EAORC BULLETIN 1,182 – 8 February 2026

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NOTICES

FORMATTED VERSION OF THIS BULLETIN

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

PUBLICATION ALERTS

If you have had a paper or book published, or you see something which would be of interest to the group, please send me a publication alert so that I can include it in the newsletter. Many thanks to those who have already sent in alerts.
If there is a journal you feel I should be tracking on a regular basis, let me know.
And if you have any other ideas for extending the "EAORC experience", please contact me.

EDITORIAL INTERJECTIONS

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

NEWS

NATURE BRIEFING – Cursive is making a comeback

Some schools that dropped the requirement to teach cursive to embrace digital learning are re-introducing penmanship into the classroom. Whether cursive has benefits over print handwriting is up for debate — some studies suggest that learning cursive equips children with better syntax skills. But there are also other, cultural reasons for keeping handwriting alive. "I feel that the next generation should be able to write a love letter or a poem by hand, or at least the grocery list, because it's part of being human, really," says neuroscientist Audrey van der Meer.
{Plus ça change plus c'est la même chose. Cursive was used because quill pens tended to blot if lifted from the page. Fountain pens and ballpoints are what rendered it unnecessary, not computers. Personally, I was taught to use cursive at junior school, but with my right hand. I'm left-handed and was never taught cursive script with the left hand, because it ends up being smudged. So I don't use cursive – but I do still have a slight stammer. I'm going to place this medieval system of torture in the "arrant boldilocks" pile.}
https://www.nature.com/articles/d41586-026-00320-6

NATURE BRIEFING – The people whose 'mind's eye' is blind

When asked to picture something in their minds, around 4% of people can only conjure a faint image, or might see nothing at all. This inability to form mental pictures is called aphantasia, a concept that was only formally described a decade ago. The discovery of aphantasia — alongside its opposite, hyperphantasia — has opened a new avenue for researchers to study how the conscious mind works, and how the strength of your 'mind's eye' might influence your emotions, memory and creativity.
https://www.nature.com/articles/d41586-026-00311-7

NATURE BRIEFING – The bonobo who came to tea

A bonobo called Kanzi was the first non-human animal observed to clearly grasp the concept of make believe. In a 'tea party' task, Kanzi learned to choose a cup that scientists had pretended to fill with juice over one they had pretended to empty. Kanzi selected the 'full' cup in 34 of 50 trials — well above the number of times expected if his choices were random. The experiments suggest that some animals have "a richer inner mental life than some people might have given them credit for", says comparative psychologist and study co-author Amalia Bastos.
https://www.nature.com/articles/d41586-026-00357-7

NEWS FROM SCIENCE – Imagination isn't just for humans, this famous ape shows

Kanzi, a bonobo studied for his language skills, understood make-believe objects.
https://www.science.org/content/article/imagination-isn-t-just-humans-famous-ape-shows

SCIENCEADVISER – How did Pleistocene humans brave the cold?

Late last month, a fierce winter storm battered large swathes of North America with freezing temperatures and deep drifts of snow, prompting many people to bundle themselves in coats, hats, scarves, and mittens. Humans in North America also faced extreme cold more than 10,000 years ago, during a particularly frigid period of the Late Pleistocene—and survived without the protection of modern clothing.
Because textiles and other objects made from perishable materials tend to degrade over time, they rarely show up in the archaeological record. Now, scientists have identified many such objects from two Pleistocene cave sites in Oregon. The items, which were analyzed using radiocarbon dating, include an abundance of bone needles, fragments of braided fiber

cordage, components of what appear to be wooden snare traps, and—most notably—the oldest known physical remains of sewn animal hide. One of these latter pieces, the team reports, may have belonged to a piece of clothing or footwear, potentially the only item of clothing ever recovered from the Pleistocene.
The findings highlight the "resilience and ingenuity" of people during that epoch, the study authors wrote, offering "critical lessons about the value of ecological knowledge for human survival and responses to climate challenges today."
https://www.science.org/doi/10.1126/sciadv.aec2916

SCIENCEADVISER – Imagination isn't just for humans, this famous ape shows

To primatologists around the world, Kanzi was a star. After years of training with sign language and a specialized keyboard, the bonobo had gained an unusually sophisticated understanding of human words, making him the focus of decades of research into nonhuman primates' language abilities. But in March 2025, researchers wanted to test something different: Kanzi's imagination.
After setting up versions of a child's tea party with the bonobo, the team found that Kanzi could reliably keep track of glasses "filled" with imaginary juice or grapes and distinguish between glasses filled with real juice and make-believe juice. The discovery, reported yesterday in Science, shows that imagination is not uniquely human and suggests it may have arisen millions of years ago, possibly among the common ancestors of humans, bonobos, and chimpanzees.
Both captive and wild apes have dabbled in alternate realities. Anecdotally, scientists have reported apes occasionally playing pretend, cradling logs in their arms as if they were children or mimicking the motions of playing with toys. Research going back decades also shows apes can plan ahead and consider the beliefs of other individuals. But until Kanzi, there had never been reproducible evidence of an ape's ability to engage with make-believe objects.
The finding also represents the final piece of Kanzi's scientific legacy. Soon after these experiments, the bonobo died at the age of 44. "Kanzi left us that one more little piece of the puzzle before he went," said the study's lead author Amalia Bastos.
https://www.science.org/doi/10.1126/science.adz0743

PUBLICATIONS

Animal Behaviour

PAPERS

OLGA PROCENKO et al with LARS CHITTKA – Bumble bee string-pulling skill spreads between colonies under open diffusion conditions

Socially transmitted behavioural traits can, if they persist in a group of animals over time, give rise to locally adapted phenotypes that can enhance survival. This capacity is widespread through the animal kingdom, and forms the foundation of cultural inheritance. While social learning is well documented among insects, and particularly in social insects such as bumble bees, the extent to which such behaviours can spread beyond initial kin groups and persist over time remains largely unknown. String pulling is a non-natural foraging behaviour where bees must manipulate a string to extract an out-of-reach artificial flower and collect a reward, and has previously been shown to spread via social learning. However, this was demonstrated only in highly controlled paired dyad settings, where interactions between bees were strictly limited. Here, we show that string pulling can spread both within and between bumble bee colonies, and persist over time, under previously untested open diffusion conditions. These are of greater ecological validity compared with classical paired dyad paradigms, and involve the seeding of a manually trained demonstrator into a group of naïve conspecifics. From this single point of origin, string-pulling behaviour spread rapidly within original, 'primary' colonies. Once the behaviour was established in the primary colonies, 'secondary' colonies were introduced, and string pulling was also acquired by these new foragers. Furthermore, string pulling was acquired through individual trial-and-error learning by a small number of bees in control colonies, which lacked trained demonstrators. These results confirm and build upon previous findings in bumble bees, and contribute to a growing body of evidence suggesting that social learning enables animals to establish local behavioural adaptations in the absence of the computational power provided by large brains.
https://www.sciencedirect.com/science/article/pii/S0003347225003665

