EAORC BULLETIN 1,190 – 5 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.

NEWS

NEWS FROM SCIENCE – Bumble bees show a surprising knack for rhythm

Flexible rhythm perception, once thought to require a big brain, has been shown in humble bumble bees.
{A species relying on the variable beating of two pairs of wings for its primary mode of movement has a knack for rhythm.}
https://www.science.org/content/article/bumble-bees-show-surprising-knack-rhythm

NEWS FROM SCIENCE – Across the social sciences, half of research doesn't replicate

Ambitious effort tested whether more than 100 papers held up on multiple types of "repeatability" tests.
https://www.science.org/content/article/across-social-sciences-half-research-doesn-t-replicate

SCIENCEADVISER – Where did evolution start going ape?

Researchers working at the Wadi Moghra archaeological site in northern Egypt unearthed teeth and jawbones belonging to a previously unknown ape genus and species, which lived around 17 to 18 million years ago during the Early Miocene epoch. "Discovering a fossil ape in this region is both significant and somewhat surprising," lead study author Shorouq Al-Ashqar told Live Science. The ancient animal, dubbed Masripithecus moghraensis , appears to be closely related to the last common ancestor of all living apes, suggesting this group actually got its start in northern Africa and the Middle East. Based on its large, textured teeth and robust jaw, the team believes M. moghraensis ate a flexible diet of fruit, nuts, and seeds—helping the species thrive during a period of climatic change.
The findings "confirm that paleontologists might have been looking for crown-hominoid ancestors in the wrong place," paleoanthropologists David Alba and Júlia Arias-Martorell wrote in a related Science Perspective. "This lesson should be taken with humility but also with renewed optimism, as the required fossils to complete the puzzle of Miocene ape evolution may be somewhere out there, waiting to be discovered."
https://www.science.org/doi/10.1126/science.aeg3100

SCIENCEADVISER – Bumble bees show a surprising knack for rhythm

Bumble bees are hardly nature's most graceful creatures, and their name reflects it. But it turns out these critters show a surprising knack for rhythm. The fuzzy insects can recognize a rhythm and also identify the same pattern when scientists change the tempo, according to research published yesterday in Science —the first time this ability has been documented outside of a few mammals and birds.
Researchers at Southern Medical University in Guangzhou, China, decided to test the remarkable cognitive abilities of bees by evaluating their ability to follow a beat. The scientists placed bumblebees in a box with two clear cups turned upside down, each of which contained a green LED. The lights blinked with brief, repeating patterns: for example, long, long, short, short—or long, short, long, short. One sequence signaled a reward, a puddle of sugar water on top of the cup, while the other did not. After learning the two rhythms, the bees tended to land on the cup associated with the reward, guided by the enticing rhythm. And when the researchers sped up or slowed down the tempo of the flashes, the bees still recognized the rhythmic pattern associated with a sugar hit and landed on that cup.
Insects including crickets and fireflies can mimic other individuals' chirps and flashes. But the ability to recognize the same rhythms had long been assumed to be a complex mental task requiring a large brain. "Imagine you're listening to a song, and it's slowed down or sped up, but you can still recognize it," said study co-author Cwyn Solvi. "That's not because you've memorized one single detail, but because you've grasped the whole structure."
https://www.science.org/doi/10.1126/science.adz2894

THE CONVERSATION – New discoveries are showing how human anatomy is far from settled

We think the human body is fully mapped. In reality, anatomy is still incomplete, and shaped by who was studied, and who wasn't.
https://theconversation.com/new-discoveries-are-showing-how-human-anatomy-is-far-from-settled-277844

THE CONVERSATION – How to build a digital 'twin' of the human brain – what existing models overlook

Existing digital models of the human brain risk missing out on what makes you 'you'.
https://theconversation.com/how-to-build-a-digital-twin-of-the-human-brain-what-existing-models-overlook-279681

PUBLICATIONS

Biology Letters

PAPERS

JIBEOM CHOI – Trade-offs among complexity, regeneration and defector risk across fraternal cooperative organizations

Fraternal cooperative organizations (FCOs), which encompass metazoan multicellularity and eusociality, rely on a division of labour among specialized members. I present a comprehensive framework to concretely classify FCO members by specialization, state transition and potency, which are associated with complexity, regeneration and defector susceptibility of the group. Across FCOs, specialization hinders plasticity, potency and regenerative capacity due to sophisticated fate-determination systems. In addition, such a sophisticated system is vulnerable to spontaneous malfunctions, generating dysfunctional or cheating group members (cancers or excessively produced queens) characterized by unregulated proliferation/reproduction. The framework explains why complex FCOs exhibit limited regeneration and why highly regenerative FCOs cannot become complex. As an exception, plants can be complex and regenerative owing to their structural robustness against cancer.

https://royalsocietypublishing.org/rsbl/article/22/4/20250699/481166/Trade-offs-among-complexity-regeneration-and

Cell Reports

PAPERS

BUFAN JIN et al – Characterization of functional human-specific regulatory elements in prefrontal cortical cells

