# EAORC BULLETIN 1,191 – 12 April 2026

## CONTENTS

# 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.

## ACADEMIA.EDU – The origins of human cumulative culture

***Philosophical Transactions of the Royal Society B 377: 20200317 (2021).***

**ANDREA BAMBERG MIGLIANO & LUCIO VINICIUS – The origins of human cumulative culture: from the foraging niche to collective intelligence**

Various studies have investigated cognitive mechanisms underlying culture in humans and other great apes. However, the adaptive reasons for the evolution of uniquely sophisticated cumulative culture in our species remain unclear. We propose that the cultural capabilities of humans are the evolutionary result of a stepwise transition from the ape-like lifestyle of earlier hominins to the foraging niche still observed in extant hunter–gatherers. Recent ethnographic, archaeological and genetic studies have provided compelling evidence that the components of the foraging niche (social egalitarianism, sexual and social division of labour, extensive co-residence and cooperation with unrelated individuals, multilocality, fluid sociality and high between-camp mobility) engendered a unique multilevel social structure where the cognitive mechanisms underlying cultural evolution (high-fidelity transmission, innovation, teaching, recombination, ratcheting) evolved as adaptations. Therefore, multilevel sociality underlies a 'social ratchet' or irreversible task specialization splitting the burden of cultural knowledge across individuals, which may explain why human collective intelligence is uniquely able to produce sophisticated cumulative culture. The foraging niche perspective may explain why a complex gene-culture dual inheritance system evolved uniquely in humans and interprets the cultural, morphological and genetic origins of Homo sapiens as a process of recombination of innovations appearing in differentiated but interconnected populations.
https://www.academia.edu/97956636/The_origins_of_human_cumulative_culture_from_the_foraging_niche_to_collective_intelligence

# NEWS

## JOHN TEMPLETON FOUNDATION – What If Today's AI Is Not a Mind, but a Cultural Technology?

On a recent evening in Los Angeles, scientists, filmmakers, and writers gathered poolside at the home of producer and writer Leigh Dana Jackson and novelist Sarah Shun-lien Bynum for a salon-style conversation about "Imagination Machines: AI and the Future of Human Storytelling," led by UC-Berkeley psychology professor Alison Gopnik.
For decades, Gopnik has studied and shared how children learn about the world. Her widely viewed TED Talk "What Do Babies Think?" argues that young minds are not incomplete adult minds but remarkably powerful learning systems, and her Wall Street Journal essay further articulated "What Babies Can Teach AI."
Gopnik's talk explored one of the defining technological questions of our time: whether today's AI systems should be understood as possessing an emerging, autonomous, artificial mind.
https://www.templeton.org/news/what-if-todays-ai-is-not-a-mind-but-a-cultural-technology

## NEWS FROM SCIENCE – What plunged these chimps into civil war? A new study traces the breakdown

Decades of observations tracked the fraying of once-friendly relations among Ugandan chimpanzees.
https://www.science.org/content/article/what-plunged-these-chimps-civil-war-new-study-traces-breakdown

## SCIENCEADVISER – Chimpanzee civil war sheds light on the biology of warfare

Chimpanzees, like humans, routinely fight, and sometimes even kill each other. But unlike us, their communities rarely split into two groups and launch a civil war. By observing a chimp community in Uganda for 30 years, the researchers behind a new Science study reveal how friends turned into foes without shortages of food or cultural rifts dividing them.
More than 200 chimps in a densely forested Kibale region called Ngogo lived peacefully between 1995, when researchers first started tracking their movements and behaviors, and 2015. Although they separated into so-called Central and Western groups, the chimps frequently intermingled, with many cross-group matings. But following the rapid death of five adult males who apparently served as peacekeepers, the Western group turned against the Central one. Over 6 years, males in the Western group killed seven adult males and 17 infants in the Central group. Even though they were larger in number, the Central group males curiously never ganged up to kill any of the Western chimps.
The civil war—only the second one ever documented in wild chimps—both clarifies motivations for human warfare and spotlights how we differ from one of our closest relatives. "You do not need ideology to generate hostilities," said Richard

Wrangham, who has studied wild chimps for more than 50 years. “The motivations for warfare are much more concerned with our biology than people would have believed a long time ago.”
As James Brooks put it in a related Perspective: “A hostile split among wild chimpanzees is a reminder of the danger that group divisions can present to human societies.”
But primatologist and co-author John Mitani said his main take home lesson is that chimps aren’t as cooperative and prosocial as humans. “Instead of attacking our neighbors, we go out of [our] way to help them, even if they are complete strangers,” he said. “I try to be optimistic, especially in these times as the world becomes increasingly polarized.”
https://www.science.org/doi/10.1126/science.aeg6719

### THE CONVERSATION – The human body: not a masterpiece, just a patchwork of evolutionary compromise

Many aspects of human anatomy are just “good enough” solutions – functional, but far from perfect.
https://theconversation.com/the-human-body-isnt-a-masterpiece-of-design-its-a-patchwork-of-evolutionary-compromise-279343

## PUBLICATIONS

### Cell Genomics

**PAPERS**

**FRANCISCO RODRIGUEZ-ALGARRA et al – Germline sequence variation within the ribosomal DNA is associated with human complex traits**