ALEXANDROS VEZYRAKIS, VALERIA MAZZA & ANJA GUENTHER – Experienced problem solvers? The ontogeny of innovation in wild house mice

Animals frequently encounter challenges requiring innovative problem solving, yet an individual's propensity to innovate is believed to change throughout life. It is still unclear how age and experience interact to shape problem-solving performance over time. Here, we investigate how juvenile and adult wild house mice, Mus musculus domesticus, spontaneously engage with and solve novel problems by combining observations from populations living in two conditions, either socially complex seminatural enclosures or in more controlled, laboratory cages. There, we ran experiments to assess (a) the onset of problem-solving behaviours in preweaned mice, (b) spontaneous problem solving across age groups and (c) whether exposure to already solved set-ups improves problem-solving performance. We found that mice interacted with novel problems well before independence, and juveniles began solving problems before reaching sexual maturity. We also observed a contrasting pattern regarding age and performance. Specifically, juveniles and adults performed similarly in spontaneous problem solving when tested alone in standardized cage housing, but adults were more successful in the

seminatural enclosures. Individual problem-solving performance remained highly consistent within each housing condition (that is, seminatural enclosures or cages), and exposure to solved set-ups did not help nonsolvers solve novel problems in either condition. In contrast, experience only benefited individuals that were already solvers, allowing them to solve more problems at a later time. Our results suggest that the ability to spontaneously problem solve is an inherent trait in house mice rather than a skill acquired through experience.
https://www.sciencedirect.com/science/article/pii/S0003347225003689

Current Biology

ARTICLES

MELISSA EMERY THOMPSON – Evolution: In the monkey mating game, misinformation saves lives
During transitions to a new leader male, gelada infants face a serious risk of infanticide. New research demonstrates that mothers reduce this risk by misrepresenting their fertility status.
https://www.cell.com/current-biology/abstract/S0960-9822(25)01696-3

PAPERS

ALICE BANIEL et al – Evidence for deceptive fertility in a wild primate
Animal signals typically convey reliable information, but deception can evolve when the sender and receiver have conflicting interests—especially in the context of mating. Here, we provide evidence from a Cercopithecine primate, the gelada (Theropithecus gelada), that females deceptively signal fertility when conception is unlikely, which functions as a counterstrategy in sexual conflict. In geladas, male takeovers are frequent and often lead to sexually selected infanticide, exacting high costs on lactating females. Using 14 years of demographic and hormone data from wild geladas in Ethiopia, we show that lactating females quickly resumed sexual swellings and mated with the new male following takeovers, but they took significantly longer to conceive than females resuming cycling at other times. Females that exhibited these post-takeover swellings were subsequently less likely to lose their infants to infanticide. Fecal hormone data revealed a surge in estrogens after takeovers, even among females with the youngest infants, suggesting that estrogens mediate both fertile ("true") and non-fertile ("false") swellings. These results support the idea that sexual swellings can deceptively blur fertility as an adaptive counterstrategy to infanticide.
https://www.cell.com/current-biology/abstract/S0960-9822(25)01451-4

eLife

PAPERS

XIAOYAN WU et al – The Self-Interest of Adolescents Overrules Cooperation in Social Dilemmas
Reviewed Preprint
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/reviewed-preprints/106840

Frontiers in Language Sciences

PAPERS

PREETI RISHI et al – Spoken sentence comprehension in Mandarin-English bilinguals: a case against the universal processing advantage of subject-relatives
This study investigates sentence comprehension in Mandarin-English bilinguals, focusing on whether the widely reported, yet contested, subject-relative processing advantage extends to bilingual speakers. We evaluate which theoretical accounts, based on syntactic structure and canonicity, best explain cross-linguistic patterns of sentence processing.
Using a sentence-picture matching task, we examined the comprehension of canonical (e.g., actives) and non-canonical (e.g., passives) sentence structures in English and Mandarin for bilingual speakers of varying ages and Mandarin and English proficiency levels across two separate studies (n = 18 and n = 35).
In English, bilingual participants exhibited a robust canonical sentence advantage across studies, with better comprehension of subject-relative over object-relative sentences and active over passive sentences, mirroring monolingual processing patterns. However, in Mandarin, comprehension patterns were less robust and more variable. While subject-relative and

object-relative comprehension did not significantly differ at the group level, passive vs. active sentences consistently posed greater difficulty and increased performance variability across both studies, particularly among lower-performing individuals. These results suggest that sentence comprehension is shaped by language-specific constraints rather than a universal subject-relative advantage. Findings align with unified theoretical accounts that incorporate canonicity-based and structural factors, including word order, syntactic structure, and experience-, usage-, and frequency-based influences. Our results highlight the complex interplay between the aforementioned factors that differ across languages, with implications for both theoretical linguistics and clinical applications.
https://www.frontiersin.org/journals/language-sciences/articles/10.3389/flang.2025.1703230/full

Frontiers in Psychology

PAPERS

ELISABETTA LOMBARDI et al – Growing decision-making: the role of theory of mind, empathy, and personality traits in school-age children

Children's decision-making is a socio-cognitive skill embedded within a broader system that promotes understanding of others and effective management of interpersonal contexts, making it closely linked to Theory of Mind (ToM) and empathy. The present study examined how these abilities, together with personality traits and cognitive skills, relate to decision-making in middle childhood, specifically regarding fairness, altruism, and delay of gratification. A sample of 94 children aged 6–10 years completed tasks assessing fairness (Ultimatum Game), altruism (Dictator Game), and delay of gratification (Marshmallow Task), together with measures of ToM, empathy, personality traits, and cognitive ability. Results revealed that fairness was predicted by ToM and situational empathy, suggesting that acting fairly involves integrating mental-state reasoning with context-dependent emotional responsiveness. Altruism, in contrast, was specifically associated with affective empathy, indicating that children's tendency to help others is primarily driven by their emotional sensitivity. Delay of gratification was unrelated to ToM or empathy. Instead, it was predicted by the personality trait of Openness to Experience, reflecting the role of trait-like motivational tendencies in delay of gratification. Age and general cognitive ability did not predict any of the decision-making outcomes. Path analyses confirmed that fairness and altruism are driven by social-cognitive mechanisms, whereas delay of gratification depends primarily on individual dispositions rather than interpersonal processing. These findings clarify the specific contributions of ToM, empathy, and personality to children's decision-making and carry important implications for developmental and educational practices.
https://www.frontiersin.org/journals/psychology/articles/10.3389/fpsyg.2026.1708789/full

iScience

PAPERS

JIAJIA LIU & CHARLES DAVIS – Art as a source of historical biodiversity data

Art has long reflected humanity's relationship with the natural world and is increasingly recognized as a valuable source of data for reconstructing past biodiversity. Here, we synthesize evidence from prehistoric cave art, historical illustrations, and literary arts to document how artworks can be used to inform our understanding of extinct species, historical population dynamics, distributional shifts, and temporal changes in species' traits. We also explore how artworks composed of biological materials such as feathers, bones, and wood can offer insights into species interactions with humans. Although artworks present unique opportunities for biodiversity research, there are limitations and challenges associated with interpreting the biodiversity data we derive from them. We advocate for interdisciplinary collaboration among art historians, archaeologists and biodiversity scientists to unlock the full potential of art in biodiversity science.
https://www.cell.com/iscience/fulltext/S2589-0042(26)00248-8

