

## References

### Aktuell

#### CERIOLI 2019

Andrea Cerioli, Lucio Barabesi, Andrea Cerasa, Mario Menegatti & Domenico Perrotta, *Newcomb–Benford law and the detection of frauds in international trade*. [PNAS 116 \(2019\), 106–115](#).

[pnas116-00106-Supplement.pdf](#)

The contrast of fraud in international trade is a crucial task of modern economic regulations. We develop statistical tools for the detection of frauds in customs declarations that rely on the Newcomb–Benford law for significant digits. Our first contribution is to show the features, in the context of a European Union market, of the traders for which the law should hold in the absence of fraudulent data manipulation. Our results shed light on a relevant and debated question, since no general known theory can exactly predict validity of the law for genuine empirical data. We also provide approximations to the distribution of test statistics when the Newcomb–Benford law does not hold. These approximations open the door to the development of modified goodness-of-fit procedures with wide applicability and good inferential properties.

**Keywords:** statistical antifraud analysis | Newcomb–Benford law | customs fraud | customs valuation | anomaly detection

**Significance:** The detection of frauds is one of the most prominent applications of the Newcomb–Benford law for significant digits. However, no general theory can exactly anticipate whether this law provides a valid model for genuine, that is, nonfraudulent, empirical observations, whose generating process cannot be known with certainty. Our first aim is then to establish conditions for the validity of the Newcomb–Benford law in the field of international trade data, where frauds typically involve huge amounts of money and constitute a major threat for national budgets. We also provide approximations to the distribution of test statistics when the Newcomb–Benford law does not hold, thus opening the door to the development of statistical procedures with good inferential properties and wide applicability.

#### GUTERSTAM 2019

Arvid Guterstam, Hope H. Kean, Taylor W. Webb, Faith S. Kean & Michael S. A. Graziano, *Implicit model of other people’s visual attention as an invisible, force-carrying beam projecting from the eyes*. [PNAS 116 \(2019\), 328–333](#).

As a part of social cognition, people automatically construct rich models of other people’s vision. Here we show that when people judge the mechanical forces acting on an object, their judgments are biased by another person gazing at the object. The bias is consistent with an implicit perception that gaze adds a gentle force, pushing on the object. The bias was present even though the participants were not explicitly aware of it and claimed that they did not believe in an extra-mission view of vision (a common folk view of vision in which the eyes emit an invisible energy). A similar result was not obtained on control trials when participants saw a blindfolded face turned toward the object, or a face with open eyes turned away from the object. The findings suggest that people automatically and

implicitly generate a model of other people's vision that uses the simplifying construct of beams coming out of the eyes. This implicit model of active gaze may be a hidden, yet fundamental, part of the rich process of social cognition, contributing to how we perceive visual agency. It may also help explain the extraordinary cultural persistence of the extramission myth of vision.

**Keywords:** gaze | social cognition | theory of mind | spatial perception | visual attention

**Significance:** Much of how people process other social agents is hidden under the surface of awareness. Here we report that people automatically and unconsciously treat other people's eyes as if beams of force-carrying energy emanate from them, gently pushing on objects in the world. The findings show how the human brain constructs surprising, rich, and at the same time schematized models of other people's internal processes such as visual attention.

## LACASA 2019

Lucas Lacasa, *Newcomb–Benford law helps customs officers to detect fraud in international trade*. [PNAS 116 \(2019\), 11–13](#).

As a result, traders can be classified into three groups: (i) legitimate traders whose activity conforms to the NBL, (ii) traders whose activity is still legitimate but does not conform to the NBL due to controlled factors, and (iii) traders whose activity does not conform to the NBL even when it should, probably due to data fabrication.

## Biologie

## EHRMANN 2005

Otto Ehrmann & Manfred Rösch, *Experimente zum neolithischen Wald-Feldbau in Forchtenberg, Einsatz und Auswirkungen des Feuers, Erträge und Probleme des Getreideanbaus – Bericht 2000–2002*. In: *Zu den Wurzeln europäischer Kulturlandschaft – experimentelle Forschungen, Wissenschaftliche Tagung Schöntal 2002 – Tagungsband; Gerhard Lang zum 80. Geburtstag gewidmet*. Materialhefte zur Archäologie (Stuttgart 2005), 109–140.