Ribosomal RNAs (rRNAs), essential components of the ribosome, are coded by the multi-copy ribosomal DNA (rDNA). Interestingly, rDNA displays substantial variation in all species, both as inter-individual differences in copy number (CN) and inter- and intragenomic sequence variation across copies (single-nucleotide variants [SNVs] and insertions/deletions [indels]). Whether germline rDNA sequence variation associates with human traits remains largely unknown. We here derive a stringently validated list of rDNA-associated SNVs and indels from UK Biobank whole-genome sequencing data, and we show that specific rDNA variants associate with human phenotypes independently of rDNA CN. Notably, variants within the 28S expansion segment 15L associate with body size traits. Variant combinations in the region present in actively translating ribosomes are predicted to alter the rRNA secondary structure. This represents the first large-scale association analysis of human traits with germline rDNA sequence variation, a largely ignored source of trait-relevant genetic variation to date.
https://www.cell.com/cell-genomics/fulltext/S2666-979X(26)00075-3

### Cell Press

**NEWS**

**Horses whinny by producing high-frequency sounds and lower tones at the same time**

A horse’s whinny is an unusually distinctive mix of sounds including both high and low frequencies. Research published in the Cell Press journal Current Biology on February 23, 2026, demonstrates how horses produce high-frequency sounds that defy their large size while simultaneously producing lower tones: they whistle through their larynx while vibrating their vocal folds as a human does while singing. The study, which has been talked about in NPR, The New York Times, Popular Science, and more, suggests that horses likely evolved these vocalizations to be able to convey multiple messages to one another at the same time.
https://www.cell.com/news-do/pr-horses-whinny

### Evolutionary Anthropology

**PAPERS**

**YEGANEH SEKHAVATI, KALEB C. SELLERS & CALLUM F. ROSS – Biomechanics and Evolution of the Primate Tongue**

Primate tongue morphology and function are critical to understanding the evolution of feeding, swallowing, and vocalization. In this paper, we examine the primate tongue as a muscular hydrostat with regionally specialized neuromuscular compartments. We integrate anatomical, kinematic, and biomechanical modeling approaches to analyze how muscle architecture and fiber orientation drive complex tongue deformations during functional behaviors. We evaluate the hydraulic mechanisms underlying tongue-base retraction, highlight species-specific adaptations in macaques and humans, and review primate tongue kinematics across distinct feeding stages. Finally, we synthesize recent advances in biomechanical modeling and experimental studies of tongue kinematics and their contributions to advancing three-dimensional analyses of tongue movement during feeding and speech.
https://onlinelibrary.wiley.com/doi/full/10.1002/evan.70026

## Evolutionary Human Sciences

### PAPERS

**ELENI SEFERIDOU & GÖZDE ATAĞ – Exploring matrilocality in history Insights from ancient DNA**

Patterns of social organization and gender differentiation in past societies are difficult to reconstruct from material culture data alone, are prone to modern interpretation biases, and often remain subjects of controversy. An important aspect of social organization is patterns of post-marital residence, for example, matrilocality and patrilocality. To date, archaeological studies have recognised mostly patrilocal societies, with rare contested exceptions that were considered "outliers" to the established rule of patrilocality. The advent of ancient DNA analysis has made it possible to evaluate past social structures from a genetic perspective as well, with the majority of ancient DNA studies identifying patrilocal societies and highlighting genetic patriline connections. Recently, three studies reported genetic evidence for matrilocality and genetic matriline connections across broad geographical and temporal scales. Here, we draw on these three studies to explore past social organisation forms in light of new evidence, and reconsider preconceptions that continue to endure over time.
https://www.cambridge.org/core/journals/evolutionary-human-sciences/article/exploring-matrilocality-in-history-insights-from-ancient-dna/0BB706D43BA41891626D6C02A96FC66D

**LUDOVIC MAISONNEUVE & LAURENT LEHMANN – How does stochasticity in learning impact the accumulation of knowledge and the evolution of learning?**

Learning is crucial for humans and other animals to acquire knowledge, enhancing survival and reproduction. In particular, individual and social learning allow populations to accumulate knowledge across generations. Here, we examine how stochasticity in the production and social acquisition of knowledge influences the evolution of learning strategies and cumulative knowledge. Using a mathematical model where learning is stochastic, we show that learning stochasticity enhances cumulative knowledge by generating variability in knowledge levels. This allows selection to enhance population knowledge: individuals who acquire more knowledge by chance are more likely to survive and reproduce, and therefore to transmit their knowledge to the next generation. As knowledge accumulates, social learning exemplars tend to possess more of it, favoring greater time investment in social learning. Because social learning provides access to substantially more knowledge when learning is stochastic, selection also favors the evolution of greater investment into learning, at the expense of a fecundity cost. Moreover, when knowledge enhances fecundity but not survival, learning stochasticity favors learning from parents rather than other adults, because learning stochasticity increases uncertainty about exemplar knowledge, making parenthood a cue for possessing fecundity-enhancing knowledge. Finally, when learning occurs predominantly from parents, learning stochasticity itself is favored by selection.
https://www.cambridge.org/core/journals/evolutionary-human-sciences/article/how-does-stochasticity-in-learning-impact-the-accumulation-of-knowledge-and-the-evolution-of-learning/A250CBEC353DE1C8717A0362FC843E74

## Frontiers in Human Neuroscience

### PAPERS

**JALAL MAJID JALIL, ASMAA ABBAS AJWAD & DIYAR MAJID JALIL – Unraveling the mystery of stuttering: clinical and physiological insights into its manifestation**