Mind & Language

PAPERS

SUSANNA SCHELLENBERG – The polysemy of "I"

Orthodoxy assumes that the first-person thoughts of an individual are anchored to a stable object. I challenge this assumption by arguing that "I" is polysemous. The perspectival anchor of a first-person thought could be the bearer of the thought, the agent, the bearer of perception, or a body, to name just a few options. These different possible anchors do not form a unity. So, a unified or minimal self cannot, without argument, be posited as the stable anchor of an individual's first-person thoughts. I show how the polysemy of "I" can be analyzed in terms of polysemous mental files.
https://onlinelibrary.wiley.com/doi/full/10.1111/mila.12551

PHILIPPE SCHLENKER et al – Anti-Babel: Three degrees of interspecies comprehension

While recent "animal linguistics" treats call form as arbitrary, various results suggest that some animals use a biological code to understand the calls of unrelated/unfamiliar species. To clarify matters, we distinguish among three degrees of interspecies comprehension. In the first ("Understand thy neighbor"), a species understands the calls of a neighboring species through exposure. In the second ("call convergence"), it understands the calls of an unrelated/unfamiliar species

through evolutionary convergence and resemblance to familiar calls. In the third degree ("featural interpretation"), it uses a rule associating a meaning to a specific acoustic feature—hence a new road to (featural) compositionality.
https://onlinelibrary.wiley.com/doi/abs/10.1111/mila.12529

ALNICA VISSER – The cognitive role of concept variability
I present and defend concept variability, the view that concepts can admit of indefinitely many variations and changes in their representational contents without thereby losing their identity. I argue that the variability of concepts is central to their role in enabling cognition, and thus that a concept's content variability is, despite philosophical orthodoxy to the contrary, a feature of our cognitive architecture and not a bug.
https://onlinelibrary.wiley.com/doi/full/10.1111/mila.12546

İSA KEREM BAYIRLI – Uniquely human temporal thoughts
Life on Earth will eventually come to an end. The thought expressed in the previous sentence is about a point in time that is not known to the individual entertaining the thought. This paper is concerned with the nature of such temporal thoughts. We propose that the capacity to mentally represent thoughts about non-specific temporal intervals is a unique aspect of human cognition. We suggest that this capacity is a consequence of the fact that human grammar defines/generates sentences involving binding of temporal variables and quantification over intervals. This leads to a view of language evolution as a transition between logics.
https://onlinelibrary.wiley.com/doi/full/10.1111/mila.12565

STINA BJÖRKHOLM – The practicality of moral language and dynamic descriptivism
When speakers make moral claims, they often indicate that they are themselves committed to, or aim to commit their addressee to, certain actions or attitudes. The way that moral language is practical in these ways is often considered to be detrimental for any descriptivist semantics of moral language. It is argued in this article that the practicality of moral language can be accommodated by appealing to dynamic pragmatics. A dynamic descriptivist accounts for the practicality of moral language in terms of how moral utterances update and relate to a shared interpersonal dimension of communication that contains content accepted by the interlocutors of a moral conversation.
https://onlinelibrary.wiley.com/doi/full/10.1111/mila.12557

Nature

NEWS

How learning handwriting trains the brain: the science behind the cursive wars
Handwriting requirements were cut from school curricula around the world. Now it's looping back, riding on a wave of evidence.
https://www.nature.com/articles/d41586-026-00320-6

Many people have no mental imagery. What's going on in their brains?
People with aphantasia are offering a window into consciousness.
https://www.nature.com/articles/d41586-026-00311-7

This bonobo had a pretend tea party — showing make believe isn't just for humans
In the first demonstration of pretend play in a non-human, the ape favoured a cup filled with imaginary juice over one with its 'contents' emptied.
https://www.nature.com/articles/d41586-026-00357-7

ARTICLES

EDDY KEMING CHEN et al – Does AI already have human-level intelligence? The evidence is clear
The vision of human-level machine intelligence laid out by Alan Turing in the 1950s is now a reality. Eyes unclouded by dread or hype will help us to prepare for what comes next.
{Which tells us either that human intelligence is nothing special, or that intelligence is only an incidental part of cognition, or that the Turing test is not as informative as we hoped. Or, possibly, that the Turing test was never intended to test the computer: after all, it is not the output of the computer that is measured, it is the response of humans to that output – it's a gullibility test.}
https://www.nature.com/articles/d41586-026-00285-6

PAPERS

MATTIAS JAKOBSSON et al with MARLIZE LOMBARD – Homo sapiens-specific evolution unveiled by ancient southern African genomes

Homo sapiens evolved hundreds of thousands of years ago in Africa, later spreading across the globe, but the early evolutionary process is debated. Here we present whole-genome sequencing data for 28 ancient southern African individuals, including six individuals with 25× to 7.2× genome coverage, dated to between 10,200 and 150 calibrated years before present (cal. bp). All ancient southern Africans dated to more than 1,400 cal. bp show a genetic make-up that is outside the range of genetic variation in modern-day humans (including southern African Khoe-San people, although some retain up to 80% ancient southern African ancestry), manifesting in a large fraction of Homo sapiens-specific variants that are unique to ancient southern Africans. Homo sapiens-specific variants at amino acid-altering sites fixed for all humans—which are likely to have evolved rapidly on the Homo sapiens branch—were enriched for genes associated with kidney function. Some Homo sapiens-specific variants fixed in ancient southern Africans—which are likely to have adapted rapidly on the southern African branch—were enriched for genes associated with protection against ultraviolet light. The ancient southern Africans show little spatiotemporal stratification for 9,000 years, consistent with a large, stable Holocene population transcending archaeological phases. While southern Africa served as a long-standing geographical refugium, there is outward gene flow over 8,000 years ago; however, inward gene flow manifests only after around 1,400 years ago. The ancient genomes reported here are therefore key to the evolution of Homo sapiens, and are important for advancing our understanding of human genomic variation.
https://www.nature.com/articles/s41586-025-09811-4

