 11,000 calibrated years before present, and substantial phenotypic diversity already existed in early Holocene dogs. Thus, this variation emerged many millennia before the intense human-mediated selection shaping modern dog breeds beginning in the 19th century.

<https://www.science.org/doi/10.1126/science.adt0995>

SHAO-JIE ZHANG et mul – Genomic evidence for the Holocene codispersal of dogs and humans across Eastern Eurasia

As the first domestic species, dogs likely dispersed with different cultural groups during the Late Pleistocene and Holocene. To test this hypothesis, we analyzed 73 ancient dog genomes, including 17 newly sequenced individuals sampled from East Asia to the West Eurasian Steppe spanning nearly 10,000 years. Our results indicate correlations between the ancestry of dogs and specific ancient human populations from eastern Europe to Eastern Siberia, including Ancient Paleo-Siberians, Eastern hunter-gatherers, East Asians, and Steppe pastoralists. We also identify multiple shifts in the ancestry of dogs that coincide with specific dispersals of hunter-gatherers, farmers, and pastoralists. Combined, our results reveal the long-term and integral role that dogs played in a multitude of human societies.

<https://www.science.org/doi/10.1126/science.adu2836>

REVIEWS

ADRIAN WOOLFSON – Francis Crick's life and legacy

In October 1958, Francis Crick and his wife, Odile, hosted a party at their house in Cambridge to celebrate Fred Sanger's Nobel Prize in Chemistry. During the festivities, a rocket was launched from the roof terrace, which landed on the roof of a nearby church and necessitated the services of the local fire brigade (1). This otherwise inconsequential event is an apt metaphor for the scientific assault on mysticism and vitalism that the atheist Crick and his contemporaries helped pioneer through their pursuit of a new "chemical physics" of biology—an endeavor that would eventually help describe the nature of life itself.

Review of 'Crick: A Mind in Motion – From DNA to the brain' by Matthew Cobb; Profile Books Ltd (2025).

<https://www.science.org/doi/10.1126/science.aeb5809>

OBITUARIES

JON COHEN – James Watson: Titan of science with tragic flaws

Science historian Nathaniel Comfort reflects on the "most famous scientist of the 20th century, and the most infamous of the 21st"

<https://www.science.org/content/article/james-watson-titan-science-tragic-flaws>

Trends in Cognitive Sciences

ARTICLES

LAURA ANNA CIACCIO & LUCA RINALDI – Refining the multimodality of semantic representations

A long-standing question in cognitive sciences concerns the specific contribution of linguistic and sensorimotor experience in shaping conceptual knowledge. A new study by Xu et al. shows that large language models (LLMs) represent a powerful tool to advance this debate, helping to disentangle the relative contribution of different experiential modalities.

[https://www.cell.com/trends/cognitive-sciences/abstract/S1364-6613\(25\)00290-6](https://www.cell.com/trends/cognitive-sciences/abstract/S1364-6613(25)00290-6)

PAPERS

PATRICK BUTLIN et al – Identifying indicators of consciousness in AI systems

Rapid progress in artificial intelligence (AI) capabilities has drawn fresh attention to the prospect of consciousness in AI. There is an urgent need for rigorous methods to assess AI systems for consciousness, but significant uncertainty about relevant issues in consciousness science. We present a method for assessing AI systems for consciousness that involves exploring what follows from existing or future neuroscientific theories of consciousness. Indicators derived from such theories can be used to inform credences about whether particular AI systems are conscious. This method allows us to make meaningful progress because some influential theories of consciousness, notably including computational functionalist theories, have implications for AI that can be investigated empirically.

[https://www.cell.com/trends/cognitive-sciences/fulltext/S1364-6613\(25\)00286-4](https://www.cell.com/trends/cognitive-sciences/fulltext/S1364-6613(25)00286-4)

MARCO TAMINETTO, DAVIDE ORSENIGO & LARS CHITTKA – Bees, blindsight, and consciousness

Blindsight patients lack conscious visual perception yet perform visual tasks effectively, suggesting many animals may similarly rely on non-conscious vision. Here, we discuss how to investigate visual consciousness in miniature brains, using bees as a case study. This new endeavor can reveal the minimal neural requirements for visual awareness.

[https://www.cell.com/trends/cognitive-sciences/fulltext/S1364-6613\(25\)00285-2](https://www.cell.com/trends/cognitive-sciences/fulltext/S1364-6613(25)00285-2)

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