

EAORC BULLETIN 1,044 – 18 June 2023

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NOTICES

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.

EAORC NEWS – Did you know you have an EAORC Number?

No? That’s hardly surprising, I have never mentioned it before. It’s really only a way for me to keep count of the number of people who have passed through EAORC over time. So why am I mentioning it now? Because we have had a new member this week, and her number is ... 200! So welcome, Fiona, our first ducentesimal. EAORC now has 64 active members.

ACADEMIA.EDU – Nightmares, Shamans & Bears

Rosalind Frank (2023).

ROSALIND FRANK – Recuperating Europe’s Indigenous Animist Past: Nightmares, Shamans & Bears

In this study, among other things, we will be peeling back the layers of meaning associated with expressions linked etymologically to the English compound term nightmare, more specifically those connected to the second element -mare. Here the expression nightmare will be discussed using its earlier meaning, as referring to the ominous “sensed presence” of Sleep Paralysis (SP). And this meaning evokes the menacing spectral being who is said to attack people in their sleep, as it has been described in the literature dedicated to the subject of the SP. This earlier meaning contrasts with the more recent understanding that the term nightmare has acquired, namely, as a way to refer generically to a “bad dream”. This approach will allow us to move back in time to earlier, more elaborated narrative frames of reference that were once part of a complex animist worldview indigenous to Europe. In the process we will investigate the way that the syndrome called Sleep Paralysis (SP) fits into and acted to transmit this overarching animist cosmivision across the centuries.

https://www.academia.edu/103295108/Recuperating_Europes_Indigenous_Animist_Past_Nightmares_Shamans_and_Bears

NEWS

NATURE BRIEFING – Laotian cave rewrites migration story

Two human bone fragments — from a skull and a leg — have been unearthed in the Tam Pà Ling cave in Laos. The fossils are older than previous finds from the cave and suggest that early modern humans were in the area up to 86,000 years ago. That’s earlier than previously thought, and calls into question hypotheses that Homo sapiens dispersed out of Africa and through Asia in a single rapid event that happened after the ending of a geological period 80,000 years ago. “I can’t overestimate the importance of having another point on our map for early modern humans in southeast Asia,” says anthropologist Miriam Stark. “Understanding southeast Asia is critical to understanding the world’s deep history,” she says.

<https://nature.us17.list-manage.com/track/click?u=2c6057c528fdc6f73fa196d9d&id=c455defd3c&e=1db4b9a19b>

SCIENCE.ORG NEWS – Ancient humans traveled half the world to Asia before main migration out of Africa

Discovery deep in Laotian cave shows humans voyaged out of Africa by at least 68,000 years ago.

<https://www.science.org/content/article/ancient-humans-traveled-half-world-asia-main-migration-out-africa>

THE CONVERSATION – Of mice and matriarchs: the female-led societies of the animal kingdom

If you think relationships between male and female animals are simple, it's time to have a rethink.

<https://theconversationuk.cmail20.com/t/r-l-tttudrx-khhilillah-w/>

PUBLICATIONS

Acta Linguistica Hafniensia

PAPERS

LORENZO CIGANA & STÉPHANE POLIS – Hjelmslev, a forerunner of the semantic maps method in linguistic typology?

In this paper, we show that Hjelmslev's approach to language description and crosslinguistic comparison, on the one hand, and the semantic maps model used in linguistic typology, on the other, differ significantly. Although Hjelmslev paved the way for employing graphic representations as a means to show how each language of the world subdivides the semantic continuum in its own way, he can hardly be considered as a forerunner of the semantic maps tradition. In a nutshell, Hjelmslev's schemas are meant to compare the specific organisation of individual linguistic systems, but the semantic maps method aims at unveiling semantic regularities across languages. The former targets the particular 'grid' imposed by each language on a given semantic space, but the latter abstracts away from specific linguistic systems and posits universal atoms of sense that can be organised in cross-linguistically valid networks.

<https://www.tandfonline.com/doi/abs/10.1080/03740463.2023.2210495>

Animal Behaviour

PAPERS

FRIEDERIKE ZENTH et al – The (surprising) importance of males in a matrilineal society: behavioural insights from a topological knockout study

Social group structure often has consequences for individual fitness and ecological and evolutionary processes, but group structure is not fixed because of demographic processes: individuals die, disperse or are recruited into social groups. Thus, it is important to understand how demographic social roles and the loss of individuals with different roles modify group structure. We studied yellow-bellied marmots, *Marmota flaviventris*, and performed a series of statistical/topological knockouts on observed marmot social networks to investigate how the social roles of individuals from specific age–sex categories (adult/yearling, males/females) contribute to group social structure and to ask whether the loss of different roles has varying structural effects. We focused on five central aspects of overall social structure: density, the global clustering coefficient, reciprocity, global degree centrality and the coefficient of variation of strength. Somewhat surprisingly, given that marmots live in matrilineal societies, our knockout results suggested that males played a key role in shaping networks: yearling males were a key cohesive element and adult males were central players in agonistic networks. Thus, social networks are dynamic and their structure is shaped in the interplay of demographic processes and individual social behaviour.

<https://www.sciencedirect.com/science/article/pii/S0003347223001069>

C. VILLETTE et al – Strong ties formation, composition and processes at play during the developmental period of juvenile vervet monkeys

Understanding the development of social relationships can provide insights into the processes by which social network structures emerge and vary across species. Here we extend a previous analysis (Vilette et al., 2022, *Animal Behaviour*, 194, 205–223) that tested Kohn's (2019, *Animal Behaviour*, 154, 1–6) model of social relationship formation in three groups of wild juvenile vervet monkeys, *Chlorocebus pygerythrus*. This previous analysis showed that, although developmental patterns did not conform to the exploration, pruning and consolidation phases identified by Kohn (2019), juveniles formed a core of strong social ties (a social 'bubble') across development. Here, we use a novel approach to objectively extract strong ties and ask whether Kohn's (2019) phases are more appropriately evaluated with reference to the subset of strong ties that constitute social bubbles. We investigate social bubble formation and composition, as well as the role of maternal behaviour in the development of these bubbles. As before, spatial and grooming social bubbles did not develop according to Kohn's (2019) framework. On the one hand, spatial bubbles were composed mainly of juveniles and showed increased association rates for family members during the annual birth season. Juvenile grooming bubbles, on the other hand, were stable over time and restricted solely to their mothers. Resulting from this, we found that juveniles did not simply groom their closest spatial associates but distributed their grooming towards specific partners. Finally, we found that a mother's grooming ties and her offspring's grooming weak ties remained mostly different as juveniles developed. This finding supports a previous analysis on our population (Jarrett et al., 2018, *Proceedings of the Royal Society B: Biological Sciences*, 285(1876), Article 20172668), where juveniles had to develop connections with nonmaternal associates in order to replicate the overall grooming network. These results indicate that the structure and composition of social bubbles in our sample reflect both the behaviour under consideration (grooming or spatial proximity) and group demography.