Stuttering is a complex neurodevelopmental speech disorder characterized by involuntary sound and syllable repetitions, prolongations, and speech blocks, accompanied by marked variability across linguistic, emotional, and situational contexts. Although numerous hypotheses have been proposed to explain its underlying mechanisms, many have encountered a fundamental limitation: the difficulty of coherently accounting for the full range of clinical, developmental, and neurobiological features observed in people who stutter. In response to this gap, the present work proposes a comprehensive, integrative hypothesis that seeks to unify the diverse physiological and clinical manifestations of stuttering within a single neurobiological framework. This model aims to link moment-to-moment fluctuations in speech behavior with neurodevelopmental alterations, offering a plausible mechanistic account for a wide spectrum of core phenomena. These include the pronounced situational variability of stuttering severity; the developmental shifts from repetitions to blocks; the transition of disfluencies from function words to content words; the tendency for stuttering to occur on key words in a sentence; and the consistently lower rates of spontaneous recovery observed in males compared to females. Furthermore, the proposed framework seeks to explore potential common mechanisms underlying the widespread structural, metabolic, and functional brain changes documented in stuttering, while considering whether these abnormalities may reflect primary contributors or secondary, compensatory adaptations. In particular, the model seeks to address a long-standing debate regarding the role of the right inferior frontal gyrus, examining whether its engagement is more consistent with a causal contribution to speech disruption or with an adaptive response to impaired speech–motor control. By integrating neurodevelopmental, physiological, and clinical evidence, this hypothesis offers a unifying perspective on key features of stuttering while proposing a neurobiological model whose assumptions and hypotheses can be empirically tested and evaluated in future experimental studies.
https://www.frontiersin.org/journals/human-neuroscience/articles/10.3389/fnhum.2026.1700499/full

## Frontiers in Psychology

### PAPERS

**MICHAEL A. ARBIB & VALENTINA CUCCIO – The body in language, the language beyond the body: embrainment and graded embodiment in the evolution and use of language**

We reject the notion that the assertion “language is embodied” has a yes/no answer and instead introduce an account of a gradient of embodiment that ranges from “strict embodiment” restricted to elements of language describing humans engaged in practical bodily interaction to fully abstract concepts. We show how concepts may blend strict embodiment and abstraction, and demonstrate that strictly embodied knowledge may ground linguistic meaning phylogenetically and ontogenetically. Much adult language use resides “high” in a tower of abstraction. However, movement away from strict embodiment need not imply movement only up the tower of abstraction. Embodied simulation combined with metaphor provides one mechanism for linking abstraction to embodiment. An account of biocultural evolution shows how changes primarily in brain structure (embrainment) made possible the linkage of practical action to pantomime in grounding protolanguages and how cultural evolution built on this to create a symbolic and physical environment that depends on the availability of grammar to create metaphors and new abstractions. Critiquing the claim that large language models mirror the human brain’s language system we show how human embrainment links disembodied processing to processes that are strictly embodied.
https://www.frontiersin.org/journals/psychology/articles/10.3389/fpsyg.2026.1774505/full

**LIN GUO, CHENGYU NAN & ZHENYAO QUAN – Patterns of Emotional Expression during the Formation of Egocentric Awareness in Early Childhood: A Case Study**

Emotional expression is a fundamental dimension of children's social development and is closely linked to psychological processes, language competence, and self-awareness. Drawing on developmental psychology and cognitive linguistics, this study traces how a two-year-old Mandarin-speaking child develops self-recognition and egocentric awareness. Through naturalistic observation and discourse analysis, this study delineates the developmental stages of emotional expression, examines the dynamic interplay between self-awareness and language awareness across stages, and further explores how affective dialogue fosters the differentiated development of egocentric awareness. The findings indicate that egocentric awareness unfolds along a developmental continuum from affective monologue to affective dialogue. In the monologue stage, self-recognition and language awareness emerge concurrently; in the dialogue stage, egocentric awareness co-develops with language-mediated embodied thinking and an increasing demand for interpersonal feedback. Bidirectional affective expression at this stage appears to promote the development of children's general cognitive abilities. Grounded in authentic linguistic and behavioral data, this study offers a preliminary exploration of emotional expression patterns during children's mental maturation and provides tentative insights for constructing an "emotion-language" co-development model.
https://www.frontiersin.org/journals/psychology/articles/10.3389/fpsyg.2026.1756750/abstract

## Frontiers in Public Health

### PAPERS

**XIAOGAI HAN et al – Investigating the mediating role of comprehensive self-efficacy in the relationship between altruistic factors and voluntary non-remunerated blood donation behavior**

To investigate the relationship between altruistic factors and voluntary non-remunerated blood donation behavior, and to examine the potential mediating role of comprehensive self-efficacy in this relationship.
A cross-sectional survey was conducted from June 2023 to April 2024 in Zhengzhou and Xinxiang, Henan Province, China. Using stratified random sampling, 9,622 residents aged 18–60 years were recruited. Data were collected via questionnaires assessing sociodemographic characteristics, altruistic factors (score range: 0–3), comprehensive self-efficacy regarding blood donation (a composite score of knowledge, situational confidence, policy awareness, and service evaluation), and self-reported blood donation history. Blood donation behavior was categorized for analysis as non-donor versus donor (≥1 donation). Multinomial logistic regression and bootstrap mediation analysis were employed.
Altruistic factors showed a significant positive association with donation behavior, exhibiting a clear dose–response relationship (ORs ranged from 1.673 to 2.592, all $p < 0.001$). Comprehensive self-efficacy was a strong independent predictor of donation ($p < 0.001$). Crucially, mediation analysis revealed a statistical pattern consistent with full mediation: the association between altruistic factors and donation behavior was significantly mediated by comprehensive self-efficacy (indirect effect: 0.335, 95% CI [0.301, 0.372]), with no significant direct effect detected. Owing to the cross-sectional nature of this study, this finding only describes the statistical association between variables, and cannot confirm a definitive causal mediating pathway. Significant demographic disparities were also observed.
Altruistic motivation provides the foundational impetus for blood donation, but its translation into action is channeled through an individual’s perceived comprehensive self-efficacy. This suggests that promotion strategies should evolve from solely emphasizing altruism towards integrated efforts that systematically build public knowledge, confidence, and trust in the donation process. Integrated strategies that enhance both altruistic motivation and comprehensive self-efficacy are essential for improving donor recruitment and retention.
https://www.frontiersin.org/journals/public-health/articles/10.3389/fpubh.2026.1795974/full

