

## EAORC BULLETIN 1,030 – 12 March 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.

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### EAORC NEWS – ResearchGate retiring Projects on March 31, 2023

After much consideration, ResearchGate have decided to discontinue Projects. You can no longer create new projects, and all current projects will be removed at the end of March. Read the blog to find out what this means for you and what they are working on next: <https://www.researchgate.net/researchgate-updates/retiring-projects>.

This means no weekly reminders about the EAORC bulletin on ResearchGate. It will still be available each week as before at [http://martinedwardes.me.uk/eaorc/eaorc\\_bulletins.html](http://martinedwardes.me.uk/eaorc/eaorc_bulletins.html), so you can continue to read them; but if you wish a weekly

reminder you will have to add your name to the EAORC list. Joining instructions are at <http://martinedwardes.me.uk/eaorc/index.html>. If you are already an EAORC member, you will not be affected by this change.

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## NEWS

### SAPIENS – Should Paviland’s Red Lady “Come Home”?

Two archaeologists explore the complicated story of 33,000-year-old human remains—and calls for their repatriation to Wales.

<https://www.sapiens.org/archaeology/paviland-red-lady/>

### SAPIENS – Did Women and Children Exist in Prehistory?

Mother Nature doesn’t play fair when it comes to the preservation of archaeological remains. Should we study gender archaeology?

<https://www.sapiens.org/archaeology/gender-archaeology/>

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## PUBLICATIONS

### American Journal of Biological Anthropology

#### PAPERS

#### **DANIELA C. SOTO et al – Genomic structural variation: A complex but important driver of human evolution**

To quote Dorothy Parker answering the telephone, “What fresh hell is this?”

Abstract not available for download, although pdf of paper is accessible (except for download or extracting quotes). Here’s a thought: if a company really doesn’t want to be in the academic papers business, perhaps they should get out of it?

<https://onlinelibrary.wiley.com/doi/epdf/10.1002/ajpa.24713>

#### **ALANNAH PEARSON, EMILIANO BRUNER & P. DAVID POLLY – Updated imaging and phylogenetic comparative methods reassess relative temporal lobe size in anthropoids and modern humans**

Two decades ago, Rilling and Seligman, hereafter abbreviated to RAS Study, suggested modern humans had relatively larger temporal lobes for brain size compared to other anthropoids. Despite many subsequent studies drawing conclusions about the evolutionary implications for the emergence of unique cerebral specializations in *Homo sapiens*, no re-assessment has occurred using updated methodologies.

We reassessed the association between right temporal lobe volume (TLV) and right hemisphere volume (HV) in the anthropoid brain. In a sample compiled de novo by us, T1-weighted in vivo Magnetic Resonance Imaging (MRI) scans of 11 extant anthropoid species were calculated by-voxel from the MRI and the raw data from RAS Study directly compared to our sample. Phylogenetic Generalized Least-Squares (PGLS) regression and trait-mapping using Blomberg’s  $K$  ( $\kappa$ ) tested the correlation between HV and TLV accounting for anthropoid phylogeny, while bootstrapped PGLS regressions tested difference in slopes and intercepts between monkey and ape subsamples.

PGLS regressions indicated statistically significant correlations ( $r^2 < 0.99$ ;  $p \leq 0.0001$ ) between TLV and HV with moderate influence from phylogeny ( $K \leq 0.42$ ). Bootstrapped PGLS regression did not show statistically significant differences in slopes between monkeys and apes but did for intercepts. In our sample, human TLV was not larger than expected for anthropoids. Updated imaging, increased sample size and advanced statistical analyses did not find statistically significant results that modern humans possessed a disproportionately large temporal lobe volume compared to the general anthropoid trend. This has important implications for human and non-human primate brain evolution.

<https://onlinelibrary.wiley.com/doi/full/10.1002/ajpa.24712>

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## Current Biology

#### PAPERS

#### **ALEX L. WHITE et al – Engaging in word recognition elicits highly specific modulations in visual cortex**

A person’s cognitive state determines how their brain responds to visual stimuli. The most common such effect is a response enhancement when stimuli are task relevant and attended rather than ignored. In this fMRI study, we report a surprising twist on such attention effects in the visual word form area (VWFA), a region that plays a key role in reading. We presented participants with strings of letters and visually similar shapes, which were either relevant for a specific task (lexical decision or gap localization) or ignored (during a fixation dot color task). In the VWFA, the enhancement of responses to attended stimuli occurred only for letter strings, whereas non-letter shapes evoked smaller responses when attended than when ignored. The enhancement of VWFA activity was accompanied by strengthened functional connectivity with higher-level language regions. These task-dependent modulations of response magnitude and functional connectivity were specific to the VWFA and absent in the rest of visual cortex. We suggest that language regions send targeted excitatory feedback into the

VWFA only when the observer is trying to read. This feedback enables the discrimination of familiar and nonsense words and is distinct from generic effects of visual attention.

