

## References

### Aktuell

#### STOLK 2014

Arjen Stolk et al., *Cerebral coherence between communicators marks the emergence of meaning*. [PNAS 111 \(2014\), 18183–18188](#).

[pnas111-18183-Supplement1.wmv](#), [pnas111-18183-Supplement2.wmv](#), [pnas111-18183-Supplement3.wmv](#), [pnas111-18183-Supplement4.wmv](#), [pnas111-18183-Supplement5.wmv](#), [pnas111-18183-Supplement6.wmv](#), [pnas111-18183-Supplement7.wmv](#)

Arjen Stolk, Matthijs L. Noordzij, Lennart Verhagen, Inge Volman, Jan-Mathijs Schoffelen, Robert Oostenveld, Peter Hagoort & Ivan Toni

How can we understand each other during communicative interactions? An influential suggestion holds that communicators are primed by each other's behaviors, with associative mechanisms automatically coordinating the production of communicative signals and the comprehension of their meanings. An alternative suggestion posits that mutual understanding requires shared conceptualizations of a signal's use, i.e., "conceptual pacts" that are abstracted away from specific experiences. Both accounts predict coherent neural dynamics across communicators, aligned either to the occurrence of a signal or to the dynamics of conceptual pacts. Using coherence spectral-density analysis of cerebral activity simultaneously measured in pairs of communicators, this study shows that establishing mutual understanding of novel signals synchronizes cerebral dynamics across communicators' right temporal lobes. This interpersonal cerebral coherence occurred only within pairs with a shared communicative history, and at temporal scales independent from signals' occurrences. These findings favor the notion that meaning emerges from shared conceptualizations of a signal's use.

social interaction | theory of mind | experimental semiotics | dual functional magnetic resonance imaging | conceptual knowledge

#### WOODRUFF 2014

J. D. Woodruff, K. Kanamaru, S. Kundu & T. L. Cook, *Depositional evidence for the Kamikaze typhoons and links to changes in typhoon climatology*. [Geology \(2014\), preprint, 1–5](#). DOI:10.1130/G36209.1.

[Geology2014-Woodruff-Supplement.pdf](#)

In the late 13th century, Kublai Khan, ruler of the Mongol Empire, launched one of the world's largest armadas of its time in an attempt to conquer Japan. Early narratives described the decimation and dispersal of these fleets by the "Kamikaze" of 1274 CE and 1281 CE, a pair of intense typhoons "divinely" sent to protect Japan from invasion. These historical accounts are prone to exaggeration, and significant questions remain regarding the occurrence and true intensity of these legendary typhoons. To provide independent insight, we present a new 2000 yr sedimentary reconstruction of extreme coastal flooding from a coastal lake near the location of the Mongol invasions. Two marine-sourced flood deposits date to the Kamikaze typhoons and are the events of record in the reconstruction. The complete reconstruction indicates periods of greater flood activity relative to modern beginning ca. 250 CE and extending past the timing of the Kamikaze events to 1600 CE. Comparisons with additional reconstructions are consistent with greater

regional typhoon activity during the Mongol invasions due to the preferential steering of storms toward Japan, and driven by greater El Niño activity relative to modern. Results are consistent with the paired Kamikaze typhoons being of significant intensity, and support accounts of them playing an important role in preventing the conquering of Japan by Mongol fleets. The Kamikaze typhoons may therefore serve as a prominent example for how past increases in severe weather associated with changing climate have had significant geopolitical impacts.

## Amerika

IGLESIAS 2014

Virginia Iglesias & Cathy Whitlock, *Fire responses to postglacial climate change and human impact in northern Patagonia (41–43°S)*. [PNAS 111 \(2014\), E5545–E5554](#).