## Nature

### NEWS

**Hallucinated citations are polluting the scientific literature. What can be done?**
Tens of thousands of publications from 2025 might include invalid references generated by AI, a Nature analysis suggests.
https://www.nature.com/articles/d41586-026-00969-z

**Mini models of the human brain are revealing how this complex organ takes shape**
Lab-grown organoids are turbo-charging the study of human brain development and disease.
https://www.nature.com/articles/d41586-026-01025-6

## Nature Communications

### PAPERS

**MANUEL WILL et al – Specialised and persistent raw material procurement by humans in the Middle Pleistocene**
The selection and acquisition of suitable raw material constitute the first steps in stone tool technology. Previous ethnographical and archaeological research suggests that hominins in the Pleistocene primarily collected their stone materials while carrying out other activities. Direct provisioning for this purpose alone remains an outlier and is rarely demonstrated. Archaeological excavations coupled with multidisciplinary analyses at Jojosi in South Africa demonstrate that early modern humans undertook specific, repeated visits to a raw material source over tens of thousands of years for the exclusive purpose of obtaining hornfels. This rare, stratified, open-air locality features uniquely preserved lithic assemblages with abundant refits dating from ~220 ka to ~110 ka for the reduction and export of a single tool stone. The scope of these knapping activities is underscored by millions of Middle Stone Age hornfels artefacts paving the modern landscape. The consistent, specialised procurement of a single raw material at Jojosi already during the Middle Pleistocene challenges the standard model of embedded procurement for this period. These findings further show that key capacities of Homo sapiens, including increased long-term planning and behavioural plasticity in the interaction with the material world, emerged early in their evolutionary history.
https://www.nature.com/articles/s41467-026-70783-8

## Nature Communications Psychology

### ARTICLES

**MICHAEL COLOMBO – A comparative perspective allows unpacking complex interpretations**
Our tendency towards rich interpretations of behaviour is common. Pigeons, however, can solve the same complicated tasks that are solved by primates, and often do so in a manner indistinguishable from primates. If we richly interpret human behaviour, or primate behaviour in general, yet find the exact same signatures of that behaviour in pigeons, we should question whether our rich interpretation is warranted. By understanding how different animals solve complex tasks we can gain a better insight into how humans may be solving those same tasks and potentially avoid the theoretical pitfalls of rich interpretations.
https://www.nature.com/articles/s44271-026-00449-0

## Nature Neuroscience

### ARTICLES

**ANA UZQUIANO – Comparing primate cerebellums**
The human brain is highly distinct from the brains of even our closest relatives. To identify molecular features that underlie these differences, Kim, Cherskov and colleagues produced a cross-primate cellular atlas of the cerebellum, generated using single-nucleus transcriptomic and chromatin-accessibility profiling. Examination of data from four species — humans, chimpanzees, rhesus macaques and common marmosets — revealed both conserved and divergent cerebellar molecular features. Genes that were differentially expressed in the human cerebellum compared to the other primates were related to synapse biology, and granule cells showed the highest transcriptomic divergence. Among the human-enriched genes in this cell type was ZP2; this gene is known for its role in mammalian reproduction but was found to be preferentially expressed in the cerebellum. Through experiments leveraging co-cultures of cerebellar and pontine cells, immunostaining, multi-electrode array recording and a human ZP2 knock-in mouse model, the authors showed that ZP2 expression is controlled by pontine mossy fibers, and its induction modulates synapse formation and consequent neuronal activity. This study primes the investigation of primate and specifically human cerebellar features and highlights ZP2 as a regulator of human synapse development in this brain region.
https://www.nature.com/articles/s41593-026-02276-2

## Nature Scientific Data

### PAPERS

**ALEJANDRO SÁNCHEZ-AMARO et mul with ROMAN M. WITTIG, MICHAEL TOMASELLO & JOSEP CALL – EVApeCognition: An 18-Year Dataset of Great Ape Cognition**

The study of great ape cognition offers insights into the evolutionary origins of human intelligence, but is hindered by small sample sizes and restricted access to data. To address this, we present the EVApeCognition Dataset, a publicly available resource comprising 262 experimental datasets from 150 scientific publications from the Wolfgang Köhler Primate Research Center (2004–2021) in Leipzig, Germany. Eighty-one apes participated in 150 studies, with a majority (N = 78) participating in more than one study. Publication of the dataset aims to make these unique datasets accessible for future meta-analyses and correlational analyses, helping us better understand how our great ape relatives think, learn, and behave.
https://www.nature.com/articles/s41597-026-07191-6