Understanding how human-specific cis-regulatory elements (CREs) drive gene expression in the adult brain remains elusive. Here, we profile the prefrontal cortex (PFC) of adult human, macaque, and mouse using single-nucleus transcriptomic (106,266 cells) and genome-wide chromatin accessibility (212,099 cells) assays, showing human-specific gene expression and chromatin accessibility. We find that human-specific candidate CREs (cCREs) are central in modulating human-biased expression, and those unique to the human genome are enriched with transposable elements such as endogenous retrovirus-K (ERVK) and long interspersed nuclear element 1 (LINE-1), suggesting a role in regulatory innovation during PFC evolution. Genome-wide association analyses indicate strong neuropsychiatric relevance of human-gained accessibility, and machine learning prioritizes disorder-associated single-nucleotide polymorphisms within these cCREs as potential functional variants influencing disease-risk genes, likely via altered transcription factor binding. In all, our findings provide distinct characteristics of human-specific transcriptional regulation and, simultaneously, a critical insight into evolution and pathological significance of human-specific gene regulation in the adult PFC.

https://www.cell.com/cell-reports/fulltext/S2211-1247(26)00291-3

Cell Reports Medicine

PAPERS

TOMMASO BERTONI et al – Multisensory integration in peripersonal space indexes consciousness states in sleep and disorders of consciousness

Reliably detecting consciousness in unresponsive patients remains an urgent ethical and clinical challenge, as no behavior-independent marker is currently accepted in clinical practice. We characterize consciousness as linked to a representation of the embodied subject of experience, mediated by multisensory integration within the peripersonal space (PPS) system. We test whether a neural marker of PPS representation could detect consciousness and predict clinical outcome in disorders of consciousness (DoC) patients. Using high-density electroencephalography (EEG) during a task-free audiotactile task, we derive a PPS index based on high-beta oscillations. In healthy participants, the PPS index is present during wakefulness and dreaming, but absent in dreamless sleep. In 72 DoC patients, the PPS index correlates with behavioral measures of consciousness and predicts recovery at discharge. The index is associated with forebrain mesocircuit integrity. These findings highlight a bedside-compatible electrophysiological marker with potential clinical utility for detecting covert consciousness and predicting outcomes in non-responsive patients.

https://www.cell.com/cell-reports-medicine/fulltext/S2666-3791(26)00122-9

eLife

PAPERS

YANIV ABIR, MICHAEL NEIL SHADLEN & DAPHNA SHOHAMY – Human exploration strategically balances approaching and avoiding uncertainty

A central purpose of exploration is to reduce goal-relevant uncertainty. Consequently, individuals often explore by focusing on areas of uncertainty in the environment. However, people sometimes adopt the opposite strategy, one of avoiding uncertainty. How are the conflicting tendencies to approach and avoid uncertainty reconciled in human exploration? We hypothesized that the balance between avoiding and approaching uncertainty can be understood by considering capacity constraints. Accordingly, people are expected to approach uncertainty in most cases, but to avoid it when overall uncertainty is highest. To test this, we developed a new task and used modeling to compare human choices to a range of plausible policies. The task required participants to learn the statistics of a simulated environment by active exploration. On each trial,

participants chose to explore a better-known or lesser-known option. Participants generally chose to approach uncertainty; however, when overall uncertainty about the choice options was highest, they instead avoided uncertainty and chose to sample better-known objects. This strategy was associated with faster decisions and, despite reducing the rate of observed information, it did not impair learning. We suggest that balancing approaching and avoiding uncertainty reduces the cognitive costs of exploration in a resource-rational manner.
https://elifesciences.org/articles/94231

KRISTOPHER T JENSEN et al – A mechanistic theory of planning in prefrontal cortex
Planning is critical for adaptive behaviour in a changing world, because it lets us anticipate the future and adjust our actions accordingly. While prefrontal cortex is crucial for this process, it remains unknown how planning is implemented in neural circuits. Prefrontal representations were recently discovered in simpler sequence memory tasks, where different populations of neurons represent different future time points. We demonstrate that combining such representations with the ubiquitous principle of neural attractor dynamics allows circuits to solve much richer problems including planning. This is achieved by embedding the environment structure directly in synaptic connections to implement an attractor network that infers desirable futures. The resulting 'spacetime attractor' excels at planning in challenging tasks known to depend on prefrontal cortex. Recurrent neural networks trained by gradient descent on such tasks learn a solution that precisely recapitulates the spacetime attractor – in representation, in dynamics, and in connectivity. Analyses of networks trained across different environment structures reveal a generalisation mechanism that rapidly reconfigures the world model used for planning, without the need for synaptic plasticity. The spacetime attractor is a testable mechanistic theory of planning. If true, it would provide a path towards detailed mechanistic understanding of how prefrontal cortex structures adaptive behaviour.
https://elifesciences.org/reviewed-preprints/109757

XIAOYAN WU et al – The self-interest of adolescents overrules cooperation in social dilemmas
Cooperation is essential for success in society. Research consistently showed that adolescents are less cooperative than adults, which is often attributed to underdeveloped mentalizing that limits their expectations of others. However, the internal computations underlying this reduced cooperation remain largely unexplored. This study compared cooperation between adolescents and adults using a repeated Prisoner's Dilemma Game. Adolescents cooperated less than adults, particularly after their partner's cooperation. Computational modeling revealed that adults increased their intrinsic reward for reciprocating when their partner continued cooperating, a pattern absent in adolescents. Both computational modeling and self-reported ratings showed that adolescents did not differ from adults in building expectations of their partner's cooperation. Therefore, the reduced cooperation appears driven by a lower intrinsic reward for reciprocity, reflecting a stronger motive to prioritize self-interest, rather than a deficiency in predicting others' cooperation in social learning. These findings provide insights into the developmental trajectory of cooperation from adolescence to adulthood.
https://elifesciences.org/articles/106840