Forest/steppe boundaries are among the most dynamic ecosystems on Earth and are highly vulnerable to changes in climate and land use. In this study we examine the postglacial history of the Patagonian forest/steppe ecotone (41–43°S) to better understand its sensitivity to past variations in climate, disturbance, and human activity before European colonization. We present regional trends in vegetation and biomass burning, as detected by generalized additive models fitted to seven pollen and charcoal records, and compare the results with other paleoenvironmental data, as well as archeological and ecological information to (i) estimate postglacial fire trends at regional scales, (ii) assess the evolution of climate–vegetation–fire linkages over the last 18,000 calibrated (cal) years B.P., and (iii) evaluate the role of humans in altering pre-European landscapes and fire regimes. Pollen and charcoal data indicate that biomass burning was relatively low during warm/dry steppe-dominated landscapes in the late glacial/Early Holocene transition and increased as more humid conditions favored forest development after ca. 10,000 cal years B.P. Postglacial fire activity was thus limited by fuel availability associated with sparse vegetation cover rather than by suitable climate conditions. In contrast to extensive burning by European settlers, variations in indigenous population densities were not associated with fluctuations in regional or watershed-scale fire occurrence, suggesting that climate–vegetation–fire linkages in northern Patagonia evolved with minimal or very localized human influences before European settlement.

charcoal | fire | climate | anthropogenic impact | Patagonia

LENTZ 2014

David L. Lentz et al., *Forests, fields, and the edge of sustainability at the ancient Maya city of Tikal*. [PNAS 111 \(2014\), 18513–18518](#).

David L. Lentz, Nicholas P. Dunning, Vernon L. Scarborough, Kevin S. Magee, Kim M. Thompson, Eric Weaver, Christopher Carr, Richard E. Terry, Gerald Islebe, Kenneth B. Tankersley, Liwy Grazioso Sierra, John G. Jones, Palma Buttles, Fred Valdez & Carmen E. Ramos Hernandez

Tikal has long been viewed as one of the leading polities of the ancient Maya realm, yet how the city was able to maintain its substantial population in the midst of a tropical forest environment has been a topic of unresolved debate among researchers for decades. We present ecological, paleoethnobotanical, hydrological, remote sensing, edaphic, and isotopic evidence that reveals how the Late Classic Maya at Tikal practiced intensive forms of agriculture (including irrigation, terrace construction, arboriculture, household gardens, and short fallow swidden)

coupled with carefully controlled agroforestry and a complex system of water retention and redistribution. Empirical evidence is presented to demonstrate that this assiduously managed anthropogenic ecosystem of the Classic period Maya was a landscape optimized in a way that provided sustenance to a relatively large population in a preindustrial, low-density urban community. This landscape productivity optimization, however, came with a heavy cost of reduced environmental resiliency and a complete reliance on consistent annual rainfall. Recent speleothem data collected from regional caves showed that persistent episodes of unusually low rainfall were prevalent in the mid-9th century A.D., a time period that coincides strikingly with the abandonment of Tikal and the erection of its last dated monument in A.D. 869. The intensified resource management strategy used at Tikal—already operating at the landscape’s carrying capacity—ceased to provide adequate food, fuel, and drinking water for the Late Classic populace in the face of extended periods of drought. As a result, social disorder and abandonment ensued.

paleoecology | Neotropics | paleoethnobotany | irrigation | root crops

## Anthropologie

GAZZANIGA 2014

Michael S. Gazzaniga, *The split-brain: Rooting consciousness in biology*. [PNAS 111 \(2014\), 18093–18094](#).

Richard Feynman used to show up at our parties, and on one memorable night, Feynman came up to me and said “You can split my brain if you can guarantee I can do physics afterwards.” Laughing, I said, “I guarantee it.” Quick as a flash, Feynman stuck out both his left and his right hand to shake on the deal! The atmosphere of expectation to do important work during those days of discovery was nothing like I had ever experienced before or since.

SHEN 2014

Helen H. Shen, *Inner Workings: Discovering the split mind*. [PNAS 111 \(2014\), 18097](#).

pnas111-18097-Supplement.wmv

In the block test, W.J.’s right hand, controlled by his left hemisphere, appeared incapable of matching a set of blocks to a pattern on a flash card. W.J.’s left hand, controlled by the right hemisphere, could execute the task with ease, however, even trying to jump in to help the fumbling right hand.