[https://www.cell.com/current-biology/fulltext/S0960-9822\(23\)00182-3](https://www.cell.com/current-biology/fulltext/S0960-9822(23)00182-3)

### **ETTORE CAMERLENGHI et al – Multilevel social structure predicts individual helping responses in a songbird**

Multilevel societies are formed when stable groups of individuals spatially overlap and associate preferentially with other groups, producing a hierarchical social structure. Once thought to be exclusive to humans and large mammals, these complex societies have recently been described in birds. However, it remains largely unclear what benefits individuals gain by forming multilevel societies. One hypothesis—based on food sharing in hunter-gatherers—is that multilevel societies facilitate access to a range of cooperative relationships, with individual investment varying across the hierarchical levels of the society. We tested experimentally whether such graded cooperation occurs in the multilevel society of a songbird, the superb fairy-wren (*Malurus cyaneus*). Specifically, we measured whether responses to playbacks of distress calls—used to recruit help when in extreme danger—varied according to the social level at which the focal individual is connected with the caller. We predicted that anti-predator responses should be highest within breeding groups (the core social unit), intermediate between groups from the same community, and lowest across groups from different communities. Our results confirm that birds exhibit the predicted hierarchical pattern of helping and that, within breeding groups, this pattern is independent of kinship. This pattern of graded helping responses supports the hypothesis that multilevel social structures can sustain stratified cooperative relationships and reveals similarity in cooperation in qualitatively different behaviors—anti-predator behavior and food sharing—in the multilevel societies of songbirds and humans.

[https://www.cell.com/current-biology/fulltext/S0960-9822\(23\)00190-2](https://www.cell.com/current-biology/fulltext/S0960-9822(23)00190-2)

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## Frontiers in Ecology and Evolution

### PAPERS

#### **IVÁN RAMÍREZ-PEDRAZA et al – Multiproxy approach to reconstruct fossil primate feeding behavior: Case study for macaque from the Plio-Pleistocene site Guefaït-4.2 (eastern Morocco)**

The genus *Macaca* belongs to Cercopithecidae (Old World monkeys), Cercopithecinae, Papionini. The presence of *Macaca* in North Africa is well known from the Late Miocene to the Late Pleistocene. However, the diet of fossil *Macaca* has been poorly described in the literature. In this study, we investigated the feeding habits of *Macaca* cf. *sylvanus* ( $n = 4$ ) from the Plio-Pleistocene site Guefaït-4.2 in eastern Morocco through multiproxy analysis combining analyses of stable carbon and oxygen isotopes from tooth enamel, buccal microtexture, and low-magnification occlusal dental microwear. For both microwear analyses, we compared the macaques with a new reference collection of extant members of Cercopithecoidea. Our occlusal microwear results show for the fossil macaque a pattern similar to the extant *Cercocebus atys* and *Lophocebus albigena*, African forest-dwelling species that are characterized by a durophagous diet based mainly on hard fruit and seed intake. Buccal microtexture results also suggest the consumption of some grasses and the exploitation of more open habitats, similar to that observed in *Theropithecus gelada*. The  $\delta^{13}\text{C}$  of *M. cf. sylvanus* indicates a C3 based-diet without the presence of C4 plants typical of the savanna grassland in eastern Africa during this period. The high  $\delta^{18}\text{O}$  values of *M. cf. sylvanus*, compared with the contemporary ungulates recovered from Guefaït-4.2, could be associated with the consumption of a different resource by the primate such as leaves or fresh fruits from the upper part of trees. The complementarity of these methods allows for a dietary reconstruction covering a large part of the individual's life.

<https://www.frontiersin.org/articles/10.3389/fevo.2023.1011208/full>

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## Nature

### ARTICLES

#### **DOM BYRNE – What happens in our brains when we're trying to be funny**

Did you hear the one about the neuroscientist who became a stand-up comic and who now researches artificial intelligence's joke-writing potential?

<https://www.nature.com/articles/d41586-023-00627-8>

#### **DOM BYRNE – Social sponges: Gendered brain development comes from society, not biology**

After debunking many myths around male and female brains, Gina Rippon's research interests now include gender gaps in science and why they persist, even in allegedly gender-equal societies.

<https://www.nature.com/articles/d41586-023-00738-2>

#### **SHIHAB JAMAL – Promoting palaeontology across Sudan**

Despite facing sociocultural and political barriers, vertebrate palaeontologist Khalafallah Salih returned home to train the next generation.

<https://www.nature.com/articles/d41586-023-00692-z>

## Nature Biomedical Engineering

### ARTICLES

#### **EDITORIAL – Prepare for truly useful large language models**

The world has barely awakened to the fact that a relatively simple yet large neural network — with a feed-forward architecture and about 100 'attention blocks' and 200 billion parameters — can generate new dialogue that passes the Turing test. Indeed, barring the use of advanced watermarking strategies, it is no longer possible to accurately distinguish text written by a human mind from that generated by a highly parallelizable artificial neural network with substantially fewer neural connections. Only a few years ago, most experts in machine learning and linguists would not have believed that human language could be mastered by a computing engine.

<https://www.nature.com/articles/s41551-023-01012-6>

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## Nature Ecology & Evolution

### PAPERS

#### **MARGHERITA MUSSI et al – A surge in obsidian exploitation more than 1.2 million years ago at Simbiro III (Melka Kunture, Upper Awash, Ethiopia)**

Pleistocene archaeology records the changing behaviour and capacities of early hominins. These behavioural changes, for example, to stone tools, are commonly linked to environmental constraints. It has been argued that, in earlier times, multiple activities of everyday life were all uniformly conducted at the same spot. The separation of focused activities across different localities, which indicates a degree of planning, according to this mindset characterizes later hominins since only 500,000 years ago. Simbiro III level C, in the upper Awash valley of Ethiopia, allows us to test this assumption in its assemblage of stone tools made only with obsidian, dated to more than 1.2 million years (Myr) old. Here we first reconstruct the palaeoenvironment, showing that the landscape was seasonally flooded. Following the deposition of an accumulation of obsidian cobbles by a meandering river, hominins began to exploit these in new ways, producing large tools with sharp cutting edges. We show through statistical analysis that this was a focused activity, that very standardized handaxes were produced and that this was a stone-tool workshop. We argue that at Simbiro III, hominins were doing much more than simply reacting to environmental changes; they were taking advantage of new opportunities, and developing new techniques and new skills according to them.