<https://www.sciencedirect.com/science/article/pii/S0003347223001136>

EMMA DOHERTY, MARINA DAVILA-ROSS & ZANNA CLAY – Multimodal communication development in semiwild chimpanzees

Human language is characterized by the integration of multiple signal modalities, including speech, facial and gestural signals. While language likely has deep evolutionary roots that are shared with some of our closest living relatives, studies of great ape communication have largely focused on each modality separately, thus hindering insights into the origins of its multimodal nature. Studying when multimodal signals emerge during great ape ontogeny can inform about both the proximate and ultimate mechanisms underlying their communication systems, shedding light on potential evolutionary continuity between humans and other apes. To this end, the current study investigated developmental patterns of multimodal signal production by 28 semiwild chimpanzees, *Pan troglodytes*, ranging in age from infancy to early adolescence. We examined the production of facial expressions, gestures and vocalizations across a range of behavioural contexts, both when produced separately and as part of multimodal signal combinations (henceforth multimodal). Overall, we found that while unimodal signals were produced consistently more often than multimodal combinations across all ages and contexts, the frequency of multimodal combinations increased significantly in older individuals and most within the aggression and play contexts, where the costs of signalling ambiguity may be higher. Furthermore, older individuals were more likely to produce a multimodal than a unimodal signal and, again, especially in aggressive contexts. Variation in production of individual signal modalities across ages and contexts are also presented and discussed. Overall, evidence that multimodality increases with age in chimpanzees is consistent with patterns of developing communicative complexity in human infancy, revealing apparent evolutionary continuity. Findings from this study contribute novel insights into the evolution and development of multimodality and highlight the importance of adopting a multimodal approach in the comparative study of primate communication.

<https://www.sciencedirect.com/science/article/pii/S0003347223000878>

COLIN DUBREUIL et al with LOUISE BARRETT & PETER S. HENZI – Age differences in the responses of vervet monkeys, *Chlorocebus pygerythrus*, to terrestrial alarm calls

The high costs of predation and the opportunity costs associated with predator avoidance are likely to select for flexibility in the development of antipredator responses based on local socioecological conditions. As group size is hypothesized to vary across populations as a function of predation risk, the development of antipredator behaviours throughout ontogeny may be influenced by the size of an individual's social group. Here, we explore the development of alarm call responses in wild vervet monkeys living at the Samara Game Reserve, South Africa. Vervet monkeys at this site live in relatively large social groups, and adult responses to alarms have previously shown less uniformity than in other sites where group sizes are smaller. We presented monkeys playback recordings of terrestrial alarm calls produced by individuals of different age–sex classes. We then videorecorded and scored the responses of receivers along an ordinal maturity scale. We used a mixed-effects ordinal logistic regression model within a Bayesian framework to explore how response intensity is affected by the age–sex of the caller, and the age of receivers. Our analysis showed that younger monkeys (<2 years old) exhibit strong evasive responses to call stimuli, regardless of the age–sex class of the caller. The intensity of these responses decreases with age, with responses to nonalarm calls decreasing earlier in development than responses to alarm calls. Adult responses to alarm calls in this population are as likely to be characterized by a general increase in vigilance as they are to consist of an evasive response. We suggest that responses in younger individuals at Samara are mediated by generalized startle responses to loud, plosive noises. Development of more specific responses throughout ontogeny is likely to be dependent on learning from adult models, whose milder responses reflect local socioecological conditions specific to Samara.

<https://www.sciencedirect.com/science/article/pii/S0003347223001070>

MATTHEW J. SILK – Conceptual representations of animal social networks: an overview

Networks are now widely used to represent, quantify and model animal behaviour. These approaches have proved valuable in linking individual behaviours to emergent population level patterns and quantifying the implications of these population structures for wider ecological and evolutionary processes. However, there are diverse conceptual representations of network data and choosing the right tool to answer a particular question can be challenging. Here I provide an overview of different network representations, highlighting their potential applications in behavioural ecology and drawing attention to key resources to help with their implementation. My aim is to provide an accessible guide that helps behavioural ecologists take full advantage of the potential of the different ways in which their data can be used to generate social other networks.

<https://www.sciencedirect.com/science/article/pii/S0003347223001100>

Cell Reports**ARTICLES****PASCAL BELIN, RÉGIS TRAPEAU & MANON OBLIGER-DEBOUCHE – A small, but vocal, brain**

Common marmosets (*Callitrix jacchus*) are small new-world primates that diverged from the human lineage approximately 35 million years ago. Because of their complex social organization, high reproduction rate even in captivity, and small brain with very few cortical sulci they have become an increasingly valuable model in neuroscience.² They are also highly vocal, with a complex call repertoire used in many social contexts, suggesting the existence of cerebral mechanisms for processing voice

information. Yet up until now, only a single publication has hinted at the existence of cortical areas selective for vocalizations in the marmoset brain.³

In the May issue of Cell Reports, Jafari et al.¹ brought crucial new data that shed detailed light on a network of voice-sensitive brain areas in marmosets. They used functional magnetic resonance imaging (fMRI, a technique measuring blood oxygenation as an indirect index of neuronal activity) to scan marmosets during auditory stimulation.

[https://www.cell.com/cell-reports/fulltext/S2211-1247\(23\)00662-9](https://www.cell.com/cell-reports/fulltext/S2211-1247(23)00662-9)

eLife

PAPERS

VICTORIA J.H. RITVO et al – Differentiation and Integration of Competing Memories: A Neural Network Model

What determines when neural representations of memories move together (integrate) or apart (differentiate)? Classic supervised learning models posit that, when two stimuli predict similar outcomes, their representations should integrate. However, these models have recently been challenged by studies showing that pairing two stimuli with a shared associate can sometimes cause differentiation, depending on the parameters of the study and the brain region being examined. Here, we provide a purely unsupervised neural network model that can explain these and other related findings. The model can exhibit integration or differentiation depending on the amount of activity allowed to spread to competitors — inactive memories are not modified, connections to moderately active competitors are weakened (leading to differentiation), and connections to highly active competitors are strengthened (leading to integration). The model also makes several novel predictions — most importantly, that differentiation will be rapid and asymmetric. Overall, these modeling results provide a computational explanation for a diverse set of seemingly contradictory empirical findings in the memory literature, as well as new insights into the dynamics at play during learning.