Nature Communications

PAPERS

AYAKA HACHISUKA et al – Neural and computational mechanisms underlying one-shot perceptual learning in humans

The ability to quickly learn and generalize is one of the brain's most impressive feats and recreating it remains a major challenge for modern artificial intelligence research. One of the most mysterious one-shot learning abilities displayed by humans is one-shot perceptual learning, whereby a single viewing experience drastically alters visual perception in a long-lasting manner. Where in the brain one-shot perceptual learning occurs and what mechanisms support it remain enigmatic. Combining psychophysics, 7 T fMRI, and intracranial recordings, we identify the high-level visual cortex as the most likely neural substrate wherein neural plasticity supports one-shot perceptual learning. We further develop a deep neural network model incorporating top-down feedback into a vision transformer, which recapitulates and predicts human behavior. The prior knowledge learnt by this model is highly similar to the neural code in the human high-level visual cortex. These results reveal the neurocomputational mechanisms underlying one-shot perceptual learning in humans.
https://www.nature.com/articles/s41467-026-68711-x

THOMAS J.H. MORGAN et al – Human prestige psychology can promote adaptive inequality in social influence

Human hunter-gatherer groups were commonly thought to be broadly egalitarian, with increasingly formal hierarchical social structures hypothesized to spread following the introduction of agriculture. However, this view is being challenged by mounting evidence for social hierarchies in several foraging populations. Nonetheless, the processes by which such hierarchies emerge, and whether human hierarchies are homologous with non-human systems of dominance, remains unclear. Here we examine the role of prestige, the tendency to freely confer status and influence on skilled or esteemed individuals and a proposed component of human-unique cultural psychology, in generating unequal patterns of social influence. Through a combination of cultural evolutionary modelling, human experimentation, and evolutionary simulations, we find that human prestige psychology generates highly unequal influence hierarchies, and that the "prestige sensitivity" we measure empirically in human participants closely matches the predictions of our evolutionary simulations, suggesting it is an evolved psychological adaptation. Nonetheless, unlike non-human dominance hierarchies, the processes involved are non-coercive, being driven by individuals freely seeking high quality information. We thus conclude that social hierarchies plausibly have a deep evolutionary history in our lineage, with prestige enabling hierarchies to be mutually beneficial as opposed to coercive.
https://www.nature.com/articles/s41467-026-68410-7

New Scientist

ARTICLES

CHRIS SIMMS – Neanderthals and early humans may have interbred over a vast area

We are getting a clearer sense of where and how often Homo sapiens and Neanderthals interbred, and it turns out the behaviour was much more common than we first thought.
https://www.newscientist.com/article/2513892-neanderthals-and-early-humans-may-have-interbred-over-a-vast-area/

COLIN BARRAS – Why is childbirth so hard for humans – and is it getting even harder?
Some think the rise of C-sections means that one day all births will require serious medical intervention. But a surprising new understanding of the pelvis suggests a different story.
https://www.newscientist.com/article/2512675-why-is-childbirth-so-hard-for-humans-and-is-it-getting-even-harder/

CHRIS SIMMS – How to live a meaningful life, according to science
The meaning of life has puzzled philosophers for millennia, but new research suggests it could be as simple as lending a helping hand.
https://www.newscientist.com/article/2513875-how-to-live-a-meaningful-life-according-to-science/

JAMES WOODFORD – Bonobo's pretend tea party shows capacity for imagination
Kanzi, a bonobo with exceptional language skills, took part in a make-believe tea party that demonstrated cognitive abilities never seen before in non-human primates.
https://www.newscientist.com/article/2514366-bonobos-pretend-tea-party-shows-capacity-for-imagination/

Philosophical Transactions of the Royal Society B

PAPERS

TIBOR TAUZIN – Infants' sensitivity to the predictability of exchanged actions in socially contingent exchanges: the contingency cube
Previous studies on social contingency have revealed that young infants are sensitive to the consistent temporal pairing of contingent responses and can draw various, evolutionarily relevant inferences from it. For example, when infants identify that it is highly probable for an unfamiliar entity to produce temporally contingent responses to another agent's actions, they can infer that the reactive entity is an intentional agent, even if it shows no other cues of agency. However, the consistent temporal pairing of contingently exchanged actions is not sufficient to account for the full range of inferences induced by contingent social reactivity. Based on recent findings, I argue that recognizing socially contingent interactions relies on the sensitivity to the predictability of subsequent actions along three dimensions. I propose that young infants monitor 'what', 'when' and 'how' response actions are produced. By tracking these three factors, infants can represent the relatedness of subsequent actions exhibited by interacting social partners, guiding their contingency-based inferences, including those that have traditionally been viewed as independent of social contingency. I conjecture that the cognitive mechanism to monitor the predictability of exchanged actions may have become further specialized during human evolution, enabling social partners to engage in complex cooperative and communicative interactions.
https://royalsocietypublishing.org/rstb/article/381/1943/20240363/480042/Infants-sensitivity-to-the-predictability-of

ELENA LUCHKINA, STEVEN L. ELMLINGER & MICHAEL H. GOLDSTEIN – Letting contingency out of the box: new perspectives on mechanisms of learning from social interaction
How do social interactions create learning opportunities? Research on human and animal learning demonstrates that social interactions facilitate many aspects of development and learning. For example, songbirds and non-human primates acquire their species-typical vocalizations more effectively when embedded in contingent interactions with conspecifics than when exposed to non-contingent or isolated input. Similarly, human infants' engagement in social interaction predicts later language skills, brain development, self-regulatory capacities, social bonding, and perspective-taking. What remains unclear are the mechanisms underlying this facilitative effect in humans and other species. This article introduces a special issue which aims to address this gap.
https://royalsocietypublishing.org/rstb/article/381/1943/20240358/480098/Letting-contingency-out-of-the-box-new

GINA MARIE MASON & MICHAEL H. GOLDSTEIN – Prior social feedback creates residual differences in infant attention
For human infants, attention is a crucial skill that both facilitates and constrains learning, with individual differences predicting cognitive development. Traditionally, early attention differences were posited to arise from predetermined non-social mechanisms. However, given human infants' altriciality and extended dependence on carers, persistent attention differences may also be affected by early social feedback. Here, we experimentally tested social influences on early attention by manipulating the form and timing of social interactions, then assessing infant attention in a subsequent behavioural vigilance task. Eighty infants aged 6–7 months interacted with an experimenter who responded to infants' looks and vocalizations using one of four response schedules, varying in contingency (rate of responding to infant behaviour) and joint focus (response congruency with infants' attention). Infants then completed the vigilance task with a new adult. We found that experimenters' prior contingency predicted infants' later attention. When rarely responded to, infants subsequently showed higher vigilance (frequent visual scanning and shorter response latencies) than infants who received high response rates. Furthermore, highly vigilant infants attended more rigidly to highly salient stimuli across task trials. Our findings provide strong experimental evidence that contingent social feedback causally organizes infant attention in later settings, suggesting possible mechanisms for interventions supporting adaptive outcomes.
https://royalsocietypublishing.org/rstb/article/381/1943/20240364/480043/Prior-social-feedback-creates-residual-differences