## RÖSCH 2017

Manfred Rösch et al., *Late Neolithic Agriculture in Temperate Europe, A Long-Term Experimental Approach*. [Land 6 \(2017\), xi, 1–17](#).

Manfred Rösch, Harald Biester, Arno Bogenrieder, Eileen Eckmeier, Otto Ehrmann, Renate Gerlach, Mathias Hall, Christoph Hartkopf-Fröder, Ludger Herrmann, Birgit Kury, Jutta Lechterbeck, Wolfram Schier & Erhard Schulz

Long-term slash-and-burn experiments, when compared with intensive tillage without manuring, resulted in a huge data set relating to potential crop yields, depending on soil quality, crop type, and agricultural measures. Cultivation without manuring or fallow phases did not produce satisfying yields, and mono-season cropping on freshly cleared and burned plots resulted in rather high yields, comparable to those produced during modern industrial agriculture – at least ten-fold the ones estimated for the medieval period. Continuous cultivation on the same plot, using imported wood from adjacent areas as fuel, causes decreasing yields over several years. The high yield of the first harvest of a slash-and-burn agriculture is caused by nutrient input through the ash produced and mobilization from the organic matter of the topsoil, due to high soil temperatures during the

burning process and higher topsoil temperatures due to the soil's black surface. The harvested crops are pure, without contamination of any weeds. Considering the amount of work required to fight weeds without burning, the slash-and-burn technique yields much better results than any other tested agricultural approach. Therefore, in dense woodland, without optimal soils and climate, slash-and-burn agriculture seems to be the best, if not the only, feasible method to start agriculture, for example, during the Late Neolithic, when agriculture expanded from the loess belt into landscapes less suitable for agriculture. Extensive and cultivation with manuring is more practical in an already-open landscape and with a denser population, but its efficiency in terms of the ratio of the manpower input to food output, is worse. Slash-and-burn agriculture is not only a phenomenon of temperate European agriculture during the Neolithic, but played a major role in land-use in forested regions worldwide, creating anthromes on a huge spatial scale.

**Keywords:** Neolithic agriculture | experimental archaeology | slash-and-burn | temperate Europe

## Klima

### CAROLIN 2019

Stacy A. Carolin et al., *Precise timing of abrupt increase in dust activity in the Middle East coincident with 4.2 ka social change*. [PNAS 116 \(2019\), 67–72](#).

[pnas116-00067-Supplement1.pdf](#), [pnas116-00067-Supplement2.xlsx](#), [pnas116-00067-Supplement3.xlsx](#), [pnas116-00067-Supplement4.xlsx](#)

Stacy A. Carolin, Richard T. Walker, Christopher C. Day, Vasile Ersek, R. Alastair Sloan, Michael W. Dee, Morteza Talebian & Gideon M. Henderson

The extent to which climate change causes significant societal disruption remains controversial. An important example is the decline of the Akkadian Empire in northern Mesopotamia  $\approx 4.2$  ka, for which the existence of a coincident climate event is still uncertain. Here we present an Iranian stalagmite record spanning 5.2 ka to 3.7 ka, dated with 25 U/Th ages that provide an average age uncertainty of 31 y ( $1\sigma$ ). We find two periods of increased Mg/Ca, beginning abruptly at 4.51 and 4.26 ka, and lasting 110 and 290 y, respectively. Each of these periods coincides with slower vertical stalagmite growth and a gradual increase in stable oxygen isotope ratios. The periods of high Mg/Ca are explained by periods of increased dust flux sourced from the Mesopotamia region, and the abrupt onset of this dustiness indicates threshold behavior in response to aridity. This interpretation is consistent with existing marine and terrestrial records from the broad region, which also suggest that the later, longer event beginning at 4.26 ka is of greater regional extent and/or amplitude. The chronological precision and high resolution of our record indicates that there is no significant difference, at decadal level, between the start date of the second, larger dust event and the timing of North Mesopotamia settlement abandonment, and furthermore reveals striking similarity between the total duration of the second dust event and settlement abandonment. The Iranian record demonstrates this region's threshold behavior in dust production, and its ability to maintain this climate state for multiple centuries naturally.