<https://elifesciences.org/reviewed-preprints/88608>

Frontiers in Earth Science

PAPERS

YIYUAN LI et al – Lithic technological strategies of Late Pleistocene hominins in the Daoshui River valley, Hunan province, central South China

The Late Pleistocene is a crucial period of dramatic changes in lithic technologies as well as interactions between modern humans and other archaic human groups. In this paper, we describe the technological analysis of lithic assemblages collected from 28 newly discovered Paleolithic sites along the Daoshui River, a tributary of the Lishui River (itself a tributary of Yangtze River) in northern Hunan Province, central South China. Luminescence dating of several sites in this region has provided a general Late Pleistocene age range for lithic assemblages. Technologically, high quality raw materials are predominantly exploited (e.g., chert and siliceous slate) and direct hard hammer percussion predominates which lacks the classic Levallois technology though conceptually, some specimens do exhibit a certain degree of volumetric control and share other common features with prepared cores, here we tentatively define them as “simply prepared cores.” Small flakes and flake tool production plays a primary role in the overall technological strategy, accompanying a small proportion of large flakes and Large Cutting Tools production. Our examination of lithic technologies in the region clearly contrasts with the traditional view of South China being characterized by a simple cobble tool industry over the course of the Pleistocene period. We further discuss the issue of the Middle Paleolithic in China, as well as the ecological adaptations of hominins in the Daoshui River valley within a Late Pleistocene climatic context.

<https://www.frontiersin.org/articles/10.3389/feart.2023.1133499/full>

Frontiers in Ecology and Evolution

PAPERS

GISELA KAPLAN – Evolution of human language: duetting as part of prosociality and cognition

The evolution of human language is a topic that has received undiminished attention. Numerous hypotheses for the origin of human language have been proposed, including gestural communication found specifically among apes. This study advances the hypothesis that human evolution, including human language development, is three-pronged: prosocial, cognitive, and collaborative. Duetting and turn-taking in primates are used as pivotal examples of how bonding leads to joint action and collaboration. It points out that such vocal behavior itself may be a crucial precursor of language evolution in the sense that it is explicitly focused on a conspecific. Some current hypotheses have acknowledged duetting as an important perceptual and behavioral example of synchronicity. Some forms of synchronized behavior, as found in duetting, synchronized dance, or even shared song, were perhaps crucial evolutionary steps preceding the evolution of human language. Duetting signifies more than that, however, because it is an observable and significant cognitive investment that signals attention toward a partner. This study also advances the hypothesis that affect and cognition would have needed to precede any form of duetting or signs of affiliation such as grooming. Hence, this study, asking what duetting in primates signifies in evolutionary terms, takes a multidisciplinary and multimodal approach to suggest important affective and cognitive steps in the evolution of human language and speech, the chief of which is prosociality. Prosociality, as an attitude and awareness of another, be

this as a friend or partner for whom one can do favors or whom one can help, is a model for collaboration and cooperation, and also increased cognition.

<https://www.frontiersin.org/articles/10.3389/fevo.2023.1004384/full>

Frontiers in Psychology

PAPERS

RICARDA I. SCHUBOTZ et al – Tool mastering today – an interdisciplinary perspective

Tools have coined human life, living conditions, and culture. Recognizing the cognitive architecture underlying tool use would allow us to comprehend its evolution, development, and physiological basis. However, the cognitive underpinnings of tool mastering remain little understood in spite of long-time research in neuroscientific, psychological, behavioral and technological fields. Moreover, the recent transition of tool use to the digital domain poses new challenges for explaining the underlying processes. In this interdisciplinary review, we propose three building blocks of tool mastering: (A) perceptual and motor abilities integrate to tool manipulation knowledge, (B) perceptual and cognitive abilities to functional tool knowledge, and (C) motor and cognitive abilities to means-end knowledge about tool use. This framework allows for integrating and structuring research findings and theoretical assumptions regarding the functional architecture of tool mastering via behavior in humans and non-human primates, brain networks, as well as computational and robotic models. An interdisciplinary perspective also helps to identify open questions and to inspire innovative research approaches. The framework can be applied to studies on the transition from classical to modern, non-mechanical tools and from analogue to digital user-tool interactions in virtual reality, which come with increased functional opacity and sensorimotor decoupling between tool user, tool, and target. By working towards an integrative theory on the cognitive architecture of the use of tools and technological assistants, this review aims at stimulating future interdisciplinary research avenues.

<https://www.frontiersin.org/articles/10.3389/fpsyg.2023.1191792/full>

iScience

PAPERS

WENDY M. ERB et al – Wildfire smoke linked to vocal changes in wild Bornean orangutans

Tropical peatlands are the sites of Earth's largest fire events, with outsized contributions to greenhouse gases, toxic smoke, and haze rich with particulate matter. The human health risks from wildfire smoke are well known, but its effects on wildlife inhabiting these ecosystems are poorly understood. In 2015, peatland fires on Borneo created a thick haze of smoke that blanketed the region. We studied its effects on the long call vocalizations of four adult male Bornean orangutans (*Pongo pygmaeus wurmbii*) in a peat swamp forest. During the period of heavy smoke, orangutans called less often and showed reduced vocal quality – lower pitch, increased harshness and perturbations, and more nonlinear phenomena – similar to changes in human smokers. Most of these changes persisted for two months after the smoke had cleared and likely signal changes in health. Our work contributes valuable information to support non-invasive acoustic monitoring of this Critically Endangered primate.