## Nature Scientific Reports

### PAPERS

**DUO LI et al – Detecting age differences in prosociality using a newly developed picture-based measure**

Previous research has indicated that older adults are more likely than younger adults to share money, suggesting more prosociality. However, the extent to which older adults exhibit prosociality in other forms, such as helping and comforting, remains unclear due to the absence of a comprehensive measure. This study addresses this gap by validating a novel picture-based measure of prosociality (PB-Prosocial) in older adults, which showed good psychometric properties. Using this measure, we examined age-related differences in prosociality and underlying mediators. Older adults were found to be more prosocial in sharing, but not in helping or comforting, compared with younger adults. The age difference in sharing appeared to result from older adults being more familiar with the situations and perceiving a lower cost of sharing than younger adults. Taken together, our study provides a validated measure of prosociality and demonstrates that older adults' increased prosociality is specific to sharing.
https://www.nature.com/articles/s41598-026-47472-z

**MAÏLYS RICHARD et al – A Middle Stone Age occupation identified at Baden-Baden in the grasslands of the Free State, South Africa**

In southern Africa, Marine Isotope Stage (MIS) 5 (~ 130 – 71 ka) is a crucial period in the evolution of Homo sapiens but poorly documented in the central interior of the subcontinent. We report here results from Baden-Baden 2, a newly discovered open-air site in the western Free State grasslands of South Africa that documents Middle Stone Age occupations dated to MIS 5. The lithic assemblage differs from known MIS 5 and post-MIS 5 industries and shows similarities with industries typically dated to MIS 6 (~ 191 – 130 ka). In order to geochronologically constrain the occupation of Baden-Baden 2, sediments for optically stimulated luminescence (OSL) dating were collected together with micromorphology blocks to correlate formation processes and luminescence data. Magnetic susceptibility and plant biomarker analyses were used to identify changes in sediment supply and reconstruct past environments, revealing a shift in sediment source or climate regime during the period of human occupation, which took place between 91 ± 8 ka and 75 ± 7 ka. The palaeoenvironment shows three relatively stable phases that match the three broad phases of sediment input identified. The combination of OSL and micromorphology shows extensive bioturbation due to termite activity in the whole sequence. We discuss here the issue of dating quartz grains in bioturbated contexts, using single grain analyses combined with the Finite Mixture Model. Our results suggest that sand at the site was deposited from 106 ± 8 ka, for the base of the sequence, to 120 ± 30 a, for the modern sample at the top. The Baden-Baden 2 assemblage overlaps temporally with different industries in other South African regions, underscoring the need for more systematic investigation of MIS 5 in the interior of South Africa.
https://www.nature.com/articles/s41598-026-43246-9

**SABINE GAUDZINSKI-WINDHEUSER et al with WIL ROEBROEKS – Shell game: Neanderthal use of the European pond turtle (Emys orbicularis) in the Last Interglacial landscape of Neumark-Nord (Germany)**

Data on palaeolithic subsistence is often obtained through studies of faunal palimpsests, containing remains of animal processing activities accumulated over non-quantifiable amounts of time. Compounding such site-specific data with evidence from other sites distributed over large areas - i.e. integrating data spanning large temporal as well as spatial scales - results in coarse-grained reconstructions of past prey diversity. In contrast, here we present prey diversity data from what is—geologically speaking—a "snapshot" of a ~ 25-hectare area frequented by Neanderthals during the Last Interglacial, with a focus on their exploitation of the pond terrapin Emys orbicularis. These data constitute the first evidence of turtle exploitation by Neanderthals north of the European mountain chains, beyond the Mediterranean basin. This Neumark-Nord record demonstrates that Last Interglacial foragers exploited a wide range of archaeologically visible resources available in this lake area, from small (~ 1 kg) pond terrapins up to and including the largest terrestrial mammals of the Pleistocene, straight-tusked elephants, with adult males weighing more than 10 tonnes. The abundance of intensively exploited medium- and large-sized mammals found alongside these Emys remains suggests that other variables than macronutrients per se played a role in the repeated harvesting of pond terrapins from these water bodies.

https://www.nature.com/articles/s41598-026-42113-x

## Neuron

### PAPERS

**BENJAMIN BESSIÈRES et al – Infant learning forms lasting memory schemas that influence adult behavior**

Early-life episodic experiences, despite seeming rapidly forgotten, are stored long-term in a latent form. The contribution of this unique hidden memory storage is not understood. Here, we show that contextual memories formed in infant mice are recovered in adulthood following weak behavioral reminders (savings) of the infantile experience. Savings in adults also facilitates new congruent learning but fails to influence other types of hippocampus-dependent learning, and this facilitation is a developmental prerogative. Both infant memory reinstatement and facilitation of new learning in adults are context-specific and functionally re-engage subsets of the prelimbic/infralimbic (PL/IL) and anterior cingulate cortex (ACC) neural networks activated in infancy. New adult learning also re-engages the dorsal hippocampus (dHC) along with PL/IL-dHC and ACC-dHC neuronal projections that were activated during infant learning. Thus, infant memories store information for a long time as memory schemas that support relearning and the formation of new congruent memories in adulthood.
https://www.cell.com/neuron/fulltext/S0896-6273(26)00209-6

## New Scientist

### NEWS

**Bumblebees surprise scientists by showing a sense of rhythm**

Recognising rhythmic patterns was thought to require a big brain, but a series of experiments has shown that buff-tailed bumblebees have this ability, too
https://www.newscientist.com/article/2522005-bumblebees-surprise-scientists-by-showing-a-sense-of-rhythm/

### ARTICLES

**JAMES URQUHART – Why early humans radically changed their toolkits 200,000 years ago**

A decline in massive herbivores in the Middle East coincided with a shift towards smaller, lighter toolkits in the archaeological record – though scientists are still in debate about why.
https://www.newscientist.com/article/2522425-why-early-humans-radically-changed-their-toolkits-200000-years-ago/