Evolutionary Human Sciences

PAPERS

NATHAN GABRIEL, ADRIAN V. BELL & PAUL E. SMALDINO – The Evolution of Identity Signals for Coordination in Diverse Societies
Individual social identities indicate group affiliations and are typically associated with group-typical preferences, signals that indicate group membership, and the propensity to condition actions on the social signals of others, resulting in group-differentiated interaction norms. Past work modeling identity signaling and coordination has typically assumed that individuals belong to one of a discrete set of groups. Yet individuals can simultaneously belong to multiple groups, which may be nested within larger groupings. Here, we introduce the generalized Bach or Stravinsky game, a coordination game with ordered preferences, which allows us to construct a model that captures the overlapping and hierarchical nature of social identity. Our model unifies several prior results into a single framework, including results related to coordination, minority disadvantage, and cross-cultural competence. Our model also allows agents to express complex social identities through multidimensional signaling, which we use to explore a variety of complex group structures. Our consideration of intersectional identities exposes flaws in naive measures of group structure, illustrating how empirical studies may overlook some social identities if they do not consider the behaviors that those identities function to afford.
https://www.cambridge.org/core/journals/evolutionary-human-sciences/article/evolution-of-identity-signals-for-coordination-in-diverse-societies/EF4FCD7030188F2A7B4B9F438385855A

WAKABA TATEISHI & HIROTAKA IMADA – Social norms and group-bounded indirect reciprocity
Indirect reciprocity is a reputation-based mechanism proposed to explain the evolution of human cooperation. Theoretical models demonstrated that the use of both first-order information (i.e., whether an evaluation target cooperated) and second-order information (i.e. the reputation of an interaction partner of the evaluation target) is critical for the evolution of cooperation. However, empirical findings on the use of second-order information have been mixed. Drawing upon the literature on group-bounded indirect reciprocity, we tested the hypothesis that individuals would be more sensitive to second-order information when evaluating ingroup interactions, compared to when evaluating outgroup interactions. We

conducted a preregistered online experiment (N = 604), where we independently manipulated group membership (ingroup vs. outgroup), target behaviour (cooperation vs. defection), and recipient reputation (good vs. bad). We found that donors who defected against good recipients were rated more negatively than those who defected against bad recipients, indicating the use of second-order information. Partly consistently with our hypothesis, when individuals evaluated coopering donors, second-order information influenced reputation for ingroup donor-recipient interactions more than for outgroup donor-recipient interactions. Nevertheless, individuals readily used second-order information, whether or not they evaluated ingroup or outgroup donor-recipient interactions.
https://www.cambridge.org/core/journals/evolutionary-human-sciences/article/social-norms-and-groupbounded-indirect-reciprocity/820828F81045E074BDA01B22C0D0B874

Frontiers in Psychology

PAPERS

YANCHUN YU & TIANHUA WANG – Grammatical metaphor studies: historical review and outlook

Grammatical metaphor, a significant theoretical innovation within Systemic Functional Linguistics (SFL), extends meaning realization from the lexical to the grammatical stratum, providing a powerful framework for analyzing abstraction and technicality in academic and scientific discourse. Adopting a methodology of combining systematic retrieval with thematic analysis, this article reviews 293 primary studies on grammatical metaphor within SFL since Halliday initial proposal. We first trace Halliday's three-stage theoretical development of grammatical metaphor. Subsequently, our thematic synthesis reveals predominant sub-themes within two major streams: theoretical development (encompassing semantic and characteristic discussion, interdisciplinary dialogues with Cognitive Linguistics and educational sociology, and typological debates) and practical application (covering language teaching, textual analysis, and translation studies). Based on the synthesis, we propose four key directions for future research: expanding the linguistic scope, broadening the population of second language learners, establishing identification criteria for grammatical metaphor in non-English languages, and delineating demetaphorization. The findings of this review offer valuable theoretical references for linguists seeking to refine grammatical metaphor theory, as well as practical guidance for language teachers and curriculum developers aiming to foster learners' academic literacy. Moreover, the proposed future directions are intended to inspire researchers to explore cross-linguistic and interdisciplinary dimensions, ultimately facilitating a more inclusive and methodologically robust field of grammatical metaphor studies.
https://www.frontiersin.org/journals/psychology/articles/10.3389/fpsyg.2026.1774523/full

GERGELY CZUKOR et al – Selecting self-and-follower goal-aware leadership styles across sectors: a decision support approach