[https://www.cell.com/iscience/fulltext/S2589-0042\(23\)01165-3](https://www.cell.com/iscience/fulltext/S2589-0042(23)01165-3)

Language Sciences

PAPERS

HENG CHEN & YAQIN WANG – How does language evolve as a multi-level system? A quantitative exploration of written Chinese

Hierarchy has been described as the backbone of a language system. However, how language evolves as a multi-level system has not been explored quantitatively based on authentic language materials. The Menzerath–Altmann law (MAL) is a statistical linguistic universal that can capture the complex relationships between language units at neighboring levels. Using the MAL, the present study explored the evolution of two regularly examined partial hierarchies in written Chinese, i.e., “clause-word-character” and “sentence-clause-word” across five periods of two millennia. The results indicate that the hierarchy in the Pre-Qin Period (Period 1) is quite different from the others since its linguistic units of character and word overlap to some extent. The two partial hierarchies show opposite evolutionary trends in the following four periods. The hierarchy fades at the “clause-word-character” levels. Nevertheless, it increases significantly at the “sentence-clause-word” levels. The evolutions are accompanied by a constant increase in word length and accelerated growth in clause length and sentence length/complexity. The findings are finally explained from the perspective of the Complex Adaptive System (CAS) theory.

<https://www.sciencedirect.com/science/article/pii/S0388000123000190>

Mind & Language

PAPERS

ROSS PAIN – Stone tools, predictive processing and the evolution of language

Recent work by Stout and colleagues indicates that the neural correlates of language and Early Stone Age toolmaking overlap significantly. The aim of this paper is to add computational detail to their findings. I use an error minimisation model to outline where the information processing overlap between toolmaking and language lies. I argue that the Early Stone Age signals the emergence of complex structured representations. I then highlight a feature of my account: It allows us to understand the early evolution of syntax in terms of an increase in the number and complexity of models in a cognitive system, rather than the development of new types of processing.

<https://onlinelibrary.wiley.com/doi/full/10.1111/mila.12419>

ELMAR UNNSTEINSSON – The social epistemology of introspection

I argue that introspection recruits the same mental mechanism as that which is required for the production of ordinary speech acts. In introspection, in effect, we intentionally tell ourselves that we are in some mental state, aiming thereby to produce belief about that state in ourselves. On one popular view of speech acts, however, this is precisely what speakers do when speaking to others. On this basis, I argue that every bias discovered by social epistemology applies to introspection and other forms of self-directed representation. If so, it becomes unclear in what sense social epistemology is social.

<https://onlinelibrary.wiley.com/doi/full/10.1111/mila.12438>

Nature

NEWS

Laos cave fossils prompt rethink of human migration map

A skull fragment and shin bone suggest that early modern humans might have passed through southeast Asia earlier than thought.

<https://www.nature.com/articles/d41586-023-01903-3>

Morality is declining, right? Scientists say that idea is an illusion

Surveys show people around the world have believed for decades that morals are decaying — but other survey data contradict that perception.

<https://www.nature.com/articles/d41586-023-01848-7>

ARTICLES

LOUISE HUMPHREY & ABDELJALIL BOUZOUGGAR – Ancient DNA reveals how farming spread into northwest Africa

Genomic data from bones and teeth found at archaeological sites across Morocco paint a picture of how Neolithic farmers and pastoralists spread into northwest Africa that is more complex than previously thought.

<https://www.nature.com/articles/d41586-023-01768-6>

PAPERS

LUCIANA G. SIMÕES et al – Northwest African Neolithic initiated by migrants from Iberia and Levant

In northwestern Africa, lifestyle transitioned from foraging to food production around 7,400 years ago but what sparked that change remains unclear. Archaeological data support conflicting views: (1) that migrant European Neolithic farmers brought the new way of life to North Africa^{1,2,3} or (2) that local hunter-gatherers adopted technological innovations^{4,5}. The latter view is also supported by archaeogenetic data⁶. Here we fill key chronological and archaeogenetic gaps for the Maghreb, from Epipalaeolithic to Middle Neolithic, by sequencing the genomes of nine individuals (to between 45.8- and 0.2-fold genome coverage). Notably, we trace 8,000 years of population continuity and isolation from the Upper Palaeolithic, via the Epipalaeolithic, to some Maghrebi Neolithic farming groups. However, remains from the earliest Neolithic contexts showed mostly European Neolithic ancestry. We suggest that farming was introduced by European migrants and was then rapidly adopted by local groups. During the Middle Neolithic a new ancestry from the Levant appears in the Maghreb, coinciding with the arrival of pastoralism in the region, and all three ancestries blend together during the Late Neolithic. Our results show ancestry shifts in the Neolithization of northwestern Africa that probably mirrored a heterogeneous economic and cultural landscape, in a more multifaceted process than observed in other regions.

<https://www.nature.com/articles/s41586-023-06166-6>

Nature Africa

NEWS

A new model of human origins in Africa

Genetically differentiated Homo populations have been mixing for hundreds of thousands of years.

<https://www.nature.com/articles/d44148-023-00145-9>

Nature Communications

PAPERS

SARAH E. FREIDLIN et al with JEAN-JACQUES HUBLIN – Early presence of Homo sapiens in Southeast Asia by 86–68 kyr at Tam Pà Ling, Northern Laos

The timing of the first arrival of Homo sapiens in East Asia from Africa and the degree to which they interbred with or replaced local archaic populations is controversial. Previous discoveries from Tam Pà Ling cave (Laos) identified H. sapiens in Southeast Asia by at least 46 kyr. We report on a recently discovered frontal bone (TPL 6) and tibial fragment (TPL 7) found in the deepest layers of TPL. Bayesian modeling of luminescence dating of sediments and U-series and combined U-series-ESR dating of mammalian teeth reveals a depositional sequence spanning ~86 kyr. TPL 6 confirms the presence of H. sapiens by 70 ± 3 kyr, and TPL 7 extends this range to 77 ± 9 kyr, supporting an early dispersal of H. sapiens into Southeast Asia. Geometric morphometric analyses of TPL 6 suggest descent from a gracile immigrant population rather than evolution from or admixture with local archaic populations.