Strangely, he could only execute the task with his left hand, not his right. This striking phenomenon, later captured on film (Movie S1), was one in a series of findings that would influence the course of cognitive neuroscience for years after.

## Biologie

JÓNSSON 2014

Hákon Jónsson et al., *Speciation with gene flow in equids despite extensive chromosomal plasticity*. [PNAS 111 \(2014\), 18655–18660](#).

pnas111-18655-Supplement1.xls, pnas111-18655-Supplement2.xls, pnas111-18655-Supplement3.xls, pnas111-18655-Supplement4.gz

Hákon Jónsson, Mikkel Schubert, Andaine Seguin-Orlando, Aurélien Ginolhac, Lillian Petersen, Matteo Fumagalli, Anders Albrechtsen, Bent Petersen, Thorfinn S. Korneliussen, Julia T. Vilstrup, Teri Lear, Jennifer Leigh Myka, Judith Lundquist, Donald C. Miller, Ahmed H. Alfarhan, Saleh A. Alquraishi,

Khaled A. S. Al-Rasheid, Julia Stagegaard, Günter Strauss, Mads Frost Bertelsen, Thomas Sicheritz-Ponten, Douglas F. Antczak, Ernest Bailey, Rasmus Nielsen, Eske Willerslev & Ludovic Orlando

Horses, asses, and zebras belong to a single genus, *Equus*, which emerged 4.0–4.5 Mya. Although the equine fossil record represents a textbook example of evolution, the succession of events that gave rise to the diversity of species existing today remains unclear. Here we present six genomes from each living species of asses and zebras. This completes the set of genomes available for all extant species in the genus, which was hitherto represented only by the horse and the domestic donkey. In addition, we used a museum specimen to characterize the genome of the quagga zebra, which was driven to extinction in the early 1900s. We scan the genomes for lineage-specific adaptations and identify 48 genes that have evolved under positive selection and are involved in olfaction, immune response, development, locomotion, and behavior. Our extensive genome dataset reveals a highly dynamic demographic history with synchronous expansions and collapses on different continents during the last 400 ky after major climatic events. We show that the earliest speciation occurred with gene flow in Northern America, and that the ancestor of present-day asses and zebras dispersed into the Old World 2.1–3.4 Mya. Strikingly, we also find evidence for gene flow involving three contemporary equine species despite chromosomal numbers varying from 16 pairs to 31 pairs. These findings challenge the claim that the accumulation of chromosomal rearrangements drive complete reproductive isolation, and promote equids as a fundamental model for understanding the interplay between chromosomal structure, gene flow, and, ultimately, speciation.

equids | evolutionary genomics | speciation | admixture | chromosomal rearrangements

## MURRAY 2014

Carson M. Murray et al., *Early social exposure in wild chimpanzees, Mothers with sons are more gregarious than mothers with daughters.* *PNAS* **111** (2014), 18189–18194.

Carson M. Murray, Elizabeth V. Lonsdorf, Margaret A. Stanton, Kaitlin R. Wellens, Jordan A. Miller, Jane Goodall & Anne E. Pusey

In many mammals, early social experience is critical to developing species-appropriate adult behaviors. Although mother–infant interactions play an undeniably significant role in social development, other individuals in the social milieu may also influence infant outcomes. Additionally, the social skills necessary for adult success may differ between the sexes. In chimpanzees (*Pan troglodytes*), adult males are more gregarious than females and rely on a suite of competitive and cooperative relationships to obtain access to females. In fission–fusion species, including humans and chimpanzees, subgroup composition is labile and individuals can vary the number of individuals with whom they associate. Thus, mothers in these species have a variety of social options. In this study, we investigated whether wild chimpanzee maternal subgrouping patterns differed based on infant sex. Our results show that mothers of sons were more gregarious than mothers of daughters; differences were especially pronounced during the first 6 mo of life, when infant behavior is unlikely to influence maternal subgrouping. Furthermore, mothers with sons spent significantly more time in parties containing males during the first 6 mo. These early differences foreshadow the well-documented sex differences in adult social behavior, and maternal gregariousness may provide sons with important observational learning experiences and social exposure early in life. The presence of these patterns in chimpanzees raises questions concerning the evolu-

tionary history of differential social exposure and its role in shaping sex-typical behavior in humans.