<https://www.nature.com/articles/s41559-022-01970-1>

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## Nature Human Behaviour

### ARTICLES

#### **CHARLOTTE CAUCHETEUX, ALEXANDRE GRAMFORT & JEAN-REMI KING – Hierarchical organization of language predictions in the brain**

Human language processing is poorly matched by artificial intelligence algorithms. We analysed fMRI brain recordings of 304 participants while they listened to short stories and compared brain activations to artificial intelligence algorithms. Unlike such algorithms, we found that the human brain operates with a hierarchy of predictions that anticipate incoming words and phrases.

<https://www.nature.com/articles/s41562-023-01534-8>

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## Nature Humanities & Social Sciences Communications

### PAPERS

#### **JIAYU WANG, GUANGYU JIN & WENHUA LI – Changing perceptions of language in sociolinguistics**

This paper traces the changing perceptions of language in sociolinguistics. These perceptions of language are reviewed in terms of language in its verbal forms, and language in vis-à-vis as a multimodal construct. In reviewing these changing perceptions, this paper examines different concepts or approaches in sociolinguistics. By reviewing these trends of thoughts and applications, this article intends to shed light on ontological issues such as what constitutes language, and where its place is in multimodal practices in sociolinguistics. Expanding the ontology of language from verbal resources toward various multimodal constructs has enabled sociolinguists to pursue meaning-making, indexicalities and social variations in its most authentic state. Language in a multimodal construct entails the boundaries and distinctions between various modes, while language as a multimodal construct sees language itself as multimodal; it focuses on the social constructs, social meaning and language as a force in social change rather than the combination or orchestration of various modes in communication. Language as a multimodal construct has become the dominant trend in contemporary sociolinguistic studies.

<https://www.nature.com/articles/s41599-023-01574-5>

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**BIRGIT RAUCHBAUER et al with ROBIN I.M. DUNBAR – Only empathy-related traits, not being mimicked or endorphin release, influence social closeness and prosocial behavior**

Seminal studies suggest that being mimicked increases experienced social closeness and prosocial behavior to a mimicking confederate (i.e., interaction partner). Here we reexamine these results by considering the role of empathy-related traits, an indirect proxy for endorphin uptake, and their combined effects as an explanation for these results. 180 female participants were mimicked or anti-mimicked in an interaction with a confederate. The effects of being mimicked versus anti-mimicked in relation to empathy-related traits and endorphin release (assessed indirectly via pain tolerance) on experienced closeness and prosocial behavior were assessed using Bayesian analyses. Our results suggest that high individual empathy-related traits increase social closeness to the anti-mimicking and mimicking confederate and to one's romantic partner, as compared to mimicry alone. Results furthermore strongly suggest that high individual empathy-related traits increase prosocial behavior (donations and willingness to help) as compared to mimicry alone. These findings extend previous work by highlighting that empathy-related traits are more influential in creating positive effects on social closeness and prosocial behavior than a one-shot mimicking encounter.

<https://www.nature.com/articles/s41598-023-30946-9>

**ULRICH BORNSCHEIN et al with WOLFGANG ENARD & SVANTE PÄÄBO – Functional dissection of two amino acid substitutions unique to the human FOXP2 protein**

The transcription factor forkhead box P2 (FOXP2) is involved in the development of language and speech in humans. Two amino acid substitutions (T303N, N325S) occurred in the human FOXP2 after the divergence from the chimpanzee lineage. It has previously been shown that when they are introduced into the FOXP2 protein of mice they alter striatal synaptic plasticity by increasing long-term depression in medium spiny neurons. Here we introduce each of these amino acid substitutions individually into mice and analyze their effects in the striatum. We find that long-term depression in medium spiny neurons is increased in mice carrying only the T303N substitution to the same extent as in mice carrying both amino acid substitutions. In contrast, the N325S substitution has no discernable effects.

<https://www.nature.com/articles/s41598-023-30663-3>

**ANA B. MARÍN-ARROYO et al – Subsistence of early anatomically modern humans in Europe as evidenced in the Protoaurignacian occupations of Fumane Cave, Italy**

Documenting the subsistence strategies developed by early modern humans is relevant for understanding the success of their dispersal throughout Eurasia. Today, we know that there was not a single colonization event and that the process was progressive while coping with the MIS3 abrupt climatic oscillations. Modern humans expanded into the continent by adapting to different topographic situations and by exploiting resources in diverse ecological niches. The northern part of Italy is one of the first European regions where early modern humans are documented. Here, we present the subsistence regimen adopted by the Protoaurignacian groups in two different levels in Fumane Cave based on archaeozoological data. New radiocarbon dates confirm an overlap between Uluzzian and Protoaurignacian occupations, around 42 and 41,000 cal BP, and reveal that modern humans occupied the cave from GI10 to GS9, the last level coinciding with the Heinrich Event 4. The data indicate seasonal site occupations during late spring/summer and that prey exploitation was focused mostly on ibex and chamois, killed in nearby areas. The whole faunal assemblage suggests the presence of early modern humans in a cold environment with mostly open landscapes and patchy woodlands. The estimation of net primary productivity (NPP) in Fumane, compared with other contemporaneous Italian sites, reflects how the NPP fluctuations in the Prealpine area, where Fumane is located, affected the biotic resources in contrast to known Mediterranean sites. From a pan-European perspective, the spatiotemporal fluctuation of the NPP versus the subsistence strategies adopted by Protoaurignacian groups in the continent supports rapid *Homo sapiens* dispersal and resilience in a mosaic of environments that were affected by significant climate changes.