<https://www.nature.com/articles/s41467-023-38715-y>

Nature Communications Biology

PAPERS

ALEXANDRA A. DE SOUSA et al with CHET C. SHERWOOD – From fossils to mind

Fossil endocasts record features of brains from the past: size, shape, vasculature, and gyrification. These data, alongside experimental and comparative evidence, are needed to resolve questions about brain energetics, cognitive specializations, and developmental plasticity. Through the application of interdisciplinary techniques to the fossil record, paleoneurology has been leading major innovations. Neuroimaging is shedding light on fossil brain organization and behaviors. Inferences about the development and physiology of the brains of extinct species can be experimentally investigated through brain organoids and transgenic models based on ancient DNA. Phylogenetic comparative methods integrate data across species and associate genotypes to phenotypes, and brains to behaviors. Meanwhile, fossil and archeological discoveries continuously contribute new knowledge. Through cooperation, the scientific community can accelerate knowledge acquisition. Sharing digitized museum collections improves the availability of rare fossils and artifacts. Comparative neuroanatomical data are available through online databases, along with tools for their measurement and analysis. In the context of these advances, the paleoneurological record provides ample opportunity for future research. Biomedical and ecological sciences can benefit from paleoneurology's approach to understanding the mind as well as its novel research pipelines that establish connections between neuroanatomy, genes and behavior.

<https://www.nature.com/articles/s42003-023-04803-4>

Nature Humanities & Social Sciences Communications

PAPERS

CHENGCHENG YOU – Genre, tradition and renewal: Animal autobiography and poetics of the multicentric self

The development of animal autobiography as a genre has been constrained by the narrative possibility and epistemological impossibility of animals as autobiographers. In spite of its limitations, animal autobiography has still developed into different generic forms. Noting the generic tradition and renewal as well as the ethical ramifications in animal autobiography, this study examines how animal selfhood is constructed to render varieties of autobiographical experiences. Drawn upon autofiction/autobiography studies and literary animal studies, this article probes into the art of self-invention in animal autobiography. A “self”-oriented analysis of Dorothy Kilner's *The Life and Perambulations of A Mouse* (1784) and Anna Sewell's *Black Beauty* (1877) reveals the genre's common representational strategies, such as multi-scaled perceptions of an autofictional self, critical anthropomorphism and an ethics of witness. Based on these strategies, it further examines how Katherine Applegate's *The One and Only Ivan* (2012) endorses a generic continuum and renewal. Following Jacques Derrida's key concepts in his lecture “The Animal that Therefore I Am” in the discourse of human–animal relations, this study concludes with a proposed poetics of the multicentric self in animal autobiography, which maps out the interplay of the first-person persona's authenticity, autofiction and literary authority, and serves the genre's increasingly prominent anti-anthropocentric purposes.

<https://www.nature.com/articles/s41599-023-01827-3>

ADRIAN KWEK et al – Distractions, analytical thinking and falling for fake news: A survey of psychological factors

Analytical thinking safeguards us against believing or spreading fake news. In various forms, this common assumption has been reported, investigated, or implemented in fake news education programs. Some have associated this assumption with the inverse claim, that distractions from analytical thinking may render us vulnerable to believing or spreading fake news. This paper surveys the research done between 2016 and 2022 on psychological factors influencing one's susceptibility to believing or spreading fake news, considers which of the psychological factors are plausible distractors to one's exercise of analytical thinking, and discusses some implications of considering them as distractors to analytical thinking. From these, the paper draws five conclusions: (1) It is not analytical thinking per se, but analytical thinking directed to evaluating the truth

that safeguards us from believing or spreading fake news. (2) While psychological factors can distract us from exercising analytical thinking and they can also distract us in exercising analytical thinking. (3) Whether a psychological factor functions as a distractor from analytical thinking or in analytical thinking may depend on contextual factors. (4) Measurements of analytical thinking may not indicate vulnerability to believing or spreading fake news. (5) The relevance of motivated reasoning to our tendency to believe fake news should not yet be dismissed. These findings may be useful to guide future research in the intersection of analytical thinking and susceptibility to believing or spreading fake news.

<https://www.nature.com/articles/s41599-023-01813-9>

Nature Scientific Reports

PAPERS

SOLANGE RIGAUD et al with JEAN-JACQUES HUBLIN – Symbolic innovation at the onset of the Upper Paleolithic in Eurasia shown by the personal ornaments from Tolbor-21 (Mongolia)

Figurative depictions in art first occur ca. 50,000 years ago in Europe, Africa, and Southeast Asia. Considered by most as an advanced form of symbolic behavior, they are restricted to our species. Here, we report a piece of ornament interpreted as a phallus-like representation. It was found in a 42,000 ca.-year-old Upper Paleolithic archaeological layer at the open-air archaeological site of Tolbor-21, in Mongolia. Mineralogical, microscopic, and rugosimetric analyses points toward the allochthonous origin of the pendant and a complex functional history. Three-dimensional phallic pendants are unknown in the Paleolithic record, and this discovery predates the earliest known sexed anthropomorphic representation. It attests that hunter-gatherer communities used sex anatomical attributes as symbols at a very early stage of their dispersal in the region. The pendant was produced during a period that overlaps with age estimates for early introgression events between *Homo sapiens* and Denisovans, and in a region where such encounters are plausible.

<https://www.nature.com/articles/s41598-023-36140-1>

ANNA MARIA KUBICKA – Changes in plasticity of the pelvic girdle from infancy to late adulthood in *Homo sapiens*

Previous research on the effects of body mass on the pelvic girdle focused mostly on adult females and males. Because the ontogenetic plasticity level in the pelvis remains largely unknown, this study investigated how the association between body mass index (BMI) and pelvic shape changes during development. It also assessed how the large variation in pelvic shape could be explained by the number of live births in females. Data included CT scans of 308 humans from infancy to late adulthood with known age, sex, body mass, body stature, and the number of live births (for adult females). 3D reconstruction and geometric morphometrics was used to analyze pelvic shape. Multivariate regression showed a significant association between BMI and pelvic shape in young females and old males. The association between the number of live births and pelvic shape in females was not significant. Less plasticity in pelvic shape in adult females than during puberty, perhaps reflects adaptation to support the abdominopelvic organs and the fetus during pregnancy. Non-significant susceptibility to BMI in young males may reflect bone maturation accelerated by excessive body mass. Hormonal secretion and biomechanical loading associated with pregnancy may not have a long-term effect on the pelvic morphology of females.