## PLoS One

### PAPERS

**ERIK C. TRACY, ELIZABETH D. YOUNG & KELLY A. CHARLTON – Judgments of American English male talkers who are perceived to sound gay or straight: Which personal attributes are associated with each group of talkers?**

Upon hearing a spoken utterance, listeners associate certain attributes (e.g., emotional) with self-identified gay male talkers and other attributes (e.g., reserved) with self-identified straight male talkers. In the current study, we explored whether listeners associated additional personal attributes with these types of talkers, and whether different contexts (e.g., listeners being informed of the talker's sexual orientation) affected how strongly listeners associated personal attributes with talkers. Twenty-four talkers (twelve who self-identified as gay and twelve who self-identified as straight) from an established corpus were examined. Notably, previous work found that these talkers' self-described sexual orientation (SO) did not always align with listener-perceived SO (i.e., a self-identified gay talker was perceived as straight sounding, and vice versa). Listeners evaluated these talkers for eight attributes (e.g., boring, confident, intelligent, mad, old, outgoing, sad, and stuck-up) in three contexts: talkers' SO not referenced, talkers' SO truthfully referenced (i.e., listeners were informed that a straight talker was straight), and talkers' SO falsely referenced (i.e., listeners were informed that a straight talker was gay). Results suggested that self-identified gay and straight talkers whom listeners perceived as sounding gay were perceived as confident, mad, stuck-up, and outgoing; self-identified gay and straight talkers whom listeners perceived as sounding straight were perceived as sad and old. Furthermore, listeners' judgments did not differ when the talkers' SO was truthfully referenced, falsely referenced, or not referenced for all attributes except sad and stuck-up. The results indicate that perceived SO generally has the greatest effect on listeners' perception of a talker's attributes and, for most attributes examined, this is the case regardless of whether the listeners are informed (truthfully or falsely) of the talkers' self-identified SO.
https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0346897

**JOSHUA J. MARCH et al – Why do self-referent cues facilitate mathematical word problem-solving? Insights from eye tracking**

Associating information with the self enhances processing of that information, with simple text cues like self-referent pronouns (i.e., 'You') increasing response speed and accuracy in processing tasks. Research suggests this can be applied in educational contexts, such as children's mathematical word problem-solving. Whilst children show faster and more accurate word problem-solving when self-pronouns are included in the text, the mechanisms underlying these effects are unclear. The current study extends previous research by using eye-tracking to monitor 9- to 11-year-old children's processing during mathematical word problem-solving. Children were faster to solve subtraction problems that contained a self-referential

pronoun, but this was not the case for addition problems. Eye tracking data revealed that faster processing time was driven by reduced fixation length on referent information in the self-pronoun problems across problem types: children spent less time looking at self-pronouns than terms referring to another person (e.g., character names). This suggests that self-pronouns may facilitate problem-solving by supporting active storage of items bound to self in working memory, reducing the need for revisitation during mathematical word-problem solving. This is likely to be particularly beneficial for more cognitively challenging problems, providing an explanation for patterns of self-reference effects reported previously.
https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0346703

**NICHOLAS SULIER, JULIO TORRES & JUDITH F. KROLL – Not just two languages: Using variation in language experience to understand how cognitive resources shape syntactic processing**
Individuals who learn and use two languages come to that experience in many different ways. Recent studies have shown that to understand bilingualism, it is necessary to characterize the variation in experience that continually shapes the use of the two languages. The current investigation explored the consequences of individual differences in cognitive resources for the processing of syntactic information in two groups of speakers. One group were adults learning Spanish and the other were heritage bilinguals with Spanish as the home language. Both groups were proficient speakers of English. We examined the effects of working memory and cognitive control on syntactic processing, measured by an elicited sentence imitation task. The findings revealed both common and distinct contributions of cognitive resources. Working memory predicted Spanish syntactic processing for second language learners but not for heritage speakers. In contrast, working memory predicted English syntactic processing only for heritage speakers, and this effect was modulated by language dominance. The results for Spanish align with expectations, but the English findings suggest that syntactic processing is shaped not only by proficiency, but also by how the two languages are learned and used together. Cognitive control also showed group-specific effects in response to syntactic complexity: heritage speakers with more reactive control strategies showed better Spanish processing as phrase complexity increased, while L2 learners with more proactive control strategies showed better English processing under increased complexity. Together, these results contribute to our understanding of the effects of language experience on cognitive engagement and shed new light on the dynamics that underlie variation in syntactic processing among bilinguals.
https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0346505

## Proceedings of the Royal Society B

### ARTICLES

**WALDIR M. SAMPAIO – Rethinking how group composition shapes cooperation**
A fundamental challenge for human societies is maintaining cooperation in large, heterogeneous groups where individuals differ in many categories, including cultural background, political alignment and economic class. While humans exhibit a generalized prosociality in early childhood, this universality is gradually constrained as development progresses. A key variable driving this shift towards parochialism is the acquisition of distinct social identities. As individuals navigate diverse group affiliations, cooperation becomes increasingly bounded by social markers, with individuals typically displaying a preferential willingness to bear costs for the benefit of the ingroup.
https://royalsocietypublishing.org/rspb/article/293/2068/20260197/481268/Rethinking-how-group-composition-shapes