infant socialization | maternal behavior | chimpanzees | fission–fusion species

#### SCHUBERT 2014

Mikkel Schubert et al., *Prehistoric genomes reveal the genetic foundation and cost of horse domestication*. [PNAS 111 \(2014\), E5661–E5669](#).  
pnas111-E5661-Supplement.xlsx

Mikkel Schubert, Hákon Jónsson, Dan Chang, Clio Der Sarkissian, Luca Ermini, Aurélien Ginolhac, Anders Albrechtsen, Isabelle Dupanloup, Adrien Foucal, Bent Petersen, Matteo Fumagalli, Maanasa Raghavan, Andaine Seguin-Orlando, Thorfinn S. Korneliussen, Amhed M. V. Velazquez, Jesper Stenderup, Cindi A. Hoover, Carl-Johan Rubin, Ahmed H. Alfarhan, Saleh A. Alquraishi, Khaled A. S. Al-Rasheid, David E. MacHugh, Ted Kalbfleisch, James N. MacLeod, Edward M. Rubin, Thomas Sicheritz-Ponten, Leif Andersson, Michael Hofreiter, Tomas Marques-Bonet, M. Thomas P. Gilbert, Rasmus Nielsen, Laurent Excoffier, Eske Willerslev, Beth Shapiro & Ludovic Orlando

The domestication of the horse  $\approx 5.5$  kya and the emergence of mounted riding, chariotry, and cavalry dramatically transformed human civilization. However, the genetics underlying horse domestication are difficult to reconstruct, given the near extinction of wild horses. We therefore sequenced two ancient horse genomes from Taymyr, Russia (at 7.4- and 24.3-fold coverage), both predating the earliest archaeological evidence of domestication. We compared these genomes with genomes of domesticated horses and the wild Przewalski’s horse and found genetic structure within Eurasia in the Late Pleistocene, with the ancient population contributing significantly to the genetic variation of domesticated breeds. We furthermore identified a conservative set of 125 potential domestication targets using four complementary scans for genes that have undergone positive selection. One group of genes is involved in muscular and limb development, articular junctions, and the cardiac system, and may represent physiological adaptations to human utilization. A second group consists of genes with cognitive functions, including social behavior, learning capabilities, fear response, and agreeableness, which may have been key for taming horses. We also found that domestication is associated with inbreeding and an excess of deleterious mutations. This genetic load is in line with the “cost of domestication” hypothesis also reported for rice, tomatoes, and dogs, and it is generally attributed to the relaxation of purifying selection resulting from the strong demographic bottlenecks accompanying domestication. Our work demonstrates the power of ancient genomes to reconstruct the complex genetic changes that transformed wild animals into their domesticated forms, and the population context in which this process took place.

ancient DNA | horse domestication | Przewalski’s horse | positive selection | cost of domestication

#### SILK 2014

Joan B. Silk, *Mothers know best*. [PNAS 111 \(2014\), 18106–18107](#).

#### ZAZULA 2014

Grant D. Zazula et al., *American mastodon extirpation in the Arctic and Subarctic predates human colonization and terminal Pleistocene climate change*. [PNAS 111 \(2014\), 18460–18465](#).

pnas111-18460-Supplement1.doc, pnas111-18460-Supplement2.doc

Grant D. Zazula, Ross D. E. MacPhee, Jessica Z. Metcalfe, Alberto V. Reyes, Fiona Brock, Patrick S. Druckenmiller, Pamela Groves, C. Richard Harington,

Gregory W. L. Hodgins, Michael L. Kunz, Fred J. Longstaffe, Daniel H. Mann, H. Gregory McDonald, Shweta Nalawade-Chavan & John R. Southon