<https://www.nature.com/articles/s41598-023-36703-2>

MASAAKI INABA & EIZO AKIYAMA – Evolution of cooperation in multiplex networks through asymmetry between interaction and replacement

Cooperation is the foundation of society and has been the subject of numerous studies over the past three decades. However, the mechanisms underlying the spread of cooperation within a group are not yet fully comprehended. We analyze cooperation in multiplex networks, a model that has recently gained attention for successfully capturing certain aspects of human social connections. Previous studies on the evolution of cooperation in multiplex networks have shown that cooperative behavior is promoted when the two key processes in evolution, interaction and strategy replacement, are performed with the same partner as much as possible, that is, symmetrically, in a variety of network structures. We focus on a particular type of symmetry, namely, symmetry in the scope of communication, to investigate whether cooperation is promoted or hindered when interactions and strategy replacements have different scopes. Through multiagent simulations, we found some cases where asymmetry can promote cooperation, contrasting with previous studies. These results hint toward the potential effectiveness of not only symmetrical but also asymmetrical approaches in fostering cooperation within particular groups under certain social conditions.

<https://www.nature.com/articles/s41598-023-37074-4>

VINCENT BUSKENS et al – Social preferences trump emotions in human responses to unfair offers

People commonly reject unfair offers even if this leaves them worse off. Some explain this as a rational response based on social preferences. Others argue that emotions override self-interest in the determination of rejection behavior. We conducted an experiment in which we measured responders' biophysical reactions (EEG and EMG) to fair and unfair offers. We measured biophysical trait anger using resting-state EEG (frontal alpha-asymmetry), state anger using facial expressions, offer expectancy processing using event-related EEG (medial-frontal negativity; MFN) and self-reported emotions. We systematically varied whether rejections led proposers to lose their share (Ultimatum Game; UG) or not (Impunity Game; IG). Results favor preference-based accounts: Impunity minimizes rejection despite increasing subjectively reported anger. Unfair

offers evoke frowning responses, but frowning does not predict rejection. Prosocial responders reject unfair UG offers more often after unmet fairness expectations. These results suggest that responders do not reject unfairness out of anger. Rather, people seem motivated to reject unfair offers when they violate their behavioral code but only when rejection has payoff consequences for the proposer, allowing them to reciprocate and restore equity. Thus, social preferences trump emotions when responding to unfair offers.

<https://www.nature.com/articles/s41598-023-36715-y>

New Scientist

NEWS

Male harbour seals may learn vocalisations years before they need them

Male harbour seals use vocalisations to woo females and they appear to learn these songs years before they need them.

<https://www.newscientist.com/article/2377854-male-harbour-seals-may-learn-vocalisations-years-before-they-need-them/>

How your brain stays focused on conversations in a noisy room

The brain processes voices differently depending on the volume of the speaker and if the listener is focused on them.

<https://www.newscientist.com/article/2377141-how-your-brain-stays-focused-on-conversations-in-a-noisy-room/>

ARTICLES

ANDREA VALENTINO – The unique, vanishing languages that hold secrets about how we think

Language isolates, like Chimané from Bolivia, are unrelated to any other known tongue. Studying them is revealing how languages evolve and influence our perception of the world around us.

<https://www.newscientist.com/article/mg25834430-800-the-unique-vanishing-languages-that-hold-secrets-about-how-we-think/>

Philosophical Transactions of the Royal Society B

PAPERS

EDITOR'S NOTE – Chimpanzee vowel-like sounds and voice quality suggest formant space expansion through the hominoid lineage

This article corrects the following: Phil. Trans. R. Soc. B 377, 20200455. (Published online 15 November 2021)

(<https://doi.org/10.1098/rstb.2020.0455>)

This is an update to the Expression of concern (Published online 26 December 2022):

<https://doi.org/10.1098/rstb.2022.0476>.

The journal's editorial team wish to update readers on this investigation which is ongoing.

The authors acknowledge that there are problems with the analyses in this paper, and they are currently re-analysing the data. The response will be independently reviewed and either a correction or retraction will be published in due course.

<https://royalsocietypublishing.org/doi/full/10.1098/rstb.2023.0201>

Philosophy Now

PAPERS

ANDREW KEMLE – Can You Be Both A Moral Rationalist & A Moral Sentimentalist?

One of the major discoveries in the social sciences over the past few decades has been that people have innate other-regarding preferences. This means that we generally take other people's interests and well-being into account when making decisions, and that although socialization can affect the strength of these preferences, we have them as part of our genetic make-up. We are born with them. Other-regarding preferences, in fact, appear to have a deep evolutionary history. Not only do other primates display signs of empathy and concern for their peers, but so do animals separated from us by hundreds of millions of years of separate evolutionary development, such as some insects and possibly certain species of octopi (Peter Godfrey-Smith's 2016 book *Other Minds* is highly enlightening in this regard).

https://philosophynow.org/issues/156/Can_You_Be_Both_A_Moral_Rationalist_and_A_Moral_Sentimentalist

PLoS One

PAPERS

HILA REEM & MAOR ZEEV-WOLF – Ostracism and sharing in an intergroup context

Previous research suggests that social exclusion is linked to a decrease in individuals' prosocial behavior. However, this effect has not been examined in an intergroup context. We manipulated social acceptance (using the Cyberball game) to examine participants' sharing with ingroup or outgroup members in a minimal group paradigm. Results revealed that when the prospective recipient was a group member who rejected them, socially excluded participants shared less than their socially accepted counterparts. However, when faced with members of an outgroup, socially excluded participants showed similar levels of prosocial behavior as their socially accepted counterparts. Further results suggest that the tendency of socially

excluded participants to act in a less prosocial manner toward members of a group that had rejected them was generalized to the group as a whole (including group members with whom there had been no previous interaction). We discuss the theoretical and practical implications of these findings.

<https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0287096>

MALVINA BAUMANN et al – On the Quina side: A Neanderthal bone industry at Chez-Pinaud site, France

Did Neanderthal produce a bone industry? The recent discovery of a large bone tool assemblage at the Neanderthal site of Chagyrskaya (Altai, Siberia, Russia) and the increasing discoveries of isolated finds of bone tools in various Mousterian sites across Eurasia stimulate the debate. Assuming that the isolate finds may be the tip of the iceberg and that the Siberian occurrence did not result from a local adaptation of easternmost Neanderthals, we looked for evidence of a similar industry in the Western side of their spread area. We assessed the bone tool potential of the Quina bone-bed level currently under excavation at chez Pinaud site (Jonzac, Charente-Maritime, France) and found as many bone tools as flint ones: not only the well-known retouchers but also beveled tools, retouched artifacts and a smooth-ended rib. Their diversity opens a window on a range of activities not expected in a butchering site and not documented by the flint tools, all involved in the carcass processing. The re-use of 20% of the bone blanks, which are mainly from large ungulates among faunal remains largely dominated by reindeer, raises the question of blank procurement and management. From the Altai to the Atlantic shore, through a multitude of sites where only a few objects have been reported so far, evidence of a Neanderthal bone industry is emerging which provides new insights on Middle Paleolithic subsistence strategies.