### PAPERS

**XINGZHI GUO et al – Statistical structure and the evolution of languages**
Human cultural development is marked by the emergence of new words and ideas, reflecting societal changes. But how does this evolution proceed? We use modern methods in natural language processing (namely, word embeddings) to measure statistical traces of cultural development, providing a testing ground to compare different models as to how this process works. We show that real embeddings of English and 21 other languages exhibit a series of previously unrecognized regularities. Specifically, these are: (i) frequency assortativity, where entities of high popularity cluster near other high-popularity entities; (ii) characteristic clustering velocity profiles due to aggregation into hierarchical structures; (iii) persistent temporal dynamics, where newly created entities appear disproportionately near other recent entries; and (iv) Taylor's law, implying that over time and across empirical semantic space the variance in new entity counts scales as a power of the mean, which helps systematize and quantify large historical fluctuations of neologisms. To explain these facts, we propose a class of generative models (specifically, directed preferential placement) that construct synthetic embeddings exhibiting similar regularities. We show that analogous regularities also occur in other datasets, suggesting that such generating models may shed light on new aspects of language and cultural evolution.
https://royalsocietypublishing.org/rspb/article/293/2068/20252374/481270/Statistical-structure-and-the-evolution-of

**ANTONIO M. ESPÍN et al – Conflicting identities and cooperation between groups: experimental evidence from a mentoring programme**
Well-functioning human societies require the integration of vulnerable minorities, yet leading scientific theories conflict on how easily diverse groups cooperate. We experimentally investigate cooperation in 14 centres of a mentoring programme where participants have two possible natural identities—individuals raised under legal guardianship, suffering a negative

stereotype (G; n = 112) and users without such a social stigma (NG; n = 82). Participants played a prisoners' dilemma game with an anonymous partner from the same centre (centre-ingroup) and from another centre (centre-outgroup). For individuals without a history within-centre interaction, we find centre-outgroup favouritism among G and centre-ingroup favouritism among NG. However, the longer G individuals have been in the centre the more centre-ingroup favouritism they display, while the opposite is true for NG. Regardless of within-centre history, both G and NG individuals cooperate less with the centre-ingroup (versus outgroup) as the probability that the centre-ingroup is G increases. Thus, we observe patterns of centre-outgroup and natural-outgroup favouritism among G which challenge theoretical frameworks exclusively focusing on ingroup favouritism. Our findings highlight the roles of system-justification and stereotypes in intergroup cooperation and have implications for the integration of vulnerable groups and the optimization of social policy programmes.
https://royalsocietypublishing.org/rspb/article/292/2052/20251363/234484

## Royal Society Open Science

### PAPERS

**ORIANA PANSARDI et al – Altruistic punishment in action: movement vigour in neuroeconomic choice**
Decision and action unfold in parallel, with movement vigour typically reflecting subjective value: the higher the subjective value assigned to an option, the greater the vigour in moving towards it. Here, we reveal a striking inversion of this classic vigour–value relationship in the context of altruistic punishment. In study 1, using a motor version of the Ultimatum Game, we found that vigour increased with offer amount when offers were accepted but decreased when offers were rejected (altruistic punishments). In study 2, we disentangled the factors driving this reversal using a social exchange task. We found that vigour during punishment was not determined by self-cost or other cost alone, but by the efficiency of punishment—the ratio of other cost to self-cost. These findings establish movement vigour as a dynamic read-out of social utility and demonstrate that social preferences can fundamentally reshape vigour–value mappings.
https://royalsocietypublishing.org/rsos/article/13/4/252403/481284/Altruistic-punishment-in-action-movement-vigour-in

## Science

### ARTICLES

**JAMES BROOKS – Civil war among wild chimpanzees**
A violent split in a group of chimpanzees highlights the evolutionary roots of war and peace.
https://www.science.org/doi/10.1126/science.aeg6719

### PAPERS

**AARON A. SANDEL et mul with KEVIN E. LANGERGRABER & JOHN C. MITANI – Lethal conflict after group fission in wild chimpanzees**
Territorial conflicts in animals can inform aspects of human warfare, but civil war, with its shifting group identities, has not been previously observed. We report a rare, permanent fission in the largest-known group of wild chimpanzees (Pan troglodytes). Using 30 years of behavioral observations and network analyses, we describe a transition from cohesion to polarization in 2015 and the emergence of two distinct groups by 2018. Over the next 7 years, members of one group made 24 attacks, killing at least seven mature males and 17 infants in the other group. These findings indicate that group identities can shift and escalate into lethal hostility in one of our closest living relatives in the absence of the cultural markers often thought necessary for human warfare.
https://www.science.org/doi/10.1126/science.adz4944

**MOHAMMED ALSOBAY et al – Integrative experiments identify how punishment affects welfare in public goods games**
Human societies face many situations where individual and collective interests conflict, often referred to as social dilemmas. Costly peer punishment has been studied for more than 25 years in public goods games (stylized behavioral experiments in which individuals decide how much to contribute to a shared pool that benefits everyone) as a mechanism to promote cooperation. Prior research has identified many contextual factors that moderate punishment's effectiveness, including game length, communication, group size, punishment cost, and so on. However, the specific conditions under which punishment improves group welfare remain unclear.
We argue that this lack of clarity derives from the dominant experimental paradigm, in which any given study manipulates only one or a few theoretically informed factors. Because such studies differ in many ways (different experimental procedures, populations), their results are often difficult to compare or integrate. Consequently, one can list many factors that have some effect, but cannot say how much each matters relative to the others, or how they work together, and as a result, cannot predict when punishment will help or harm welfare in new settings. To address this fundamental knowledge gap, we use an integrative experimental design and systematically vary 14 parameters across 360 conditions (147,618 decisions from 7100 participants) to elucidate when punishment improves versus undermines welfare in public goods games, which factors matter most, and how they interact.
The effect of punishment on welfare ranged from 43% improvement to 44% reduction depending on the specific combination of game parameters. To characterize this heterogeneity, we trained a model that outperformed all 553 human