Current leadership research falls short of addressing multidimensional performance criteria such as employee engagement, team productivity, innovation, job security, and sustainability in a balanced manner. Instead, it largely focuses solely on follower-focused approaches and fails to systematically assess leaders' own goal awareness. This situation increases the need for holistic and data-driven decision-making models for leadership style selection across various sectors. Studies conducted on this objective are quite limited in the literature. The aim of this study is to determine the most appropriate self-and-follower goal-aware leadership model (SFGAL)-based leadership style for the energy, automotive, healthcare, and information and communication technologies sectors and to reveal differences across sectors. The study evaluates four leadership alternatives (win-win, self-oriented, self-neglecting/over-giving, and lose-lose). Expert weights are determined using a machine learning-based mechanism that considers the demographic and professional characteristics of the experts. Criteria weights are calculated using the criteria importance through intercriteria correlation (CIMAS) method, and the ranking of the alternatives is performed using the combined compromise solution (CoCoSo) technique. The innovative Koch Snowflake fuzzy set approach is used to model uncertainties and linguistic evaluations. The study's key contributions to the literature are as follows: (1) developing a sector-sensitive decision-making framework that enables the generation of unique leadership strategies for different sectors; (2) strengthening uncertainty modeling by applying the Koch Snowflake fuzzy set application within the context of MCDM in leadership assessment; and (3) increasing the reliability and validity of the decision process by employing a demographic and attribute-based approach to expert weighting. Key findings indicate that innovation is the most important criterion in the automotive and information technology sectors, while occupational safety is paramount in the energy sector and employee engagement in the healthcare sector. A win-win leadership style is identified as the most suitable option in all sectors, with self-oriented leadership being the second priority in the energy, healthcare, and information technology sectors.
https://www.frontiersin.org/journals/psychology/articles/10.3389/fpsyg.2026.1685841/full

iScience

PAPERS

MIGUEL GARETA GARCÍA et al with REDOUAN BSHARY – Coordination costs may counteract the positive effects of a larger group size in determining the winner of between-group conflicts

Collective defence of territories and resources is a key benefit of group living and is often modelled as a public goods game. Although larger animal groups have the potential to mobilise greater fighting power in between-group competition, this advantage may be constrained by coordination. Our review of quantitative studies shows that independently of a population's average group size, larger groups usually win, with few exceptions. We examined one such case in vervet monkeys. As expected, group size was positively correlated with group spatial spread, and more dispersed groups were less likely to win encounters, implicating coordination problems. We then developed a mathematical model showing that, as coordination costs rise with group size due to spatial spread, they can cancel the usual "strength in numbers" advantage of larger groups in between-group conflicts. Our work highlights how between-group competition provides a natural setting for integrating ecological constraints into models of N-player cooperation.
https://www.cell.com/iscience/fulltext/S2589-0042(26)00871-0

Journal of Linguistics

REVIEWS

ROBERT D. BORSLEY – Syntax: A cognitive approach

Review of 'Syntax: A cognitive approach' by Edward A. F. Gibson, MIT Press, 2025.
https://www.cambridge.org/core/journals/journal-of-linguistics/article/abs/edward-a-f-gibson-syntax-a-cognitive-approach-cambridge-ma-mit-press-2025-pp-vii-366/C233F653A9B3E3FD0E46624AB28CEDD7

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 Scientific Reports

PAPERS

GANG CHEN et al – A multi-objective optimization consensus model for large-scale group decision-making considering dynamic social networks

We are providing an unedited version of this manuscript to give early access to its findings. Before final publication, the manuscript will undergo further editing. Please note there may be errors present which affect the content, and all legal disclaimers apply.

As global climate change intensifies and fossil fuel resources continue to deplete, transitioning to alternative energy sources has become a vital strategy for sustainable development. Photovoltaic (PV) power generation, recognized for its clean, renewable, and low-carbon characteristics, is advancing rapidly. Against this background, site selection for PV power plant stations has become a crucial decision-making factor in ensuring project success. However, in large-scale group decision-making (LGDM), the complex backgrounds and substantial number of decision-makers (DMs) pose a significant challenge in reaching consensus efficiently. Therefore, this paper proposes a multi-objective optimization consensus model (MOOCM) utilizing dynamic trust networks to solve LGDM problems. First, a hybrid trust network (HTN) is built by integrating preference similarity and trust relationships, and DMs are clustered using the Louvain algorithm based on this hybrid network. Second, a MOOCM is designed with the objectives of minimizing costs, maximizing fairness, and achieving a high consensus level. Then, after consensus is reached, the HTN is updated, and secondary clustering is performed to obtain dynamic weights for DMs. Finally, a PV power plant site selection problem with 20 DMs, four alternatives, and four attributes is used as a case study for validation. In the first clustering, the DMs are divided into four subgroups. After consensus is reached, the HTN is updated and a second clustering is performed, which finally produces three subgroups. At the same time, the proposed method can achieve a group consensus level (GCL) of 0.9597, with Cost = 1.7422 and Fairness = 0.9043. These results verify the effectiveness and practical utility of the proposed method in LGDM.
https://www.nature.com/articles/s41598-026-45239-0

LUCIE BINDER et al – Assessing three altruism facets by economic games and self-report: a multitrait-multimethod investigation

We are providing an unedited version of this manuscript to give early access to its findings. Before final publication, the manuscript will undergo further editing. Please note there may be errors present which affect the content, and all legal disclaimers apply.