KELSEY WEST et al – Social communication development in a contingent world: insights from autism
Children learn to communicate via real-time behavioural feedback loops with their social partners (e.g. infant vocalizes, caregiver responds and infant learns from the response). Across development, feedback loops become increasingly complex as children master new skills, engage in new activities, interact with a growing network of social partners, and thus elicit a tremendous variety of social responses. For autistic individuals, these feedback loops unfold in distinct ways. Autistic people's social behaviours (like gaze, gestures and language) differ from the behaviours of non-autistic people; as a result, they elicit different input from social partners, which then has cascading impacts on future social behaviour. Here, we review literature on the mechanisms that underpin social communication development in autism from infancy through adulthood. We discuss how changes in abilities (e.g. motor, cognitive, emotion, communication), social demands and environmental contexts (e.g. interactions with peers) influence the social contingency experiences of autistic individuals. We propose that differences in real-time behavioural feedback loops contribute, in part, to broader developmental trends in autism (e.g. the pace of language learning). Research from neurodiverse samples offers insights into how feedback loops facilitate social communicative development broadly and has real-world implications for clinical and educational initiatives.
https://royalsocietypublishing.org/rstb/article/381/1943/20240365/480044/Social-communication-development-in-a-contingent

YINING CHEN, FIRRHAANA SAYANVALA & JON T. SAKATA – Dynamic vocal and behavioural contingencies vary between learning and courtship interactions in zebra finches
During communicative interactions, individuals exert reciprocal influences on each other; senders influence receivers and receivers influence senders. Relatively little is known about how contingent interactions vary across social contexts (audiences), and such investigations could provide insight into the function of behavioural contingencies. Here, we analyse behavioural contingencies across two different social contexts in zebra finches. Specifically, because male zebra finches learn their vocalizations during social interactions in development and use these learnt vocalizations during courtship interactions in adulthood, we analysed behavioural contingencies between adult and juvenile males (learning) and between adult males and females (courtship). We discovered that adult male zebra finches (senders) can display 'overt behaviours' before song production that increase the attention of receivers and, moreover, that the contingent attentional responses of juvenile males but not of adult females predicted the type of song produced by the adult male. Specifically, adult males were more likely to direct songs at juveniles when juveniles became attentive after the overt behaviour, but they directed songs at females regardless of the female's attentional state. Together, these data underscore that audiences differentially affect song production in songbirds and suggest that behavioural contingencies could be more important for learning than for reproduction.
https://royalsocietypublishing.org/rstb/article/381/1943/20240368/480045/Dynamic-vocal-and-behavioural-contingencies-vary

SASHA L. WINKLER & ERICA A. CARTMILL – Does playful teasing help great apes learn about social relationships?
Understanding social relationships is critical to succeeding in primate societies. In species with complex social networks (including humans), correctly predicting the strength of one's social relationships or bonds helps individuals better navigate future interactions. Social contingency—behaviour that depends on and directly responds to another's actions—is a key feature of interaction that provides opportunities to learn about these relationships. We propose that playful teasing in great apes represents a specialized form of social contingency that enables relationship assessment in a relatively safe context. Playful teasing involves one individual pestering, harassing or provoking another in a playful manner. An ape can learn about their bond by observing how a social partner responds to mild provocation—seeing how far they can push the other before receiving an explicitly negative response. Since responses range from mild aversion to benign tolerance to reciprocal play, the teaser can gain valuable information about relationship quality through monitoring the socially contingent responses to teasing actions. This form of learning through contingency may have evolved as a relatively low-risk method to assess social relationships through direct feedback, though several alternative explanations exist. We examine multiple evolutionary hypotheses for playful teasing and offer suggestions for future empirical testing.
https://royalsocietypublishing.org/rstb/article/381/1943/20240371/480047/Does-playful-teasing-help-great-apes-learn-about

YOUTAO LU et al – Gaze crossing: a new paradigm to assess social contingency and word learning during real-time infant–adult interactions
Children's social interactions with caregivers play a crucial role in their development. One strong cue to an ongoing social interaction is the mutual dependency of interaction partners' behaviours, a feature we refer to as social contingency. Socially contingent interactions have been shown to support learning, but it remains underexplored whether social contingency alone, even in the absence of other social cues, can drive developmental advantages. Addressing this question requires faithfully representing bi-directional contingency in infant–adult interactions while isolating it from other social cues. Building on the perceptual crossing paradigm, we designed an innovative setup where infants and adults interact in real time using eye gaze, with all interactions mediated through a non-social, screen-based display. Extending beyond the one-way

responsiveness in previous studies, this setup captures bi-directional contingency through dependencies in gaze movement upon mutual detection. Our findings demonstrate that social contingency modifies infant behaviour even in such a streamlined context. To extend the paradigm's applicability, we integrated it with word learning, a task sensitive to the concurrent effect of social interaction. Preliminary evidence suggests that contingency facilitates word learning, underscoring the potential of the gaze-crossing paradigm to further elucidate the role of contingency in child development.
https://royalsocietypublishing.org/rstb/article/381/1943/20240376/480049/Gaze-crossing-a-new-paradigm-to-assess-social

ASIF A. GHAZANFAR, RENATA B. BIAZZI & YISI S. ZHANG – The integrative biology of marmoset monkey vocal learning
Primates exhibit a range of vocal behaviours. This range arises from species-specific developmental processes which, in turn, are shaped by evolutionary pressures. We must therefore consider that all primate species do not follow the same developmental path to their vocal behaviours. We will use marmoset monkeys as a case study for the integrative biology of vocal learning. As we will show, marmoset contact call development exhibits a pattern of socially guided vocal production learning that is like the pattern exhibited by prelinguistic human infants and the juvenile zebra finch, a songbird. This socially guided contact call development and other vocal behaviours emerge in a landscape of anatomical changes that is modulated by a large-scale neural system. Comparing their vocal developmental strategies with humans, we will then consider the possibility that the marmoset monkey's potential for infant vocal production learning may be the result of similar (convergent) evolutionary changes to their developmental timing and life history strategy. Overall, we hope that the example of marmoset monkeys presented here reveals how species differences in vocal behaviours—vocal learning, in this instance—can unfold across the different timescales of evolution, development and behaviour.
https://royalsocietypublishing.org/rstb/article/381/1943/20250097/480050/The-integrative-biology-of-marmoset-monkey-vocal