**Keywords:** 4.2 ka event | stalagmite | drought | Mesopotamia | dust

**Significance:** A speleothem geochemical record from northern Iran captures significant climate fluctuations during the mid-to-late Holocene at high resolution. Two abrupt shifts in Mg/Ca last for more than a century and are interpreted as enhanced dust activity, indicating a threshold behavior in response to aridity. Coincident gradual peaks in  $d_{18}O$  support the interpretation of regional drying. The

precise chronology shows the later event, 4.26 ka to 3.97 ka, is coincident within decades of the period of abandonment of advanced urban settlements in northern Mesopotamia, strengthening the argument for association between societal and climatic change. The record demonstrates the abrupt onset of dust production in the region and ability to maintain this dry climate state for multiple centuries naturally.

GAO 2019

Jing Gao, Tandong Yao, Valérie Masson-Delmotte, Hans Christian Steen-Larsen & Weicai Wang, *Collapsing glaciers threaten Asia's water supplies*. [nature](#) **565** (2019), 19–21.

Tracking moisture, snow and meltwater across the 'third pole' will help communities to plan for climate change, argue Jing Gao and colleagues.

## Neolithikum

BAUM 2014

Tilman Georg Baum, *Models of wetland settlement and associated land use in South-West Germany during the fourth millennium B.C.* [Vegetation History and Archaeobotany](#) **23** (2014), Supplement, S67–S80.

A GIS-based modelling approach is presented that interprets existing data on subsistence strategies of pile-dwelling people of the Lake Constance area in South-Western Germany and North-Eastern Switzerland. This is conducted using the examples of the settlement sites at Hornstaad-Hörnle 1, Sipplingen-Osthafen and Degersee. Soil distribution and the geomorphologic features of a landscape are used as the basis for illustrating various scenarios of land use depicting hypotheses of economic strategies and aspects of the human-environment-system. In particular the implications of the crop system and the discussion about Shifting Cultivation or Intensive Garden Cultivation are used as different modelling inputs, alongside the spatial demand for cattle herding and for the extraction of timber. The Carrying Capacity of the landscape around the three settlement sites is calculated with respect to the agricultural system applied.

Keywords: GIS | Carrying Capacity | Wetland archaeology | Landscape archaeology | Archaeological modeling | Neolithic land use

BAUM 2016

Tilman Baum, Claas Nendel, Stefanie Jacomet, Miquel Colobran & Renate Ebersbach, *“Slash and burn” or “weed and manure”? A modelling approach to explore hypotheses of late Neolithic crop cultivation in prealpine wetland sites*. [Vegetation History and Archaeobotany](#) **25** (2016), 611–627.

The record of prehistoric crop cultivation in central Europe dates as far back as 5500 BC. In the piledwellings of the north-western pre-alpine forelands, dating roughly from 4300 to 800 BC, favourable taphonomic conditions provide evidence for the ways of cereal cultivation and consumption in unmatched detail. Based on different sets of (bio-) archaeological and palynological evidence, different hypotheses of crop husbandry methods have been developed for the wetland settlements. During the late Neolithic, two partly antithetic ideas are discussed: On one hand Shifting Cultivation assumes frequently shifted crop fields and the use of fire