Reliable and valid measurement of the various components of prosociality calls for tools that capture its diverse behavioral expressions. Here, we evaluate how economic game measures derived from the Dictator Game, Public Goods Game, and Ultimatum Game as well as a novel Third-Party Intervention Paradigm correspond with their self-reported counterparts within a design informed by a multitrait–multimethod approach. The self-report scales described Help Giving, Peer Punishment, and Moral Courage as behavioral traits in real life. Each game decision was regressed on all three of these scales using data from 22 studies. Convergent validity emerged, with the strongest associations for help giving and the weakest for peer punishment. Discriminant validity was evidenced by the lack of significant cross-correlations, with one minor exception regarding the Peer Punishment scale and the Dictator Game. Overall, the findings support the distinctiveness of the facets, particularly for help giving and moral courage, while highlighting challenges in capturing punishment-related altruism. While several procedures for improving correspondence are discussed, the descriptively higher correlations within methods than across traits suggest a persistent gap in criterion validation.
https://www.nature.com/articles/s41598-026-46603-w

JIANXIANG CHEN et al – The earliest known ceramic beads as adornment from Nanzhuangtou site in North China 10,000 years ago

We are providing an unedited version of this manuscript to give early access to its findings. Before final publication, the manuscript will undergo further editing. Please note there may be errors present which affect the content, and all legal disclaimers apply.

The innovation of artificial materials marks a pivotal advancement in human technology. However, direct evidence of their earliest symbolic application remains scarce. In this paper, two tubular ceramic beads were studied, approximately 10,000-year-old, from the Nanzhuangtou site in North China. These beads represent among the earliest known ornaments made from a fully synthetic material, with their age constrained to approximately 10,000 cal BP through stratigraphic association with directly dated materials. A multi-analytical approach was employed, incorporating X-ray fluorescence, high-resolution micro-computed tomography, scanning electron and optical microscopy, and Fourier transform infrared spectroscopy. This approach was used to demonstrate that the beads were fabricated from locally sourced clay. They were formed around a plant stem to create a hollow structure, and were fired at low temperatures (around 500–600℃). Their morphological attributes strongly suggest that they were used as personal adornments. This discovery provides crucial empirical evidence that nascent pottery technology was used for symbolic expression during the critical Palaeolithic-Neolithic transition, thus extending the known chronology of the decorative use of synthetic materials by millennia.
https://www.nature.com/articles/s41598-026-47203-4

TAMÁS FARAGÓ et al with KATIE E. SLOCOMBE – Dogs' reactions to motivations and emotions in conspecific and heterospecific vocalizations

We are providing an unedited version of this manuscript to give early access to its findings. Before final publication, the manuscript will undergo further editing. Please note there may be errors present which affect the content, and all legal disclaimers apply.

Vocalizations convey information about both emotional valence (negative/positive) and motivational states (hostile/non-hostile). However, it remains unclear which of these dimensions primarily determines what the listener decodes from vocalizations as social messages, guiding their reaction (approach/withdraw). To test this question, we presented agonistic (negative|hostile), play/comfort (positive|non-hostile), and distress sounds (negative|non-hostile) to dogs. In Study 1, the motivational state encoded in conspecific calls better explained dogs' reactions than emotional valence. Distress calls evoked faster approaches but slower withdrawal than agonistic calls, indicating that dogs primarily decode conspecific social messages based on the caller's motivation. In Study 2, we tested cross-species decodability with chimpanzee and human calls and speech. Neither the callers' motivational state nor emotional valence explained dogs' reactions, which did not support predictions based on Morton's rules and other proposed universal principles of emotion encoding. These findings suggest that the caller's motivation may have been more significant in close-contact call evolution than emotions, and the mechanisms underlying the processing of conspecific vocalizations do not directly generalize to cross-species vocalizations. Consequently, decoding social messages from vocalizations may rely less on universal rules than previously thought.
https://www.nature.com/articles/s41598-026-46906-y

Neuron

ARTICLES

ZILU LIANG & MIRIAM C. KLEIN-FLÜGGE – When breaking down helps you move forward: Pursuing complex goals
Achieving complex goals often requires breaking them down into simpler subgoals. In this issue of Neuron, Grossman et al. show that people structure their behavior hierarchically when pursuing goals, and they reveal candidate brain computations that support this planning.
https://www.cell.com/neuron/abstract/S0896-6273(26)00178-9

PAPERS

AKILA KADAMBI et al with ANTONIO DAMASIO – Embodiment in multimodal large language models
As new generations of large language models (LLMs) continue to develop, multimodal large language models (MLLMs), or large multimodal models, continue to reveal impressive capabilities in interpreting text and images. These models are equipped with vast datasets that allow them to parse and generate complex multimodal representations. MLLMs achieve state-of-the-art performance on a range of multimodal tasks, including image captioning and computer vision. MLLMs broadly include vision language models (VLMs), including DeepMind's Flamingo,1 Gemini 3.0 Pro,2 OpenAI's GPT-5,3 GPT-4o,4 CLIP,5 Amazon's Nova,6 Meta's Llama models,7 video language models such as VideoCLIP8 and VideoLLaMa,9 and many others. Due to their capabilities on a range of multimodal tasks, MLLMs have also been synonymously termed "large-world models" or "multimodal foundation models" (see Box 1 for glossary of key terms).
https://www.cell.com/neuron/fulltext/S0896-6273(26)00168-6