Existing radiocarbon ( $^{14}\text{C}$ ) dates on American mastodon (*Mammuthus americanus*) fossils from eastern Beringia (Alaska and Yukon) have been interpreted as evidence they inhabited the Arctic and Subarctic during Pleistocene full-glacial times ( $\approx 18,000$   $^{14}\text{C}$  years B.P.). However, this chronology is inconsistent with inferred habitat preferences of mastodons and correlative paleoecological evidence. To establish a last appearance date (LAD) for *M. americanus* regionally, we obtained 53 new  $^{14}\text{C}$  dates on 36 fossils, including specimens with previously published dates. Using collagen ultrafiltration and single amino acid (hydroxyproline) methods, these specimens consistently date to beyond or near the  $\approx 50,000$  y B.P. limit of  $^{14}\text{C}$  dating. Some erroneously “young”  $^{14}\text{C}$  dates are due to contamination by exogenous carbon from natural sources and conservation treatments used in museums. We suggest mastodons inhabited the high latitudes only during warm intervals, particularly the Last Interglacial [Marine Isotope Stage (MIS) 5] when boreal forests existed regionally. Our  $^{14}\text{C}$  dataset suggests that mastodons were extirpated from eastern Beringia during the MIS 4 glacial interval ( $\approx 75,000$  y ago), following the ecological shift from boreal forest to steppe tundra. Mastodons thereafter became restricted to areas south of the continental ice sheets, where they suffered complete extinction  $\approx 10,000$   $^{14}\text{C}$  years B.P. Mastodons were already absent from eastern Beringia several tens of millennia before the first humans crossed the Bering Isthmus or the onset of climate changes during the terminal Pleistocene. Local extirpations of mastodons and other megafaunal populations in eastern Beringia were asynchronous and independent of their final extinction south of the continental ice sheets.

extinctions | Pleistocene | radiocarbon | megafauna | Beringia

## Datierung

FROESE 2014

Duane Froese, *The curious case of the Arctic mastodons*. [PNAS 111 \(2014\), 18405–18406](#).

The evidence presented by Zazula et al. clearly shows that all dated mastodons from the north predate the arrival of humans by tens of millennia, and most likely date to the last interglacial period (125,000–75,000 y ago) when boreal forest and shrubs characterized eastern Beringia (15, 16). The corollary being that extirpation of the northern mastodons was quite independent of their extinction to the south of the ice sheets, where they survived until  $\approx 10,000$   $^{14}\text{C}$  y B.P. Zazula et al.’s paper underscores the importance of establishing individual species’ responses to forcing mechanisms to understand the collective problem of the late Pleistocene megafauna extinctions. The regular oscillation of environmental extremes between boreal forest during interglacials and steppe-tundra during glacials has been established through diverse archives of late Quaternary environmental data in northwestern Canada and Alaska. Given the habitat preference of mastodons and mammoths, we predict that their populations similarly waxed and waned during these oscillations. In the case of grazers, one should expect an inverse response to that of a browser such as the mastodon; that is, the grazer populations should contract and browser populations expand during an interglacial as steppe-tundra is replaced by boreal forest. During the latest Pleistocene (14,000–10,000  $^{14}\text{C}$  y B.P.), when we have precise radiocarbon chronologies available, this was the case as elk and moose replaced mammoths and horses.



## Energie

KANG 2014

Mary Kang et al., *Direct measurements of methane emissions from abandoned oil and gas wells in Pennsylvania*. *PNAS* **111** (2014), 18173–18177.

Mary Kang, Cynthia M. Kanno, Matthew C. Reid, Xin Zhang, Denise L. Mauzerall, Michael A. Celia, Yuheng Chen & Tullis C. Onstott