to provide nitrogen for plant uptake; On the other hand Permanent Cultivation reconstructs longer-ranging use of the fields, to which nitrogen may have been provided by various means. From the Bronze Age onwards, most probably some form of extensive arid cultivation was applied. In this article, we explore the implications of the different hypotheses for the socio-ecological system of the wetland sites. We combine the capability of agent-based modelling to simulate dynamic processes with the benefits provided by geographical information systems and the possibilities provided by the use of modern agro-ecosystem modelling tools. First, we used a mechanistic crop growth model, MONICA, to evaluate the influence of important factors of prehistoric crop yield formation: the climatic conditions, the soil texture and the degree of nitrogen availability. Second, we applied an agent-based model (WELASSIMO\_crops) to simulate the spatial and economic implications related to the different crop husbandry Methods. Our results provide quantitative information on the extent of crop husbandry activities in the wetland sites and on the effect of natural and anthropogenic factors on prehistoric crop yields. Without manure application, initial average yields of 1.0 t ha<sup>-1</sup> a<sup>-1</sup> are shown to decrease rapidly to only 50 % after 10 years. A manuring rate of 10 t ha<sup>-1</sup> a<sup>-1</sup> allows for higher yields of 1.7 t ha<sup>-1</sup> a<sup>-1</sup> and a slower rate of fertility decrease, but requires high numbers of livestock per capita. In shifting cultivation, high yields of 2.7 t ha<sup>-1</sup> a<sup>-1</sup> are reasonable, while necessitating a very large area and high labour input. Using the model results and a case study, we argue that permanent cultivation is more likely to have been the standard method, while burning of the landscape may have had different objectives than crop husbandry. We find that the combination of agent-based social and process-based biophysical modelling is a powerful tool to study the complex interdependencies in human-environment systems in the past.

**Keywords:** Prehistoric crop husbandry | Wetland settlements | Land use | Agent-based model (ABM) | Crop growth model

## JACOMET 2016

Stefanie Jacomet et al., *On-site data cast doubts on the hypothesis of shifting cultivation in the late Neolithic (c. 4300–2400 cal. BC), Landscape management as an alternative paradigm. The Holocene* **26** (2016), 1858–1874.

Stefanie Jacomet, Renate Ebersbach, Örne Akeret, Ferran Antolín, Tilman Baum, Amy Bogaard, Christoph Brombacher, Niels K. Bleicher, Annekathi Heitz-Weniger, Heide Hüster-Plogmann, Eda Gross, Marlu Kühn, Philippe Rentzel, Bigna L. Steiner, Lucia Wick & Jörg M. Schibler

This article brings together in a comprehensive way, and for the first time, on- and off-site palaeoenvironmental data from the area of the Central European lake dwellings (a UNESCO World Cultural Heritage Site since 2011). The types of data considered are as follows: high-resolution off-site pollen cores, including micro-charcoal counts, and on-site data, including botanical macro- and micro-remains, hand-collected animal bones, remains of microfauna, and data on woodland management (dendrotypology). The period considered is the late Neolithic (c. 4300–2400 cal. BC). For this period, especially for its earlier phases, discussions of land-use patterns are contradictory. Based on off-site data, slash-and-burn – as known from tropical regions – is thought to be the only possible way to cultivate the land. On-site data however show a completely different picture: all indications point to the permanent cultivation of cereals (*Triticum* spp., *Hordeum vulgare*), pea (*Pisum sativum*), flax (*Linum usitatissimum*) and opium-poppy (*Papaver somniferum*). Cycles of landscape use are traceable, including coppicing and moving around the landscape with animal herds. Archaeobiological studies further indicate also that hunting and gathering were an important component and that the land-

scape was manipulated accordingly. Late Neolithic land-use systems also included the use of fire as a tool for opening up the landscape. Here we argue that bringing together all the types of palaeoenvironmental proxies in an integrative way allows us to draw a more comprehensive and reliable picture of the land-use systems in the late Neolithic than had been reconstructed previously largely on the basis of off-site data.

**Keywords:** archaeobotany | archaeozoology | Central Europe | niche construction | type of farming | use of fire | wetland settlements

## RÖSCH 1987

Manfred Rösch, *Zur Umwelt und Wirtschaft des Jungneolithikums am Bodensee, Botanische Untersuchungen in Bodman-Blissenhalde. Archäologische Nachrichten aus Baden* **38** (1987), 42–53.