<https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0284081>

Proceedings of the Royal Society B

PAPERS

VELISAR MANEA et al – An initial but receding altercentric bias in preverbal infants' memory

Young learners would seem to face a daunting challenge in selecting to what they should attend, a problem that may have been exacerbated in human infants by changes in carrying practices during human evolution. A novel theory proposes that human infant cognition has an altercentric bias whereby early in life, infants prioritize encoding events that are the targets of others' attention. We tested for this bias by asking whether, when the infant and an observing agent have a conflicting perspective on an object's location, the co-witnessed location is better remembered. We found that 8- but not 12-month-olds expected the object to be at the location where the agent had seen it. These findings suggest that in the first year of life, infants may prioritize the encoding of events to which others attend, even though it may sometimes result in memory errors. However, the disappearance of this bias by 12 months suggests that altercentricism is a feature of very early cognition. We propose that it facilitates learning at a unique stage in the life history when motoric immaturity limits infants' interaction with the environment; at this stage, observing others could maximally leverage the information selection process.

<https://royalsocietypublishing.org/doi/full/10.1098/rspb.2023.0738>

MIA LYBKÆR KRONBORG NIELSEN et al – Temporal dynamics of mother–offspring relationships in Bigg's killer whales: opportunities for kin-directed help by post-reproductive females

Age-related changes in the patterns of local relatedness (kinship dynamics) can be a significant selective force shaping the evolution of life history and social behaviour. In humans and some species of toothed whales, average female relatedness increases with age, which can select for a prolonged post-reproductive lifespan in older females due to both costs of reproductive conflict and benefits of late-life helping of kin. Killer whales (*Orcinus orca*) provide a valuable system for exploring social dynamics related to such costs and benefits in a mammal with an extended post-reproductive female lifespan. We use more than 40 years of demographic and association data on the mammal-eating Bigg's killer whale to quantify how mother–offspring social relationships change with offspring age and identify opportunities for late-life helping and the potential for an intergenerational reproductive conflict. Our results suggest a high degree of male philopatry and female-biased budding dispersal in Bigg's killer whales, with some variability in the dispersal rate for both sexes. These patterns of dispersal provide opportunities for late-life helping particularly between mothers and their adult sons, while partly mitigating the costs of mother–daughter reproductive conflict. Our results provide an important step towards understanding why and how menopause has evolved in Bigg's killer whales.

<https://royalsocietypublishing.org/doi/full/10.1098/rspb.2023.0139>

LINNÉA M. BÅVIK, ROHAN S. MEHTA & DANIEL B. WEISSMAN – Fifty shades of greenbeard: robust evolution of altruism based on similarity of complex phenotypes

We study the evolution of altruistic behaviour under a model where individuals choose to cooperate by comparing a set of continuous phenotype tags. Individuals play a donation game and only donate to other individuals that are sufficiently similar to themselves in a multidimensional phenotype space. We find the generic maintenance of robust altruism when phenotypes are multidimensional. Selection for altruism is driven by the coevolution of individual strategy and phenotype; altruism levels shape the distribution of individuals in phenotype space. Low donation rates induce a phenotype distribution that renders the population vulnerable to the invasion of altruists, whereas high donation rates prime a population for cheater invasion, resulting in cyclic dynamics that maintain substantial levels of altruism. Altruism is therefore robust to invasion by cheaters in

the long term in this model. Furthermore, the shape of the phenotype distribution in high phenotypic dimension allows altruists to better resist the invasion by cheaters, and as a result the amount of donation increases with increasing phenotype dimension. We also generalize previous results in the regime of weak selection to two competing strategies in continuous phenotype space, and show that success under weak selection is crucial to success under strong selection in our model. Our results support the viability of a simple similarity-based mechanism for altruism in a well-mixed population.

<https://royalsocietypublishing.org/doi/abs/10.1098/rspb.2022.2579>

BUSHRA MOUSSAOUI et al – Evidence for maintenance of key components of vocal learning in ageing budgerigars despite diminished affiliative social interaction

In some species, the ability to acquire new vocalizations persists into adulthood and may be an important mediator of social interactions. While it is generally assumed that vocal learning persists undiminished throughout the lifespan of these open-ended learners, the stability of this trait remains largely unexplored. We hypothesize that vocal learning exhibits senescence, as is typical of complex cognitive traits, and that this decline relates to age-dependent changes in social behaviour. The budgerigar (*Melopsittacus undulatus*), an open-ended learner that develops new contact call types that are shared with social associates upon joining new flocks, provides a robust assay for measuring the effects of ageing on vocal learning ability. We formed captive flocks of 4 previously unfamiliar adult males of the same age class, either 'young adults' (6 mo–1 y) or 'older adults' (≥ 3 y), and concurrently tracked changes in contact call structure and social interactions over time. Older adults exhibited decreased vocal diversity, which may be related to sparser and weaker affiliative bonds observed in older adults. Older adults, however, displayed equivalent levels of vocal plasticity and vocal convergence compared to young adults, suggesting that many components of vocal learning are largely maintained into later adulthood in an open-ended learner.

<https://royalsocietypublishing.org/doi/10.1098/rspb.2023.0365>

KATHERINE A. J. DANIELS & J. F. BURN – Human locomotion over obstacles reveals real-time prediction of energy expenditure for optimized decision-making

Despite decades of evidence revealing a multitude of ways in which animals are adapted to minimize the energy cost of locomotion, little is known about how energy expenditure shapes adaptive gait over complex terrain. Here, we show that the principle of energy optimality in human locomotion can be generalized to complex task-level locomotor behaviours requiring advance decision-making and anticipatory control. Participants completed a forced-choice locomotor task requiring them to choose between discrete multi-step obstacle negotiation strategies to cross a 'hole' in the ground. By modelling and analysing mechanical energy cost of transport for preferred and non-preferred manoeuvres over a wide range of obstacle dimensions, we showed that strategy selection was predicted by relative energy cost integrated across the complete multi-step task. Vision-based remote sensing was sufficient to select the strategy associated with the lowest prospective energy cost in advance of obstacle encounter, demonstrating the capacity for energetic optimization of locomotor behaviour in the absence of online proprioceptive or chemosensory feedback mechanisms. We highlight the integrative hierarchic optimizations that are required to facilitate energetically efficient locomotion over complex terrain and propose a new behavioural level linking mechanics, remote sensing and cognition that can be leveraged to explore locomotor control and decision-making.