<https://www.nature.com/articles/s41598-023-30059-3>

**ANNIKA B. E. BENZ et al – Increased empathic distress in adults is associated with higher levels of childhood maltreatment**

While many studies investigated basic facets of empathy, less is known about the association with early life adversity (ELA). To investigate a possible association of empathy with ELA, we assessed self-reported ELA, using the Childhood Trauma Questionnaire (CTQ), the Parental Bonding Instrument (PBI) for mother and father, and empathy, using the Interpersonal Reactivity Index (IRI), in a sample of  $N = 228$  (83% female, age mean =  $30.51 \pm 9.88$  years, age range = 18–60). Further, we measured willingness to donate a certain percentage of study compensation to a charity as an index of prosocial behavior. In line with our hypotheses that stated a positive association of empathy with ELA, increased levels of emotional, physical, and sexual abuse, and emotional and physical neglect were positively correlated with personal distress in response to others' suffering. Likewise, higher parental overprotection and lower parental care were related to higher personal distress. Furthermore, while participants with higher levels of ELA tended to donate more money on a merely descriptive level, only higher levels of sexual abuse were significantly related to larger donations after correction for multiple statistical tests. Other

facets of the IRI (empathic concern, perspective taking and fantasy) were not related to any other ELA measure. This suggests ELA only affects levels of personal distress.

<https://www.nature.com/articles/s41598-023-30891-7>

### **RUBÉN ANDRÉS MIRANDA-RODRÍGUEZ et al – Moral reasoning and moral competence as predictors of cooperative behavior in a social dilemma**

The level of moral development may be crucial to understand behavior when people have to choose between prioritizing individual gains or pursuing general social benefits. This study evaluated whether two different psychological constructs, moral reasoning and moral competence, are associated with cooperative behavior in the context of the prisoner's dilemma game, a two-person social dilemma where individuals choose between cooperation or defection. One hundred and eighty-nine Mexican university students completed the Defining Issues Test (DIT-2; measuring moral reasoning) and the Moral Competence Test (MCT) and played an online version of the prisoner's dilemma game, once against each participant in a group of 6–10 players. Our results indicate that cooperative behavior is strongly affected by the outcomes in previous rounds: Except when both participants cooperated, the probability of cooperation with other participants in subsequent rounds decreased. Both the DIT-2 and MCT independently moderated this effect of previous experiences, particularly in the case of sucker-outcomes. Individuals with high scores on both tests were not affected when in previous rounds the other player defected while they cooperated. Our findings suggest that more sophisticated moral reasoning and moral competence promote the maintenance of cooperative behaviors despite facing adverse situations.

<https://www.nature.com/articles/s41598-023-30314-7>

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## Neuron

### PAPERS

#### **MOMCHIL S. TOMOV et al – The neural architecture of theory-based reinforcement learning**

Humans learn internal models of the world that support planning and generalization in complex environments. Yet it remains unclear how such internal models are represented and learned in the brain. We approach this question using theory-based reinforcement learning, a strong form of model-based reinforcement learning in which the model is a kind of intuitive theory. We analyzed fMRI data from human participants learning to play Atari-style games. We found evidence of theory representations in prefrontal cortex and of theory updating in prefrontal cortex, occipital cortex, and fusiform gyrus. Theory updates coincided with transient strengthening of theory representations. Effective connectivity during theory updating suggests that information flows from prefrontal theory-coding regions to posterior theory-updating regions. Together, our results are consistent with a neural architecture in which top-down theory representations originating in prefrontal regions shape sensory predictions in visual areas, where factored theory prediction errors are computed and trigger bottom-up updates of the theory.

[https://www.cell.com/neuron/fulltext/S0896-6273\(23\)00073-9](https://www.cell.com/neuron/fulltext/S0896-6273(23)00073-9)

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## PeerJ

### PAPERS

#### **BENJAMIN G. FARRAR et al – Reporting and interpreting non-significant results in animal cognition research**

How statistically non-significant results are reported and interpreted following null hypothesis significance testing is often criticized. This issue is important for animal cognition research because studies in the field are often underpowered to detect theoretically meaningful effect sizes, i.e., often produce non-significant p-values even when the null hypothesis is incorrect. Thus, we manually extracted and classified how researchers report and interpret non-significant p-values and examined the p-value distribution of these non-significant results across published articles in animal cognition and related fields. We found a large amount of heterogeneity in how researchers report statistically non-significant p-values in the result sections of articles, and how they interpret them in the titles and abstracts. Reporting of the non-significant results as “No Effect” was common in the titles (84%), abstracts (64%), and results sections (41%) of papers, whereas reporting of the results as “Non-Significant” was less common in the titles (0%) and abstracts (26%), but was present in the results (52%). Discussions of effect sizes were rare (<5% of articles). A p-value distribution analysis was consistent with research being performed with low power of statistical tests to detect effect sizes of interest. These findings suggest that researchers in animal cognition should pay close attention to the evidence used to support claims of absence of effects in the literature, and—in their own work—report statistically non-significant results clearly and formally correct, as well as use more formal methods of assessing evidence against theoretical predictions.