Abandoned oil and gas wells provide a potential pathway for subsurface migration and emissions of methane and other fluids to the atmosphere. Little is known about methane fluxes from the millions of abandoned wells that exist in the United States. Here, we report direct measurements of methane fluxes from abandoned oil and gas wells in Pennsylvania, using static flux chambers. A total of 42 and 52 direct measurements were made at wells and at locations near the wells ("controls") in forested, wetland, grassland, and river areas in July, August, October 2013 and January 2014, respectively. The mean methane flow rates at these well locations were 0.27 kg/d/well, and the mean methane flow rate at the control locations was  $4.5 \times 10^{-6}$  kg/d/location. Three out of the 19 measured wells were high emitters that had methane flow rates that were three orders of magnitude larger than the median flow rate of  $1.3 \times 10^{-3}$  kg/d/well. Assuming the mean flow rate found here is representative of all abandoned wells in Pennsylvania, we scaled the methane emissions to be 4–7% of estimated total anthropogenic methane emissions in Pennsylvania. The presence of ethane, propane, and n-butane, along with the methane isotopic composition, indicate that the emitted methane is predominantly of thermogenic origin. These measurements show that methane emissions from abandoned oil and gas wells can be significant. The research required to quantify these emissions nationally should be undertaken so they can be accurately described and included in greenhouse gas emissions inventories.

methane emissions | oil and gas | abandoned wells | hydrocarbons | isotopes

## Kultur

MITHEN 2012

Steven Mithen & Sue Mithen, *Thirst, Water and power in the ancient world*. (London 2013).

The planet faces a 21st-century global water crisis – but to what extent is this really new? Past societies and ancient civilisations have always faced climate change and been dependent on their ability to harness and manage a water supply. This has often been a key driver of historical change, leading to some of the most remarkable engineering projects of antiquity.

In *Thirst*, renowned archaeologist and prehistorian Steven Mithen examines the history of water management in the ancient world. From the first flushing toilets at Knossos on Minoan Crete to the aqueducts of Petra and the Incas, from the bath houses of Rome to the canals of ancient China and the vast reservoirs of the Khmer and Maya civilisations, water management is shown to have been not only essential for human survival but a source of political power. It will remain so as we face global climate change, population growth and mega-urbanisation on a massive scale. So, does the past give us reason for hope or for despair?

## Methoden

FLYNN 2014

Peter Flynn, *Human interfaces to structured documents, The usability of software for authoring and editing*. Dissertation, University College Cork (Cork 2014). <http://hdl.handle.net/10468/1690>.

This research investigates why non-technical writers appear to have difficulties using software for editing structured documents, and the low adoption rate of such software in environments where structured documents are written and used. It examines the background of structured documents, the nature of the software, and the measurements that can be made to test usability. Four studies were carried out among experts in the field, existing users, potential users asking about software, and with the software itself. A representative set of functions was derived for which an alternative interface or behaviour could be devised. These new functions were tested in a paper prototype by writers unaware of the existence of structured editors. The results indicate that making the functions do what the users expected, and making them easier to recognise, could lead to improvements in writing efficiency, and to greater effectiveness in the construction of a structured document without the user needing to see or know the markup.

KNAUFF 2014

Markus Knauff & Jelica Nejasmic, *An Efficiency Comparison of Document Preparation Systems Used in Academic Research and Development*. *PLoS ONE* **9** (2014), e115069.

[DOI:10.1371/journal.pone.0115069](https://doi.org/10.1371/journal.pone.0115069).

[pone09-e115069-Supplement1.xlsx](#), [pone09-e115069-Supplement2.txt](#), [pone09-e115069-Supplement3.pdf](#)

The choice of an efficient document preparation system is an important decision for any academic researcher. To assist the research community, we report a software usability study in which 40 researchers across different disciplines prepared scholarly texts with either Microsoft Word or LaTeX. The probe texts included simple continuous text, text with tables and subheadings, and complex text with several mathematical equations. We show that LaTeX users were slower than Word users, wrote less text in the same amount of time, and produced more typesetting, orthographical, grammatical, and formatting errors. On most measures, expert LaTeX users performed even worse than novice Word users. LaTeX users, however, more often report enjoying using their respective software. We conclude that even experienced LaTeX users may suffer a loss in productivity when LaTeX is used, relative to other document preparation systems. Individuals, institutions, and journals should carefully consider the ramifications of this finding when choosing document preparation strategies, or requiring them of authors.