Wie die bisherigen Ausführungen zu zeigen versuchten, wurde im Zuge der jungneolithischen Besiedlung mit Brandschicht- die Waldzusammensetzung großflächig und nachhaltig verändert. Es entstanden ackerbaulich genutzte Flächen und darüber hinaus sammlerisch genutzte Sekundärstandorte. Die große Bedeutung dieser durch Sanimeltätigkeit gewonnenen pflanzlichen Nahrung (Erdbeeren, Himbeeren, Brombeeren, Holzäpfel, Haselnüsse, um nur einige herauszugreifen) legt eine größere Flächenausdehnung der sie beherbergenden Standorte nahe, als dies in der heutigen Kulturlandschaft der Fall ist und als dies auch in der Urlandschaft vor der neolithischen Besiedlung der Fall war. Für die Entstehung dieser Flächen sind zwei Erklärungsmöglichkeiten denkbar: Erstens erzeugen viele kleine Lichtungen mehr Randstandorte für Gebüsche und Krautsäume als eine große Lichtung gleicher Fläche, und für enge Nachbarschaft der Felder zum Wald sprechen auch die in Kulturpflanzenvorräten nachgewiesenen Unkräuter. Unter ihnen sind kaum typische Unkräuter heutiger Äcker, sondern hauptsächlich mehrjährige und einigermaßen schattfeste Arten, die heute vor allem an Waldrändern und Ruderalstellen wachsen, wo keine regelmäßige Bodenbearbeitung stattfindet. Zweitens stellen Staudenfluren und Gebüsche mit den erwähnten und anderen nachgewiesenen Arten Übergangsstadien der Rückentwicklung zum geschlossenen Wald dar, wie sie abläuft, wenn man eine gerodete Fläche sich selbst überläßt oder nur noch in ganz bestimmter schonender Weise beeinflußt. Unterbricht man diese sogenannte “regressive Sukzession” nach 15 bis 20 Jahren durch erneuten Einschlag, wird der Übergangs- zum Dauerzustand. Und man erhält mit dieser Art “Niederwaldwirtschaft” gegenüber einem Naturwald – bei etwa gleichbleibender Biomassegesamtproduktion – einen enormen Zuwachs an nutzbaren pflanzlichen Rohstoffen.

## RÖSCH 2014

Manfred Rösch, Angelika Kleinmann, Jutta Lechterbeck & Lucia Wick, *Botanical off-site and on-site data as indicators of different land use systems, A discussion with examples from Southwest Germany. Vegetation History and Archaeobotany* **23** (2014), Supplement, S121–S133.

Off-site pollen data as well as onsite plant macrofossil data from Southwest Germany enable the distinguishing of three main phases of agricultural land use history. The last phase, here simplified called the “Extensive ard phase”, had already started in the Bronze Age and ends in the 19th century A.D. It is characterized by extensive land management, permanent fields with short fallow phases, ploughing, the use of animal dung as fertilizer, and grazed woodlands. The first phase, comprising the Old and Middle Neolithic, is characterized by hoe-farming only on very fertile soils and a very restricted set of crops. For the second phase, comprising the

Young, Late and Final Neolithic, a slash-and-burn-like agricultural system is most probable. During the Late and Final Neolithic, this cultivation system with fire use and shifting fields was gradually practised on permanent fields and was modified, leading finally to the “Extensive ard” land use system with fertilizer and ploughing instead of burning.

Keywords: Land use systems | Prehistory | Temperate Europe | Pollen data | Plant macrofossil data

## Ostasien

HU 2019

Yue Hu, Ben Marwick, Jia-Fu Zhang, Xue Rui, Ya-Mei Hou, Jian-Ping Yue, Wen-Rong Chen, Wei-Wen Huang & Bo Li, *Late Middle Pleistocene Levallois stone-tool technology in southwest China*. [nature](#) **565** (2019), 82–85.

n565-0082-Supplement.pdf

Levallois approaches are one of the best known variants of prepared-core technologies, and are an important hallmark of stone technologies developed around 300,000 years ago in Africa and west Eurasia<sup>1,2</sup>. Existing archaeological evidence suggests that the stone technology of east Asian hominins lacked a Levallois component during the late Middle Pleistocene epoch and it is not until the Late Pleistocene (around 40,000–30,000 years ago) that this technology spread into east Asia in association with a dispersal of modern humans. Here we present evidence of Levallois technology from the lithic assemblage of the Guanyindong Cave site in southwest China, dated to approximately 170,000–80,000 years ago. To our knowledge, this is the earliest evidence of Levallois technology in east Asia. Our findings thus challenge the existing model of the origin and spread of Levallois technologies in east Asia and its links to a Late Pleistocene dispersal of modern humans.