<https://peerj.com/articles/14963/>

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## Philosophical Transactions of the Royal Society B

### PAPERS

#### **SAYAKA KIDBY et al – Parent–infant affect synchrony during social and solo play**

While mother–infant affect synchrony has been proposed to facilitate the early development of social understanding, most investigations into affect synchrony have concentrated more on negative than positive affect. We analysed affect sharing

during parent–infant object play, comparing positive and negative affect, to examine how it is modulated by shared playful activity. Mother–infant dyads (N = 20, average infant age 10.7 months) played together (social) or separately (solo) using an object. Both participants increased positive affect during social play as compared with solo play. Positive affect synchrony also increased during social play compared with solo play, whereas negative affect synchrony did not differ. Closer examination of the temporal dynamics of affect changes showed that infants' shifts to positive affect tended to occur contingently in response to their mothers', whereas mothers' shifts to negative affect followed their infants'. Further, during social play, positive affect displays were more long-lived while negative more short-lived. While our sample was small and from a homogeneous population (e.g. white, highly educated parents), limiting the implications of the findings, these results demonstrate that maternal active engagement in playful interaction with her infant affords, increases, and extends infant positive affect and parent–infant positive affect synchrony, providing insights into how the social context modulates infants' affective experiences.

<https://royalsocietypublishing.org/doi/abs/10.1098/rstb.2021.0482>

**TRINH NGUYEN, LUCIE ZIMMER & STEFANIE HOEHL – Your turn, my turn. Neural synchrony in mother–infant proto-conversation**

Even before infants utter their first words, they engage in highly coordinated vocal exchanges with their caregivers. During these so-called proto-conversations, caregiver–infant dyads use a presumably universal communication structure—turn-taking, which has been linked to favourable developmental outcomes. However, little is known about potential mechanisms involved in early turn-taking. Previous research pointed to interpersonal synchronization of brain activity between adults and preschool-aged children during turn-taking. Here, we assessed caregivers and infants at 4–6 months of age (N = 55) during a face-to-face interaction. We used functional-near infrared spectroscopy hyperscanning to measure dyads' brain activity and microcoded their turn-taking. We also measured infants' inter-hemispheric connectivity as an index for brain maturity and later vocabulary size and attachment security as developmental outcomes potentially linked to turn-taking. The results showed that more frequent turn-taking was related to interpersonal neural synchrony, but the strength of the relation decreased over the course of the proto-conversation. Importantly, turn-taking was positively associated with infant brain maturity and later vocabulary size, but not with later attachment security. Taken together, these findings shed light on mechanisms facilitating preverbal turn-taking and stress the importance of emerging turn-taking for child brain and language development.

<https://royalsocietypublishing.org/doi/full/10.1098/rstb.2021.0488>

**EMMA M. TEMPLETON et al – Long gaps between turns are awkward for strangers but not for friends**

When people feel connected they tend to respond quickly in conversation, creating short gaps between turns. But are long gaps always a sign that things have gone awry? We analysed the frequency and impact of long gaps (greater than 2 s) in conversations between strangers and between friends. As predicted, long gaps signalled disconnection between strangers. However, long gaps between friends marked moments of increased connection and friends tended to have more of them. These differences in connection were also perceived by independent raters: only the long gaps between strangers were rated as awkward, and increasingly so the longer they lasted. Finally, we show that, compared to strangers, long gaps between friends include more genuine laughter and are less likely to precede a topic change. This suggests that the gaps of friends may not function as 'gaps' at all, but instead allow space for enjoyment and mutual reflection. Together, these findings suggest that the turn-taking dynamics of friends are meaningfully different from those of strangers and may be less bound by social conventions. More broadly, this work illustrates that samples of convenience—pairs of strangers being the modal paradigm for interaction research—may not capture the social dynamics of more familiar relationships.

<https://royalsocietypublishing.org/doi/full/10.1098/rstb.2021.0471>

**KOBIN H. KENDRICK, JUDITH HOLLER & STEPHEN C. LEVINSON – Turn-taking in human face-to-face interaction is multimodal: gaze direction and manual gestures aid the coordination of turn transitions**

Human communicative interaction is characterized by rapid and precise turn-taking. This is achieved by an intricate system that has been elucidated in the field of conversation analysis, based largely on the study of the auditory signal. This model suggests that transitions occur at points of possible completion identified in terms of linguistic units. Despite this, considerable evidence exists that visible bodily actions including gaze and gestures also play a role. To reconcile disparate models and observations in the literature, we combine qualitative and quantitative methods to analyse turn-taking in a corpus of multimodal interaction using eye-trackers and multiple cameras. We show that transitions seem to be inhibited when a speaker averts their gaze at a point of possible turn completion, or when a speaker produces gestures which are beginning or unfinished at such points. We further show that while the direction of a speaker's gaze does not affect the speed of transitions, the production of manual gestures does: turns with gestures have faster transitions. Our findings suggest that the coordination of transitions involves not only linguistic resources but also visual gestural ones and that the transition-relevance places in turns are multimodal in nature.