CATALINA SUAREZ-RIVERA & CATHERINE S. TAMIS-LEMONDA – Pathways from social contingency to infant language learning
Social contingencies—the timely responses that follow infant action—facilitate learning in the moment and over developmental time. Although links between social contingencies and infant learning are well documented, the mechanisms of influence remain underspecified. We draw on a growing body of research to propose several pathways that lead from infant action to social contingency to infant learning, with a focus on early word learning as a model system. Specifically, we contend that social contingency: (i) builds on infant attention, (ii) creates multisensory experiences, (iii) spurs a self-sustaining feedback loop that engenders continued engagement by the infant, (iv) facilitates connections among events in memory, and (v) supports infants' learning of the pragmatics of human communication. We conclude with consideration of the role of social contingency beyond infancy, across domains, and across nested timescales.
https://royalsocietypublishing.org/rstb/article/381/1943/20240359/480061/Pathways-from-social-contingency-to-infant

STEVEN L. ELMLINGER et al – The social origins of vocal sequences in songbirds and human infants
From birdsong to human language, acoustic communication by vocal learners involves the concatenation of sounds into sequences. Sequences are more efficient for the producer and more accommodating to the capacities of receivers. Over development, the compression of syllables into rapid sequences (in terms of more syllables per second) may reflect both social learning and motor maturation. We tested whether sequence compression could be predicted uniquely by exogenous (i.e. social) and endogenous (i.e. motor) sources. In human infants, we found that (i) vocal sequences strongly engage adults, (ii) from 5 to 10 months, sequences compress, (iii) social feedback to 5-month-olds' sequences predicted sequence compression over development, and (iv) sequence compression over development predicted infants' vocabulary development. We next examined the extent to which compression develops in a paradigm in which we could separate social feedback from motor practice. In zebra finch (Taeniopygia guttata), we found that (i) motor development predicted sequence compression, but (ii) compression only predicted song maturity (similarity to tutor) when birds received contingent social feedback to their immature vocalizing. In addition, (iii) social feedback predicted finches' sequence compression. These findings demonstrate the potency of social feedback across two vocal learning species in the emergence of vocal efficiency.
https://royalsocietypublishing.org/rstb/article/381/1943/20240366/480063/The-social-origins-of-vocal-sequences-in-songbirds

NIKHIL PHANIRAJ et al with JUDITH M. BURKART – Opportunities and mechanisms for learning through social interactions: lessons from marmosets
Social interactions are crucial for learning not only in humans but also in non-human animals. To date, comparative studies have typically focused on what is learned from others and on purely observational learning, while paying less attention on how social interactions facilitate learning. Here, we present how computational approaches can be leveraged to examine the role of contingency in learning through social interactions, focusing on callitrichid monkeys. They are the only primates besides humans in which group members other than the mother contribute significantly to infant care (i.e. cooperative breeding), resulting in more and richer opportunities for social interactions and learning, in both immatures and adults. We first review how contingency, turn-taking and social timing fundamentally shape learning and inter-individual coordination. We then zoom in on turn-taking in vigilance and vocal accommodation, illustrating how mathematical modelling can offer

unique insights into the underlying mechanisms. We also highlight the potential of hybrid approaches that combine machine learning's pattern detection strengths with the interpretability and explanatory power of mathematical models. Overall, we find that contingency is key to learning through social interactions not only in humans but also in non-human primates, and perhaps particularly so in the cooperatively breeding callitrichids.
https://royalsocietypublishing.org/rstb/article/381/1943/20240367/480064/Opportunities-and-mechanisms-for-learning-through

CHEN YU et al – Examining micro-level natural behaviour to improve generalizability in behavioural science: a case study of parent–child joint attention

One of the primary aims of cognitive and behavioural sciences is to generate empirical findings that are both reproducible and generalizable to real-world settings. The present study investigates the extent to which results obtained from a structured laboratory task—parent–infant toy play—can be generalized to more naturalistic contexts and everyday activities. We focused on joint attention between parents and infants, a construct that has been extensively examined within developmental science. To characterize parent–infant joint attention during toy play, we recorded and analysed contingent gaze behaviour captured through dual head-mounted eye-tracking devices worn simultaneously by parents and their infants during spontaneous activities such as toy play and meal preparation. By continuously monitoring gaze locations and manual actions, we obtained fine-grained measures of how often dyads fixated on the same object concurrently and how their coordinated visual and manual behaviours contributed to the establishment and maintenance of joint attention. Our results suggest that laboratory findings can be both replicated and generalized when: (i) the study is designed to capture natural behaviours rather than to elicit specific, constrained responses, and (ii) the theoretical constructs are clearly defined and precisely measured through high-resolution behavioural data.
https://royalsocietypublishing.org/rstb/article/381/1943/20240377/480065/Examining-micro-level-natural-behaviour-to-improve

MITJA NIKOLAUS & ABDELLAH FOURTASSI – Modelling children's grammar learning via caregiver feedback in natural conversations

Many debates in the language acquisition literature have revolved around the role of negative evidence for the acquisition of grammar. The scientific study of this question has not been settled with traditional research methods, given that it requires handling children's natural social interaction while controlling for the specific role of error-contingent feedback, independent of other types of input. Here, we leveraged computational modelling to test whether there are learning gains in grammar induced by caregivers' feedback above and beyond learning from input alone. More specifically, we compared language models trained on large corpora of child-directed language to the same models that were additionally fine-tuned through reinforcement learning using a reward model trained to provide caregiver-like feedback. Focusing on clarification requests, we found that fine-tuned models produced more grammatical utterances than baseline models. However, performance on challenging benchmarks of grammar knowledge evaluation did not improve. We showed that these benchmarks could, in principle, be improved through integration of other types of feedback. The broad impact of the current work is to introduce a methodological framework that enables scientists to test many types of feedback, including signals beyond the verbal modality, leading to a more comprehensive evaluation of caregiver feedback in language development.
https://royalsocietypublishing.org/rstb/article/381/1943/20240374/480099/Modelling-children-s-grammar-learning-via

GABRIEL J. SEVERINO et al – Social contingency in embodied neural networks relies on co-constructed dynamical mechanisms