COOPER D. GROSSMAN, VINCENT MAN & JOHN P. O'DOHERTY – The representation and valuation of subgoals in the human brain during model-based hierarchical behavior
Planning and performing complex, sequential behavior toward distant goals relies on dividing behavior into structured segments. This hierarchical organization requires the brain to designate certain states as subgoals to mark successful segment completion. How the brain represents subgoals and computes decision values as a function of them remains unknown. While most models of hierarchical behavior lack environmental knowledge, decision-making involves planning with an internal world model. Consequently, how the brain integrates hierarchical and model-based processes has yet to be explained. Using a sequential-subgoal decision-making task with functional magnetic resonance imaging (fMRI), we evoked hierarchical, model-based behavior. We decoded the current subgoal in insula and ventromedial prefrontal cortex activity—a critical latent representation for orienting sequential behavior. Using a model-based, hierarchical reinforcement learning model, we identified key decision value signals in the frontal cortex. These findings illuminate neural correlates of subgoals and decision values computed as a function of subgoals and environmental knowledge.
https://www.cell.com/neuron/abstract/S0896-6273(25)00979-1

New Scientist

ARTICLES

OLIVIA GOLDHILL – Interview of Michael Pollan: "Consciousness is really under siege"
A psychedelic experience set author Michael Pollan on a quest to understand consciousness in his new book 'A World Appears'. He tells what he learned – and how it changed him.
https://www.newscientist.com/article/2521412-michael-pollan-consciousness-is-really-under-siege/

MICHAEL MARSHALL – Genetic clues tell the story of Neanderthals' decline
The Neanderthal population shrank during a cold spell around 75,000 years ago, and the loss of genetic diversity may have contributed to their eventual extinction.
https://www.newscientist.com/article/2520319-genetic-clues-tell-the-story-of-neanderthals-decline/

CHRIS SIMMS – Oldest known dog extends the genetic history of our canine companions
The remains of dogs from more than 14,000 years ago have been found in Turkey and the UK, revealing that domesticated animals were spread across Europe by hunter-gatherers.
https://www.newscientist.com/article/2520476-oldest-known-dog-extends-the-genetic-history-of-our-canine-companions/

EMILY H. WILSON – Ancient bones reveal vivid details of a Neanderthal elephant hunt
Researchers have re-analysed a set of elephant bones and a wooden spear found in Germany in 1948, which provide compelling evidence of Neanderthals' big game hunting abilities.
https://www.newscientist.com/article/2520535-ancient-bones-reveal-vivid-details-of-a-neanderthal-elephant-hunt/

JAMES WOODFORD – First glimpse of sperm whale birth reveals teamwork to support newborn
A female sperm whale has been filmed giving birth for the first time, supported by 10 adult females who lifted the calf out of the water and protected it from predators.

https://www.newscientist.com/article/2521103-first-glimpse-of-sperm-whale-birth-reveals-teamwork-to-support-newborn/

REVIEWS

GRACE WADE – Can Michael Pollan crack the problem of consciousness in his new book?
The science writer delves into the vast subject of consciousness in his new book A World Appears – and draws some surprising conclusions.
Review of 'A World Appears: A journey into consciousness' by Michael Pollan, Penguin, 2026.
https://www.newscientist.com/article/2517590-can-michael-pollan-crack-the-problem-of-consciousness-in-his-new-book/

Notes and Records

ARTICLES

KIERA EVANS – Francis Galton's eugenics and the Royal Society, 1860–1911
Francis Galton's Fellowship of the Royal Society spanned the entirety of his eugenic career: he was elected in 1860, five years before he first articulated his eugenic ideas in Macmillan's Magazine. In this article, I trace the various branches of Galton's activity in the Royal Society for the first time, including exhibits he presented at soirées, his involvement in the Evolution Committee, and endorsements of candidates for election. In doing so, I establish how, and how far, Galton's eugenics was connected to his activity within the Royal Society. I argue that although his official roles in the Royal Society were not linked to eugenics, Galton's activity elsewhere in the organization provided opportunities for him to share ideas related to his eugenic thought and build his claim that eugenics was scientifically legitimate.
https://royalsocietypublishing.org/rsnr/article/doi/10.1098/rsnr.2025.0056/481202/Francis-Galton-s-eugenics-and-the-Royal-Society

NPJ Heritage Science

PAPERS

YINGCHUN CAO et al – Ancient echoes as clues to the structural relationship between grotto soundscapes and auditory perception
This study investigates the acoustic and auditory perceptual characteristics of six representative grottoes in the Xiang Tang Shan (XTS) Grottoes. The results show that key acoustic parameters exhibit systematic differentiation with changes in spatial scale and form, and that objective acoustic indicators display a stable structural correspondence with subjective auditory experience, with the major acoustic characteristics falling within a moderate range of the broader acoustic distribution of religious architectural spaces. The study proposes treating soundscape as an analytical dimension centered on auditory perception, with the potential to be extended toward a typological research approach. The findings help address the lack of an auditory perceptual dimension in traditional grotto typologies dominated by material form and provide a new analytical pathway for a comprehensive understanding of "living" religious practice—an issue crucial within Buddhist systems of knowledge and practice, in which sound is regarded as one of the core constitutive elements.
https://www.nature.com/articles/s40494-026-02487-7