<https://royalsocietypublishing.org/doi/abs/10.1098/rstb.2021.0473>



**ANNA K. KUHLEN & RASHA ABDEL RAHMAN – Beyond speaking: neurocognitive perspectives on language production in social interaction**

The human faculty to speak has evolved, so has been argued, for communicating with others and for engaging in social interactions. Hence the human cognitive system should be equipped to address the demands that social interaction places on the language production system. These demands include the need to coordinate speaking with listening, the need to integrate own (verbal) actions with the interlocutor's actions, and the need to adapt language flexibly to the interlocutor and the social context. In order to meet these demands, core processes of language production are supported by cognitive processes that enable interpersonal coordination and social cognition. To fully understand the cognitive architecture and its neural implementation enabling humans to speak in social interaction, our understanding of how humans produce language needs to be connected to our understanding of how humans gain insights into other people's mental states and coordinate in social interaction. This article reviews theories and neurocognitive experiments that make this connection and can contribute to advancing our understanding of speaking in social interaction.

<https://royalsocietypublishing.org/doi/abs/10.1098/rstb.2021.0483>

**SEBASTIAN KAHL & STEFAN KOPP – Intertwining the social and the cognitive loops: socially enactive cognition for human-compatible interactive systems**

It is increasingly important for technical systems to be able to interact flexibly, robustly and fluently with humans in real-world scenarios. However, while current AI systems excel at narrow task competencies, they lack crucial interaction abilities for the adaptive and co-constructed social interactions that humans engage in. We argue that a possible avenue to tackle the corresponding computational modelling challenges is to embrace interactive theories of social understanding in humans. We propose the notion of socially enactive cognitive systems that do not rely solely on abstract and (quasi-)complete internal models for separate social perception, reasoning and action. By contrast, socially enactive cognitive agents are supposed to enable a close interlinking of the enactive socio-cognitive processing loops within each agent, and the social-communicative loop between them. We discuss theoretical foundations of this view, identify principles and requirements for according computational approaches, and highlight three examples of our own research that showcase the interaction abilities achievable in this way.

<https://royalsocietypublishing.org/doi/abs/10.1098/rstb.2021.0474>

**FEDERICA AMICI et al with KATJA LIEBAL – Face to face interactions in chimpanzee (*Pan troglodytes*) and human (*Homo sapiens*) mother-infant dyads**

Human mothers interact with their infants in different ways. In Western, educated, industrialized, rich and democratic (WEIRD) societies, face-to-face interactions and mutual gazes are especially frequent, yet little is known about their developmental trajectories and if they differ from those of other primates. Using a cross-species developmental approach, we compared mother–infant interactions in 10 dyads of urban humans from a WEIRD society (*Homo sapiens*) and 10 dyads of captive zoo-based chimpanzees (*Pan troglodytes*), when infants were one, six and 12 months old. Results showed that face-to-face interactions with mutual gaze events were common in both groups throughout the infant's first year of life. The developmental trajectories of maternal and infants' looks partially differed between species, but mutual gaze events were overall longer in humans than in chimpanzees. Mutual gazes were also more frequent in humans, peaking at six months in humans, while increasing with age in chimpanzees. The duration and frequency of mutual gazes varied across contexts in both groups, with mutual gazes being longer during caring/grooming and feeding contexts. These findings confirm that some aspects of early socio-cognitive development are shared by humans and other primates, and highlight the importance of combining developmental and cross-species approaches to better understand the evolutionary roots of parenting behaviour.

<https://royalsocietypublishing.org/doi/abs/10.1098/rstb.2021.0478>

**STEPHEN C. LEVINSON – Gesture, spatial cognition and the evolution of language**

Human communication displays a striking contrast between the diversity of languages and the universality of the principles underlying their use in conversation. Despite the importance of this interactional base, it is not obvious that it heavily imprints the structure of languages. However, a deep-time perspective suggests that early hominin communication was gestural, in line with all the other Hominidae. This gestural phase of early language development seems to have left its traces in the way in which spatial concepts, implemented in the hippocampus, provide organizing principles at the heart of grammar.

<https://royalsocietypublishing.org/doi/full/10.1098/rstb.2021.0481>

**ANTONIA F DE C. HAMILTON & JUDITH HOLLER – Face2face: advancing the science of social interaction**

Face-to-face interaction is core to human sociality and its evolution, and provides the environment in which most of human communication occurs. Research into the full complexities that define face-to-face interaction requires a multi-disciplinary, multi-level approach, illuminating from different perspectives how we and other species interact. This special issue showcases a wide range of approaches, bringing together detailed studies of naturalistic social-interactive behaviour with larger scale analyses for generalization, and investigations of socially contextualized cognitive and neural processes that underpin the behaviour we observe. We suggest that this integrative approach will allow us to propel forwards the science of

face-to-face interaction by leading us to new paradigms and novel, more ecologically grounded and comprehensive insights into how we interact with one another and with artificial agents, how differences in psychological profiles might affect interaction, and how the capacity to socially interact develops and has evolved in the human and other species. This theme issue makes a first step into this direction, with the aim to break down disciplinary boundaries and emphasizing the value of illuminating the many facets of face-to-face interaction.