What are the mechanisms that enable organisms to detect and respond to the actions of others? Social contingency, or the degree to which one's actions reliably elicit timely and relevant responses from another, underlies adaptive behaviour and social interaction across species. In order to investigate general principles underlying this phenomenon, we trained and analysed populations of embodied recurrent neural networks engaged in the perceptual crossing task, a minimal social interaction experiment in humans. Through extensive robustness and performance testing, we isolated a subset of 111 circuits. Analysis revealed several shared principles among the robust subset. First, despite uniform performance, we found four distinct behavioural strategies that agents would switch to depending on state history and the strategy of their partner. Next, we found that social contingency does not depend on a single feature of feedback but rather on a scaled relationship between feedback parameters. Finally, using dynamical systems analysis, we identified a shared mechanism for social contingency across all successful circuits. Specifically, it was necessary for the nervous system to couple a contingency cue, a specific temporal pattern in the sensor's activation that distinguishes social from non-social interactions, with a method of conditional stability, a way of structuring the nervous system such that interactions are stable only if the appropriate temporal cue is present.
https://royalsocietypublishing.org/rstb/article/381/1943/20250098/480104/Social-contingency-in-embodied-neural-networks

PLoS Biology

PAPERS

ROBERTA BIANCO et al – Human newborns form musical predictions based on rhythmic but not melodic structure

The ability to anticipate rhythmic and melodic structures in music is considered a fundamental human trait, present across all cultures and predating linguistic comprehension in human development. Yet, it remains unclear the extent to which this ability is already developed at birth. Here, we used temporal response functions to assess rhythmic and melodic neural encoding in newborns (N = 49) exposed to classical monophonic musical pieces (real condition) and control stimuli with shuffled tones and inter-onset intervals (shuffled condition). We computationally quantified context-based rhythmic and melodic expectations and dissociated these high-level processes from low-level acoustic tracking, such as local changes in timing and pitch. We observed encoding of probabilistic rhythmic expectations only in response to real but not shuffled music. This proves newborns' ability to rely on rhythmic statistical regularities to generate musical expectations. We found no evidence for the tracking of melodic information, demonstrating a downweighting of this dimension compared to the rhythmic one. This study provides neurophysiological evidence that the capacity to track statistical regularities in music is present at birth and driven by rhythm. Melodic tracking, in contrast, may receive more weight through development with exposure to signals relevant to communication, such as speech and music.
https://journals.plos.org/plosbiology/article?id=10.1371/journal.pbio.3003600

PLoS One

PAPERS

SUSAN NITTROUER et al – How auditory development affects language acquisition: Influences of socioeconomic status and gestational age at birth

Technological advances in recent decades have intensified the need for strong language and literacy skills, such that deficits in these skills can significantly reduce occupational opportunities and social richness. Nonetheless, the causes of language and literacy deficits remain scarcely understood, so treatment consists mostly of drill on the very skills affected individuals struggle to perform. The purpose of this study was to test two related hypotheses. Hypothesis 1 was that delays in the development of the central auditory pathways greatly constrain acquisition of language skills dependent upon auditory development; these skills primarily involve those that are late emerging, namely phonological sensitivity. A corollary is that language skills that begin emergence early in life are less affected by delays in auditory development; this largely encompasses lexicosyntactic knowledge. Hypothesis 2 was that some conditions heretofore recognized as impacting language acquisition (poverty and premature birth, for the purpose of this study) take their toll at least in part by constraining the timely development of the central auditory pathways. To test these hypotheses, 104 children (5–6 years old) spanning continua of socioeconomic status and gestational age at birth were tested on (1) three measures of suprathreshold auditory functions associated with development of the central auditory pathways, (2) two measures of lexicosyntactic knowledge, and (3) two measures of phonological sensitivity. Results largely supported both hypotheses: Strong relationships were found between suprathreshold auditory functions and language measures, especially phonological sensitivity, and both socioeconomic status and gestational age appeared to exert their influence on language acquisition completely or partly through an effect on auditory function. These results should serve to refocus the search for causes of language and literacy deficits from purely environmental shortcomings to biological determinants, with newly inspired directions for interventional approaches.
https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0341841

Royal Society Open Science

PAPERS

EVA VIVIANI, MICHAEL RAMSCAR & ELIZABETH WONNACOTT – Go above and beyond: does input variability affect children's ability to learn spatial adpositions in a novel language?

Human language is characterized by productivity, that is, the ability to use words and structures in novel contexts. How do learners acquire these productive systems? Under a discriminative learning approach, language learning involves using cues to predict and discriminate linguistic outcomes and 'generalization' involves dissociating idiosyncratic irrelevant cues in favour of informative, invariant cues. The current work tests the predictions of this account using the learning of spatial adpositions as a test case. Spatial adpositions describe the location of one object in relation to another (e.g. English prepositions 'above' and 'below') and may occur in reversible sentences, such as the picture is above the window; generalization involves using these terms in novel contexts, such as with unattested nouns. Computational simulations implementing an error-driven, discriminative learning process, demonstrate that broadening the irrelevant cues associated with the stimuli may boost the discovery of invariant cues, i.e. the association between the adposition and the spatial relation. We explored the predictions of these models in human learners by adapting a training paradigm introduced by Hsu & Bishop (Hsu, Bishop 2014 PeerJ2, e656 (doi:10.7717/peerj.656)) to teach typically developing 7–8-year olds spatial adpositions in an unfamiliar language (Japanese) using a computerized learning game. We manipulated the cue variability by comparing groups of children trained with more variable sentences (HV) with a condition with repetition of the same sentences (LV). A third condition (skew) tested whether learning and generalization are boosted when learning from a heavy

tailed distribution that more closely resembles that of natural language. We examined the following predictions: (i) for sentences with novel nouns, participants trained with variable sentences will show better performance (i.e. stronger generalization) than those trained with repeated sentences; (ii) in contrast, those trained with repeated sentences will show stronger performance in training itself (i.e. stronger item learning); and (iii) training with a heavy tailed distribution—more closely resembling the natural one—will lead to the strongest item learning and generalization. In our main analyses, for (i) we found clear evidence that the HV condition outperformed the LV condition in generalization, in line with predictions of the computational model when trained on the same datasets. However, for (ii) the frequency advantage was not clearly observed and for (iii) skewed input did not provide an additional benefit over variability (with Bayesian evidence for the null that it was beneficial for generalization). Interestingly, the fact that the skew condition did not outperform the high variability benefit was in fact consistent with the computational modelling, although skew was found to be supportive in other domains. Finally, exploratory analyses indicate interesting individual differences in how learners respond to variability and frequency in their input, which may be owing to their current environment as well as learner characteristics.
https://royalsocietypublishing.org/rsos/article/13/2/251853/480095/Go-above-and-beyond-does-input-variability-affect

Science

PAPERS

AMALIA P. M. BASTOS & CHRISTOPHER KRUPENYE – Evidence for representation of pretend objects by Kanzi, a language-trained bonobo