Physics of Life Reviews

COMMENTARIES

BALTHASAR BICKEL et al with KLAUS ZUBERBÜHLER & CAREL VAN SCHAIK – Languages evolve ergodically: clarifications and responses
The ergodicity of word evolution
Popescu & Fitch and Mufwene claim that linguistic evolution can be ratcheting (and thus non-ergodic) by adapting to new niches in technology — concretely by creating new words for new technologies, practices, or institutions. This claim confuses linguistic and conceptual evolution. Concepts typically arise from innovation in thought(s) and usually first require lengthy descriptions (full sentences or even entire texts), profiting from language's generative freedom. Concepts often spread and …
Vertical vs horizontal transmission
Bromham and Mufwene point to the fact that language variants can be acquired by anyone throughout life and, based on this, suggest we underestimate horizontal transmission in language. Mufwene specifically emphasizes peer input and occasional cases where children change the language of adults. Bromham furthermore notes that verticality and the success of tree models in language typically comes from deliberately excluding borrowing in the data on which the models are based. These observations …
Ergodic evolution outside language
Popescu & Fitch, Boeckx, and Osiurak & Cladière ask which other species might show ergodically evolving behavior. We agree that changes in the song of songbirds and humpback whales is an intriguing possibility provided it can be shown to evolve without concomitant biological evolution. A related question is which other behavior might show ergodicity in humans. We agree with our commenters that music, fashion, and, as Osiurak & Cladière suggest, art in general can evolve ergodically, at least …
The evolution of linguistic evolution

Boeckx, Bromham, Dunbar, and Osiurak & Cladière ask important when and why questions. There is an overall agreement with our hypothesis that linguistic evolution emerged chiefly from the needs for recognition of in-group strangers when populations started to grow mid-Pleistocene, a claim for which Dunbar and Osiurak & Cladière cite further support and which we have also elaborated in other work [5]. However, the neurobiological mechanisms behind this transition are largely unresolved, chiefly …

Mufwene

Mufwene considers language as a technology, highlighting parallels in gradual change and social conditions. But even if one calls language a technology, the fact remains that languages don't optimize utility while technologies do when they evolve. While social norms only rarely override utility in technological evolution (with the Amish being a relatively well known example), such an override is the standard in linguistic evolution: non-optimal dispreferred states recur regularly, and, because of …

https://www.sciencedirect.com/science/article/abs/pii/S1571064526000278

PLoS One

PAPERS

NICOLAS COUCKE et al with AXEL CLEEREMANS – Best-of-n decision making by human groups

Collective decision making is a fundamental aspect of group behavior in both animals and humans, and often involves reaching a consensus on the best of n options, using empirical evidence. Although many parallels have been drawn between human and animal collective decisions, collective human behavior is rarely studied in the type of embodied scenarios that animals are often faced with. In this study, we placed human groups in a virtual setup similar to nest site selection in social animals, in which they explored a shared environment and reached a consensus based on their observations of empirical features. In groups of up to 10, participants had to reach consensus on the empirically largest of four candidate sites without verbal communication, instead using movement-based interactions in a custom-developed 3D virtual environment for online multi-participant experiments. The results showed that the speed and accuracy of consensus was importantly modulated by perceptual difficulty and information availability, but that no speed–accuracy trade-off was present. Participants attempted to reach consensus on the empirically largest site by flexibly adapting their use of social information to perceptual difficulty, their spatial position, and the time already spent supporting some option. When a minority of informed individuals were present, these individuals exercised greater independence and influenced the group to faster and more accurate consensus. These results extend previous findings on social decision making strategies in humans to nonverbal scenarios akin to those of social insects.

https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0329722

ÉMILIE BROCHARD et al with FRANCESCO D'ERRICO – Carved in stone: Experimental criteria for identifying Paleolithic bas-relief production techniques and sculptors' expertise

Paleolithic bas-relief is a rare yet technically demanding form of parietal art whose production methods and skill requirements remain poorly understood. Investigating their production is essential because carving methods and required skills reveal the degree of technical investment, cognitive planning, and craftsmanship mobilized by prehistoric artists. This study presents the first integrated experimental, qualitative, and quantitative investigation of their manufacture. Using Coniacian limestone blocks, we replicated 19 carving modalities, covering pecking, scraping, polishing, engraving, and sequential combinations, executed by participants ranging from novices to a professional sculptor. Each surface was documented through high-resolution photography, Reflectance Transformation Imaging, and 3D scanning, then analyzed via standardized descriptive criteria, roughness measurements, and elliptical Fourier analysis of engraving profiles. Results show that some techniques, such as pecking and engraving, leave distinctive traces, while scraping and polishing often produce overlapping surface signatures, especially when techniques are superimposed. Quantitative data confirm a continuum of surface textures rather than discrete categories and reveal how the sequence of actions can partially obscure earlier marks. Expertise strongly influences mark regularity, efficiency, and isotropy, with the expert producing more controlled and less complex surfaces. The combined qualitative–quantitative approach proved essential: numerical parameters objectively discriminate patterns, but visual assessment remains critical for interpreting surface reliefs in archaeological contexts. By establishing experimentally validated diagnostic criteria for techniques and skill levels, this work provides a robust reference framework for identifying carving methods on archaeological bas-reliefs. The findings open new perspectives for reconstructing chaînes opératoires, assessing knowledge transmission, and exploring the role of specialization in Upper Paleolithic hunter-gatherer societies.

https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0346099

Royal Society Open Science

PAPERS

DEBOTTAM BHATTACHARJEE et al – Many facets of self-directed behaviours in macaques