<https://royalsocietypublishing.org/doi/10.1098/rstb.2021.0470>

### **MARIANNA ANICHINI et al – Measuring rhythms of vocal interactions: a proof of principle in harbour seal pups**

Rhythmic patterns in interactive contexts characterize human behaviours such as conversational turn-taking. These timed patterns are also present in other animals, and often described as rhythm. Understanding fine-grained temporal adjustments in interaction requires complementary quantitative methodologies. Here, we showcase how vocal interactive rhythmicity in a non-human animal can be quantified using a multi-method approach. We record vocal interactions in harbour seal pups (*Phoca vitulina*) under controlled conditions. We analyse these data by combining analytical approaches, namely categorical rhythm analysis, circular statistics and time series analyses. We test whether pups' vocal rhythmicity varies across behavioural contexts depending on the absence or presence of a calling partner. Four research questions illustrate which analytical approaches are complementary versus orthogonal. For our data, circular statistics and categorical rhythms suggest that a calling partner affects a pup's call timing. Granger causality suggests that pups predictively adjust their call timing when interacting with a real partner. Lastly, the ADaptation and Anticipation Model estimates statistical parameters for a potential mechanism of temporal adaptation and anticipation. Our analytical complementary approach constitutes a proof of concept; it shows feasibility in applying typically unrelated techniques to seals to quantify vocal rhythmic interactivity across behavioural contexts.

<https://royalsocietypublishing.org/doi/10.1098/rstb.2021.0477>

## PLoS Biology

### PAPERS

### **CAREL P. VAN SCHAİK et al – Extended parental provisioning and variation in vertebrate brain sizes**

Large brains provide adaptive cognitive benefits but require unusually high, near-constant energy inputs and become fully functional well after their growth is completed. Consequently, young of most larger-brained endotherms should not be able to independently support the growth and development of their own brains. This paradox is solved if the evolution of extended parental provisioning facilitated brain size evolution. Comparative studies indeed show that extended parental provisioning coevolved with brain size and that it may improve immature survival. The major role of extended parental provisioning supports the idea that the ability to sustain the costs of brains limited brain size evolution.

<https://journals.plos.org/plosbiology/article?id=10.1371/journal.pbio.3002016>

## PLoS One

### PAPERS

### **JIANCU CHEN et al – An effective emotion tendency perception model in empathic dialogue**

The effectiveness of open-domain dialogue systems depends heavily on emotion. In dialogue systems, previous models primarily detected emotions by looking for emotional words embedded in sentences. However, they did not precisely quantify the association of all words with emotions, which has led to a certain bias. To overcome this issue, we propose an emotion tendency perception model. The model uses an emotion encoder to accurately quantify the emotional tendencies of all words. Meanwhile, it uses a shared fusion decoder to equip the decoder with the sentiment and semantic capabilities of the encoder. We conducted extensive evaluations on Empathetic Dialogue. Experimental results demonstrate its efficacy. Compared with the state of the art, our approach has distinctive advantages.

<https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0282926>

### **JENNIFER M. WHITE et al – Adding pattern and process to eco-evo theory and applications**

Eco-evolutionary dynamics result when interacting biological forces simultaneously produce demographic and genetic population responses. Eco-evolutionary simulators traditionally manage complexity by minimizing the influence of spatial pattern on process. However, such simplifications can limit their utility in real-world applications. We present a novel simulation modeling approach for investigating eco-evolutionary dynamics, centered on the driving role of landscape pattern. Our spatially-explicit, individual-based mechanistic simulation approach overcomes existing methodological challenges, generates new insights, and paves the way for future investigations in four focal disciplines: Landscape Genetics, Population Genetics, Conservation Biology, and Evolutionary Ecology. We developed a simple individual-based model to illustrate how spatial structure drives eco-evo dynamics. By making minor changes to our landscape's structure, we simulated continuous, isolated, and semi-connected landscapes, and simultaneously tested several classical assumptions of the focal disciplines. Our results exhibit expected patterns of isolation, drift, and extinction. By imposing landscape change on otherwise functionally-static eco-evolutionary models, we altered key emergent properties such as gene-flow and adaptive selection. We observed demo-genetic responses to these landscape manipulations, including changes in population size,

probability of extinction, and allele frequencies. Our model also demonstrated how demo-genetic traits, including generation time and migration rate, can arise from a mechanistic model, rather than being specified a priori. We identify simplifying assumptions common to four focal disciplines, and illustrate how new insights might be developed in eco-evolutionary theory and applications by better linking biological processes to landscape patterns that we know influence them, but that have understandably been left out of many past modeling studies.

<https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0282535>

### **MICHALIS DROUVELIS et al – Large losses from little lies: Strategic gender misrepresentation and cooperation**

This paper investigates the possibility that a small deceptive act of misrepresenting one's gender to others reduces cooperation in the Golden Balls game, a variant of a prisoner's dilemma game. Compared to treatments where either participants' true genders are revealed to each other in a pair or no information on gender is given, the treatment effects of randomly selecting people to be allowed to misrepresent their gender on defection are positive, sizeable, and statistically significant. Allowing people to misrepresent their gender reduces the average cooperation rate by approximately 10–12 percentage points. While one explanation for the significant treatment effects is that participants who chose to misrepresent their gender in the treatment where they were allowed to do so defect substantially more, the potential of being matched with someone who could be misrepresenting their gender also caused people to defect more than usual as well. On average, individuals who chose to misrepresent their gender are around 32 percentage points more likely to defect than those in the blind and true gender treatments. Further analysis reveals that a large part of the effect is driven by women who misrepresented in same-sex pairs and men who misrepresented in mixed-sex pairs. We conclude that even small short-term opportunities to misrepresent one's gender can potentially be extremely harmful to later human cooperation.