Secondary representations enable our minds to depart from the here-and-now and generate imaginary, hypothetical, or alternate possibilities that are decoupled from reality, supporting many of our richest cognitive capacities such as mental-state attribution, simulation of possible futures, and pretense. We present experimental evidence that a nonhuman primate can represent pretend objects. Kanzi, a lexigram-trained bonobo, correctly identified the location of pretend objects (e.g., "juice" poured between empty containers), in response to verbal prompts in scaffolded pretense interactions. Across three experiments, we conceptually replicated this finding and excluded key alternative explanations. Our findings suggest that the capacity to form secondary representations of pretend objects is within the cognitive potential of, at least, an enculturated ape and likely dates back 6 to 9 million years, to our common evolutionary ancestors.
https://www.science.org/doi/10.1126/science.adz0743

Science Advances

PAPERS

RICHARD L. ROSENCRANCE et al – Complex perishable technologies from the North American Great Basin reveal specialized Late Pleistocene adaptations

Structurally and functionally complex technologies were a defining element of Late Pleistocene societies, but physical examples of them remain extremely rare in the archaeological record because most were made from perishable raw materials. The sparse material record of those myriad technologies limits our ability to formulate nuanced models about this critical period in human history. We present radiocarbon, Zooarchaeology by Mass Spectrometry, and other taxonomic identification data from two of the largest Late Pleistocene perishable assemblages in the world, Cougar Mountain Cave and Paisley Caves, Oregon, US. These data include 66 radiocarbon dates on 55 items made from 15 different plant and animal taxa, including the oldest known physical remains of sewn hide. We provide data on eyed bone needles from four regional sites, showing that they are among the finest bone needles made in the Pleistocene. Our study illuminates the complex interplay of culture, climate, and technology in the Pleistocene.
https://www.science.org/doi/10.1126/sciadv.aec2916

DORSA AMIR et al – The emergence of cooperative behaviors, norms, and strategies across five diverse societies

Human cooperation involves a set of interconnected behaviors that develop in conjunction with the cultural environment. Despite recent advances in Western, industrialized contexts, we know far less about how cooperative behaviors emerge across cultures, how normative environments shape their development, and how these behaviors relate to one another. Here, we examined the development of four cooperative behaviors—fairness, trustworthiness, forgiveness, and honesty—in children (N = 413) aged 5 to 13 from five societies: urban United States, rural Uganda, Canada, Peru, and the hunter-horticulturalist Shuar of Ecuador. We also collected normative judgments from peers (N = 163) and adults (N = 86) of each community. We find substantial variation in cooperative behaviors and norms across populations, but, more generally, that children's behaviors and norms tend to converge toward community-specific norms in middle childhood. We also identify three cooperative strategies—maximization, generic cooperation, and partner-contingent cooperation—whose prevalence shifts with age and differs across societies. Together, these findings illuminate how cooperative behavior develops within and across cultures.
https://www.science.org/doi/10.1126/sciadv.adw9995

QIONG ZHU et al – Introgressed mitochondrial fragments from archaic hominins alter nuclear genome function in modern humans

Archaic introgression introduced functionally relevant variants into modern humans, yet small-scale insertions remain understudied. Here, we leverage 2519 modern human genomes and four high-coverage archaic hominin genomes to systematically characterize nuclear mitochondrial DNA segments (NUMTs). We uncover 483 polymorphic NUMTs across globally diverse human populations and 10 in archaic genomes. By combining overlap with Neanderthal-derived and Denisovan-derived haplotypes, phylogenetic analyses, insertion time estimates, and haplotype colocalization, we identify five NUMTs introduced into modern humans via archaic hominin introgression. Functional analyses reveal that introgressed NUMTs can modulate gene expression, including allele-specific up-regulation of the immune-related gene RASGRP3, and reshape three-dimensional chromatin structure at loci such as SCD5 and HNRNPD. These findings highlight an underappreciated mechanism by which archaic mitochondrial fragments shape nuclear genome function and evolution. Our study reframes NUMTs not as passive genomic fossils but as dynamic elements influencing modern human diversity and adaptation.
https://www.science.org/doi/10.1126/sciadv.aea0706

Trends in Cognitive Sciences

PAPERS

HELENA MITON & JOSHUA C. JACKSON – Complex technology requires cultural innovations for distributing cognition

Over the last decade, new research has shown how human collectives can develop technologies that no single individual could discover on their own. However, this research often overlooks how technology can become so complex that individuals cannot operate it on their own. At this level of technological complexity, distributing cognition is a necessary process for reducing cognitive load on individuals. Yet distributing cognition also imposes coordination costs as technological systems become larger and the individuals in these systems become more specialized. We describe a sprawling set of cultural innovations that facilitate cognitive distribution by reducing cognitive load, reducing coordination costs, or doing both. Preliminary evidence suggests that these cultural innovations co-evolve with technological complexity.
https://www.cell.com/trends/cognitive-sciences/fulltext/S1364-6613(25)00212-8

Trends in Ecology and Evolution

PAPERS

TANYA T. SHOOT et al – Is cognition at the root of plant behavior?

Information processing underlies the behavior of many species, including plants. However, there remains uncertainty about how plants integrate and use information, and whether this is analogous to animal cognition. We propose a conceptual and experimental framework, Plant Information Processing (PIP), that draws from advances in comparative psychology. Our framework challenges plants with increasingly complex processing tasks designed to reveal algorithmic patterns of information use. The PIP framework emphasizes not only behavioral outcomes, but also the associated errors, limitations, and biases, which reveal how information processing occurs in plants. This sequential, evidence-based strategy sidesteps semantic debates and facilitates meaningful cross-taxa comparisons that could advance the broader discipline of cognition.
https://www.cell.com/trends/ecology-evolution/abstract/S0169-5347(25)00322-2

Trends in Neurosciences

ARTICLES

SORAIA BARÃO & ULRICH MÜLLER – Basal progenitors as drivers of neocortical expansion

The diversification and expansion of distinct progenitor cell subtypes during embryogenesis are essential to form the sophisticated brain structures present in vertebrates. In particular, the emergence of highly proliferative basal progenitors contributed to the evolutionary enlargement of the mammalian neocortex. Basal progenitors are at the center of indirect neurogenesis and can be divided into two main subtypes: the classical TBR2-positive intermediate progenitor cells and the outer radial glial cells, which are especially abundant in gyrencephalic species. While the function of some transcriptomic regulators is conserved across the mammalian clade, recent studies have identified human-specific genes and enhancers that uniquely affect progenitor biology, possibly driving the increased neocortical complexity and disease-susceptibility of the human brain. Here, we review the evolution of basal progenitors, highlighting species-specific traits, molecular drivers of proliferation, and how imbalances in neurogenesis contribute to human brain disorders.
https://www.cell.com/trends/neurosciences/abstract/S0166-2236(25)00264-4

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