<https://royalsocietypublishing.org/doi/10.1098/rspb.2023.0200>

Royal Society Open Science

PAPERS

KYOSHIRO SASAKI et al – The evasive truth: do mere exposures at the subliminal and supraliminal levels drive the illusory truth effect?

The subjective truth of a statement is boosted by mere exposure to itself or a part of itself. This phenomenon is referred to as the illusory truth effect. We examined whether subliminal pre-exposure to the statement topic would increase its subjective truth. In the exposure phase, participants observed the topic, which was presented supraliminally or subliminally. After the exposure phase, they rated the subjective truth of the statement. If unconscious processing contributed to the illusory truth effect, subliminal exposure to the topic would increase the subjective truth of the statement. On the other hand, if the illusory truth effect required conscious and controlled processing, increases in the subjective truth of a statement would be induced only by supraliminal exposure to the topic. The results showed that the illusory truth effect was not found in either supraliminal or subliminal groups. Our findings provide no reliable evidence that pre-exposure to the statement topic saliently promotes its subjective truth.

<https://royalsocietypublishing.org/doi/10.1098/rsos.201791>

ASHLEIGH L. A. WISEMAN – Three-dimensional volumetric muscle reconstruction of the *Australopithecus afarensis* pelvis and limb, with estimations of limb leverage

To understand how an extinct species may have moved, we first need to reconstruct the missing soft tissues of the skeleton, which rarely preserve, with an understanding of segmental volume and muscular composition within the body. The *Australopithecus afarensis* specimen AL 288-1 is one of the most complete hominin skeletons. Despite 40+ years of research,

the frequency and efficiency of bipedal movement in this specimen is still debated. Here, 36 muscles of the pelvis and lower limb were reconstructed using three-dimensional polygonal modelling, guided by imaging scan data and muscle scarring. Reconstructed muscle masses and configurations guided musculoskeletal modelling of the lower limb in comparison with a modern human. Results show that the moment arms of both species were comparable, hinting towards similar limb functionality. Moving forward, the polygonal muscle modelling approach has demonstrated promise for reconstructing the soft tissues of hominins and providing information on muscle configuration and space filling. This method demonstrates that volumetric reconstructions are required to know where space must be occupied by muscles and thus where lines of action might not be feasible due to interference with another muscle. This approach is effective for reconstructing muscle volumes in extinct hominins for which musculature is unknown.

<https://royalsocietypublishing.org/doi/10.1098/rsos.230356>

Science

REVIEWS

ZOE DRAYSON – The body's predictive processor

Review of 'The Experience Machine: How Our Minds Predict and Shape Reality' by Andy Clark. Pantheon, 2023.

<https://www.science.org/doi/10.1126/science.adh9416>

Scientific American

ARTICLES

RYAN F. MANDELBAUM – Parrots Are Taking Over the World

Smart, adaptable and loud, parrots are thriving in cities far outside their native ranges.

<https://www.scientificamerican.com/article/parrots-are-taking-over-the-world/>

Trends in Cognitive Sciences

COMMENTARIES

SHARI LIU et al – No evidence for discontinuity between infants and adults

Based on studies of infant gaze, developmental psychologists have ascribed abstract cognitive functions to young infants. In their thought-provoking article, Blumberg and Adolph (B+A) consider the implications of developmental neurobiology for these claims. Abstract cognitive functions in adults depend on cortical circuits; however, B+A hypothesize that the developing cortex is too immature to drive gaze in the youngest infants. If this is true, then subcortical regions must be driving all observed gaze behavior in young infants. If infants' gaze relies on entirely distinct neural mechanisms from those underlying abstract adult cognition, B+A argue, 'claims of developmental continuity between infant and adult cognition are suspect' (p. 233). We challenge this line of reasoning, and instead argue that the available, though admittedly limited, neural data from young infants suggests remarkable continuity between infant and adult minds and brains.

[https://www.cell.com/trends/cognitive-sciences/fulltext/S1364-6613\(23\)00093-1](https://www.cell.com/trends/cognitive-sciences/fulltext/S1364-6613(23)00093-1)

RICHARD N. ASLIN et al – Multiple pathways to developmental continuity in infant cognition

In their provocative opinion piece, Blumberg and Adolph (B&A) argue that inferences regarding cognitive development in infancy that are based on young infants' motor behaviors are misleading. They assert that the motor behaviors, including eye movements and looking-time measures traditionally used to characterize cognition between birth and 4 months, are mediated by subcortical mechanisms and, therefore, that this disconnect between the cortex and motor behaviors 'does not support claims of developmental continuity between early infant and adult cognition'. In our view, their thesis (i) is inconsistent with several lines of evidence, and (ii) fails to provide a productive path forward in studies of infant development.

[https://www.cell.com/trends/cognitive-sciences/fulltext/S1364-6613\(23\)00097-9](https://www.cell.com/trends/cognitive-sciences/fulltext/S1364-6613(23)00097-9)

MARK S. BLUMBERG & KAREN E. ADOLPH – Infant action and cognition: what's at stake?

In two independent responses to our opinion article, Liu et al. and Aslin et al. (henceforth Liu or Aslin) critiqued our argument that the protracted development of motor cortex in mammals constrains rich interpretations of infant cognition. We welcome this opportunity to clarify what's at stake. One issue concerns the neural basis of cognition across early development and the evidence researchers rely on to reveal it. Another issue concerns 'core knowledge' and whether representations of numerosity, moral reasoning, and the like are developmentally continuous between infant and adult minds. In addition to addressing these issues, we chart a path forward by placing the dispute surrounding our piece into a developmental-comparative framework.

[https://www.cell.com/trends/cognitive-sciences/fulltext/S1364-6613\(23\)00125-0](https://www.cell.com/trends/cognitive-sciences/fulltext/S1364-6613(23)00125-0)

Original paper: MARK S. BLUMBERG & KAREN E. ADOLPH – Protracted development of motor cortex constrains rich interpretations of infant cognition

EAORC Bulletin 1,027.

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