<https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0282335>

## Royal Society Open Science

### PAPERS

### **MD SAMS AFIF NIRJHOR & MAYUKO NAKAMARU – The evolution of cooperation in the unidirectional linear division of labour of finite roles**

Evolution of cooperation is a puzzle in evolutionary biology and social sciences. Previous studies assumed that players are equal and have symmetric relationships. In our society, players are in different roles, have an asymmetric relationship and cooperate together. We focused on the linear division of labour in a unidirectional chain that has finite roles, each of which is assigned to one group with cooperators and defectors. A cooperator in an upstream group produces and modifies a product, paying a cost of cooperation, and hands it to a player in a downstream group who obtains the benefit from the product. If players in all roles cooperate, a final product can be completed. However, if a player in a group chooses defection, the division of labour stops, the final product cannot be completed and all players in all roles suffer damage. By using the replicator equations of the asymmetric game, we investigate which sanction system promotes the evolution of cooperation in the division of labour. We find that not the benefit of the product but the cost of cooperation matters to the evolutionary dynamics and that the probability of finding a defector determines which sanction system promotes the evolution of cooperation.

<https://royalsocietypublishing.org/doi/10.1098/rsos.220856>

## Science

### ARTICLES

### **LARS CHITTKA & NATACHA ROSSI – Bees learn to dance: Experience yields precision in the waggle dance of honey bees**

Many animals can guide or call other members of their group to a rich foraging site. By contrast, honey bees have a distinctive form of communication that allows them to send nestmates to the location of a food source by using symbols. The coordinates are encoded by intricate movements (the “dance”) on the vertical wax comb in the hive, using gravity and time as references. The motions are followed by recruits in the darkness of the hive, who subsequently decode the extracted flight vector information and follow the dancer's instructions once outside. Like many of the elaborate behaviors of social insects, this communication system was thought to be innate. However, on page 1015 of this issue, Dong et al. reveal that honey bees only deliver precise spatial information in their dances if they previously had the opportunity to attend dances by experienced role models—the communication system must in part be learnt socially.

<https://www.science.org/doi/10.1126/science.adg6020>

### PAPERS

### **SHIHAO DONG et al – Social signal learning of the waggle dance in honey bees**

Honey bees use a complex form of spatial referential communication. Their “waggle dance” communicates the direction, distance, and quality of a resource to nestmates by encoding celestial cues, retinal optic flow, and relative food value into motion and sound within the nest. We show that correct waggle dancing requires social learning. Bees without the opportunity to follow any dances before they first danced produced significantly more disordered dances with larger waggle

angle divergence errors and encoded distance incorrectly. The former deficit improved with experience, but distance encoding was set for life. The first dances of bees that could follow other dancers showed neither impairment. Social learning, therefore, shapes honey bee signaling, as it does communication in human infants, birds, and multiple other vertebrate species.

<https://www.science.org/doi/10.1126/science.ade1702>

## COMMENTARIES

### **ROBERTO H. HERAI, KATERINA SEMENDEFERI & ALYSSON R. MUOTRI – Comment on “Human TKTL1 implies greater neurogenesis in frontal neocortex of modern humans than Neanderthals”**

Pinson et al. [ANNELINE PINSON et al with SVANTE PÄÄBO – Human TKTL1 implies greater neurogenesis in frontal neocortex of modern humans than Neanderthals, EAORC 1,004] concluded that the modern human TKTL1 gene is responsible for an increased number of cortical neurons. We show that the “putative Neanderthal variant” of TKTL1 is present in modern human backgrounds. We dispute their argument that this genetic variant is responsible for brain differences in modern humans as opposed to Neanderthals.

<https://www.science.org/doi/10.1126/science.adf0602>

### **ANNELINE PINSON et al with SVANTE PÄÄBO – Response to Comment on “Human TKTL1 implies greater neurogenesis in frontal neocortex of modern humans than Neanderthals”**

Heraï et al. discuss the known fact that a low percentage of modern humans who lack any overt phenotypes carry the ancestral TKTL1 allele. Our paper demonstrates that the amino acid substitution in TKTL1 increases neural progenitor cells and neurogenesis in the developing brain. It is another question if, and to what extent, this has consequences for the adult brain.

<https://www.science.org/doi/10.1126/science.adf2212>

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## Science Advances

### PAPERS

#### **TOMOS PROFFITT et al – Wild macaques challenge the origin of intentional tool production**

Intentionally produced sharp-edged stone flakes and flaked pieces are our primary evidence for the emergence of technology in our lineage. This evidence is used to decipher the earliest hominin behavior, cognition, and subsistence strategies. Here, we report on the largest lithic assemblage associated with a primate foraging behavior undertaken by long-tailed macaques (*Macaca fascicularis*). This behavior results in a landscape-wide record of flaked stone material, almost indistinguishable from early hominin flaked pieces and flakes. It is now clear that the production of unintentional conchoidal sharp-edged flakes can result from tool-assisted foraging in nonhominin primates. Comparisons with Plio-Pleistocene lithic assemblages, dating from 3.3 to 1.56 million years ago, show that flakes produced by macaques fall within the technological range of artifacts made by early hominins. In the absence of behavioral observations, the assemblage produced by monkeys would likely be identified as anthropogenic in origin and interpreted as evidence of intentional tool production.

<https://www.science.org/doi/full/10.1126/sciadv.ade8159>

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