Emotional states like anxiety are adaptive, assisting individuals during social uncertainty and threats. Humans can self-report anxiety, whereas in nonhuman animals, particularly in primates, it is commonly inferred from self-directed behaviours (SDBs)

such as self-scratch, autogroom and yawn. These behaviours are often treated as interchangeable indicators of a single underlying dimension of anxiety, yet support for this assumption remains limited. Moreover, how variations in SDBs are shaped by demography, social interactions and status, and the broader social dynamics, are poorly understood. To address these knowledge gaps, we studied 13 macaque groups across six species spanning a despotic–egalitarian social style. Our findings revealed partial correlational consistency among the SDBs, where only self-scratch and autogroom positively correlated. SDBs differed in their associations with demographic and social variables: males yawned more than females, individuals receiving less aggression engaged in longer autogroom, dominance rank showed behaviour-specific patterns and alpha individuals yawned more frequently than others. Social style showed no consistent effects across behaviours. These results show heterogeneity in the expression of SDBs that cautions against treating them as equivalent measures of anxiety. While not demonstrating functional dissociation, we highlight the need for greater conceptual precision in using SDBs to infer emotions in primates.
https://royalsocietypublishing.org/rsos/article/13/4/252422/481204/Many-facets-of-self-directed-behaviours-in

Science

ARTICLES

DAVID M. ALBA & JÚLIA ARIAS-MARTORELL – The dawn of modern apes: An Egyptian fossil places the origin of modern apes in northeastern Afro-Arabia

Research on the closest extinct relatives of humans (such as australopiths) can only explain the most recent evolutionary history of the human lineage. Older apes are essential to reconstructing the last common ancestor of chimpanzees and humans—that is, the starting point of human evolution (1). The ape and human lineage (hominoids) diverged from Old World monkeys in Afro-Arabia more than 25 million years ago (Ma) (2). In the Miocene epoch (23 to 5 Ma), apes were much more diverse and widespread than they are today (1, 3). Various lineages of African archaic (stem) hominoids evolved before the origin of modern (crown) hominoids and their eventual dispersal into Eurasia. However, the origins of crown hominoids are still unclear. On page 1383 of this issue, Al-Ashqar et al. (4) describe a previously unknown Miocene ape from North Africa and discuss its relevance for crown-hominoid origins.
https://www.science.org/doi/10.1126/science.aeg3100

PAPERS

SHOROUQ F. AL-ASHQAR et al – An Early Miocene ape from the biogeographic crossroads of African and Eurasian Hominoidea

The Early Miocene fossil record documenting hominoid evolution has long been restricted primarily to sites in East Africa, whereas contemporaneous North African sites have only yielded remains of cercopithecoid monkeys. Here, we describe a fossil ape from North Africa, a new genus (Masripithecus) from the Early Miocene (~17 million to 18 million years) of northern Egypt, on the basis of mandibular remains. A combined molecular-morphological Bayesian tip-dating analysis positions Masripithecus closer to crown hominoids than coeval fossil apes from East Africa, thereby filling a phylogenetic and biogeographic gap in the evolution of stem hominoids. This evidence suggests that crown Hominoidea might have originated during the Early Miocene in the underexplored northeastern part of Afro-Arabia, rather than in eastern Africa or Eurasia.
https://www.science.org/doi/10.1126/science.adz4102

ZIJIE ZENG et al – Flexible, abstract rhythm perception in bumble bees

Flexible, abstract rhythm perception underpins human music, dance, and speech, but thus far, it has only been demonstrated in a few birds and mammals. In this work, we show that bumble bees also form robust abstract rhythm representations. Free-flying bees learned to discriminate two arbitrary repeating flashing light sequences, balanced to preclude the use of any local cues. Bees successfully recognized these learned rhythmic patterns at new, faster, and slower tempi. Bees trained on vibrational patterns transferred their learning to equivalent flashing light patterns, demonstrating cross-modal rhythm perception. These findings suggest that an insect brain can encode and generalize arbitrary complex temporal patterns, which suggests that abstract rhythm perception can emerge from relatively simple neural architectures and points to deep evolutionary roots for a domain-general rhythm cognition across animals.
https://www.science.org/doi/10.1126/science.adz2894

Trends in Cognitive Sciences

PAPERS

JEAN-PIERRE CHANGEUX & MICHELE FARISCO – The Global Neuronal Workspace as a multilevel model of conscious processing

Debates in consciousness science increasingly question whether computational functionalism is sufficient to explain conscious processing. We summarize three core features of the Global Neuronal Workspace (GNW) theory that highlight the multilevel architecture of conscious processing, extending from cellular and molecular mechanisms to large-scale network dynamics. On this interpretation, GNW is not a functionalist computational theory, unlike the Global Workspace theory, with which it is frequently conflated.

https://www.cell.com/trends/cognitive-sciences/abstract/S1364-6613(26)00054-9

Trends in Ecology and Evolution

PAPERS

BRADLEY D. OHLINGER et al with JOSEP CALL – Animal cumulative culture through changing environments

Humanity's ecological success is often attributed to cumulative cultural evolution (CCE). While experimental and observational studies have generated increasing empirical support for the presence of CCE in animals, few have conclusively demonstrated it. One possible explanation for the dearth of direct evidence for animal CCE is that existing experiments might not provide the requisite conditions. Therefore, some animals could be capable of CCE, but new methods are needed to detect the process. We identify key experimental limitations in the animal CCE literature, offer new methodologies for addressing them, and illustrate our methods using Temnothorax ants as a model system. In doing so, we introduce a broadly generalizable experimental paradigm for testing animal CCE.
https://www.cell.com/trends/ecology-evolution/abstract/S0169-5347(26)00050-9

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