forecasters (laypeople and experts) in predicting whether punishment would help or harm welfare in new experiments. Communication emerged as roughly three times more important than any other factor, followed by contribution framing (opt in versus opt out), contribution type (variable versus all-or-nothing), game length, and peer outcome visibility (whether participants can see others' earnings). These factors often interact. For example, longer games enhance punishment's effectiveness only when communication is available, and contribution framing effects depend on both contribution type and outcome visibility.
Many phenomena in social science are shaped by many factors whose interactions are consequential, yet the dominant experimental paradigm often limits its inquiry to "does a given effect exist?" and examines hypothesized factors in isolation. As a result, research programs can accumulate many partial explanations without a clear picture of how they combine to determine outcomes across settings. Knowing that factors matter individually is fundamentally different from knowing how much each matters and how they interact. The integrative approach implemented here offers one way forward. It varies many factors simultaneously within a shared design space, evaluates models by their predictive accuracy on new experiments, and probes those models to constrain and develop theory. Our hope is that integrative experiment designs, combined with models that integrate prediction and explanation, represent a path toward more cumulative social science.
https://www.science.org/doi/10.1126/science.aeb5280

## Trends in Cognitive Sciences

### PAPERS

**NED BLOCK – Can only meat machines be conscious?**
Computational functionalism claims that executing certain computations is sufficient for consciousness, regardless of the physical mechanisms implementing those computations. This view neglects a compelling alternative: that subcomputational biological mechanisms, which realize computational processes, are necessary for consciousness. By contrasting computational roles with their subcomputational biological realizers, I show that there is a systematic tension in our criteria for consciousness: prioritizing computational roles favors consciousness in AI, while prioritizing subcomputational biological realizers favors consciousness in simpler animals. Current theories of consciousness are 'meat-neutral', but if specific physical substrates are necessary, AI may never achieve consciousness. Understanding whether consciousness depends on computational roles, biological realizers, or both, is crucial for assessing the prospects of consciousness in AI and less complex animals.
https://www.cell.com/trends/cognitive-sciences/fulltext/S1364-6613(25)00234-7

**JÖRG GROSS, CAROLINE GRAF & CHARLOTTE S.L. ROSSETTI – The hidden costs of human cooperation**
Cooperation enables humans to reshape entire environments and build complex societies. Although often celebrated, cooperation also has hidden costs. By presenting core mechanisms behind its emergence, we demonstrate that maintaining cooperation frequently relies on social control and coercion, which can lead to extortion and discrimination. Group cooperation further necessitates defining who belongs to the group, fostering exclusion and intergroup conflict. Free-rider concerns fuel scapegoating and polarization. These downsides challenge the notion of cooperation as a simple success story. The resulting conundrum for scientists is not just to explain cooperation but to identify institutions that harness its benefits while limiting its risks. Understanding these complexities is crucial to ensuring that human cooperation serves the common good rather than deepening social divides.
https://www.cell.com/trends/cognitive-sciences/fulltext/S1364-6613(25)00269-4

**FRANCESCO ELLIA & NAOTSUGU TSUCHIYA – Explanation, scope, and perspective: sources of schismogenesis in consciousness science**
Contemporary consciousness science faces an impasse: competing theoretical frameworks—structuralist versus functionalist, universal versus local, intrinsic versus extrinsic—appear to be inducing philosophical deadlocks and conceptual standstills. While these debates have generated valuable insights, they have proceeded in parallel, without a systematic framework for understanding their relationships and implications. We contend that these parallel disputes reflect deeper, unresolved tensions in the conceptualization of consciousness. These debates can be addressed by recognizing three fundamental dimensions that encompass models of consciousness at a meta-theoretical level: explanatory medium, scope, and perspective. We show the interplay among different dimensions and how they mutually condition evidence, language, and concepts, reframing theoretical conflicts into tractable disagreements.
https://www.cell.com/trends/cognitive-sciences/fulltext/S1364-6613(26)00055-0

**MOIRA R. DILLON – The cognitive origins of geometry**
Geometry is often considered the paradigmatic model of abstract thought, with thinkers since at least Plato exploring its origins. A dominant hypothesis posits that a specialized, modular language of thought underlies our species' unique geometric abilities. Challenging this view, I propose the Wanderers Hypothesis for Geometry, which suggests that human geometry is primarily rooted in navigation-like mental processes shared by humans and nonhuman animals and that these processes approximate Euclidean geometry. Drawing on infant experiments, cross-cultural experiments, and cognitive modeling, I argue that humans access these primitive processes through natural language, supporting their flexible

application and our capacity for formal learning. This perspective broadens our understanding of geometric cognition and the nature of the human mind.
https://www.cell.com/trends/cognitive-sciences/abstract/S1364-6613(26)00005-7

## Trends in Ecology and Evolution

**PAPERS**

**CHRISTINE W. MILLER et al – Toward an integrated understanding of animal weapons**

Animals resolve conflict using an astonishing array of weapons—from electric fields and sonic shock waves to deadly venom and high-impact strikes. Yet, most weapon research has been narrowly focused, for example, only considering mechanical weapons under sexual selection. Furthermore, few studies have examined how weapons are integrated into animal phenotypes. For these reasons, it is not surprising that major questions remain about why weapons have evolved such extraordinary diversity in form and function. By synthesizing insights across weapon modalities and research traditions, we identify key themes for future research on animal weapons and discuss several ways in which research into animal weapons can provide broad insights into evolutionary processes.
https://www.cell.com/trends/ecology-evolution/fulltext/S0169-5347(26)00054-6

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