International Conference

Percussive Technology and Human Evolution

(London 18th-19th September 2014)

ABSTRACTS

The limestone percussion tools from the Lower Pleistocene sites of Barranco León and Fuente Nueva 3 (Orce, Spain)

Deborah Barsky, Josep-Maria Vergès, Robert Sala, Isidro Toro-Moyano

Institut Català de Paleoecologia Humana i Evolució Social (IPHES). Area de Prehistoria, Universitat Rovira i Virgili (URV)

Since their discovery in the 1990's, Barranco León and Fuente Nueva 3 (Orce, Spain) have yielded some of the richest and best preserved lithic and faunal evidences for a Late Lower Pleistocene hominin presence in Western Europe. Situated on the shores of the paleo-lake Baza in the Guadix-Baza depression, these sites provide a rare window to study and interpret earliest hominin activities. The stone tool assemblages show a clear dichotomy between small-sized flint knapping waste and much larger limestone toolkits, composed mainly of hammerstones. Nearly half of the limestone collected displays a remarkably wide range of traces attributed to battering, such as: fracture angles, crush marks, facetted negatives, pitting, etc. This remarkable assemblage has sparked renewed interest in the study of the - sometimes neglected- 'macro' tools in early assemblages, which can provide precious information about the kinds of activities being carried out at Oldowan sites. This renewed research objective has led to the elaboration of a new morpho-technological methodology for the study and inter-site comparison of Oldowan macro toolkits worldwide. Experiments have been carried out in order to better understand percussive trace morphologies and intensity in relation to the formal qualities of the tools (e.g. shape, size). A variety of tasks were experimentally reproduced to test a series of possible activities that could have been performed on-site: bone breaking, flint and limestone core reduction, woodworking. Finally, surveying has opened up new perspectives for understanding how the limestone was introduced into the sites and the role of expediency in its exploitation.

Nut cracking with tools in Chimpanzees and Aka hunter-gatherers

Christophe Boesch

Max Planck Institute for Evolutionary Anthropology, Department of Primatology

In an attempt to answer the question, "What makes us human?", humans and chimpanzees have often been compared in situations that were not directly comparable. Aka hunter-gatherers in the forests of Central African Republic and chimpanzees in the Taï National Park, Côte d'Ivoire, have for generations cracked wild nuts for food, and therefore these two groups offer one of the best opportunities to compare the two species tool-use in a totally natural setting. Sequential analyses of the nut-cracking techniques reveal a large amount of overlap in the way the two populations crack nuts, with both using exactly the same technical chains for small nut species. For larger-sized nuts, however, some important differences emerge. Aka foragers incorporate metal tools in their technique, thereby gaining access to a wider variety of wild nut species than chimpanzees. As a result, the nut-cracking technique of the Aka foragers is less variable than that of the Taï chimpanzees and the limited availability of metal tools implies that fewer individuals within the group have a direct access to the nuts. In addition, if nut cracking efficiencies are higher in the Aka women compared to Taï chimpanzee females, they are also more variable in the Aka than in the chimpanzees. These results are discussed in light of the evolution of tool selection and use as well as tool complexity in chimpanzees and humans.

How similar are stone flaking and nut cracking? A functional approach to percussive technology provides a better understanding of commonalities and differences between nut-cracking and stone-flaking

Blandine Bril

École des Hautes Études en Sciences Sociales

Various authors have suggested similarities between tool-use in early hominins and chimpanzees nut cracking considered as the most complex skill found among wild apes, where nut cracking might be interpreted as a precursor of more complex stone flaking. It has been argued that there is no major qualitative difference between what the chimpanzee does when he cracks a nut and what early hominins did when they detached a flake from a core. The question is then: do the skills necessary to produce organised sequences of flaking and nut cracking activity requires similar or different skills and different levels of functional understanding of the percussive action.

Based on our recent work on experts and novices stone flaking, and chimpanzees and humans (children and adults) nut cracking activity, we shall examine similarities and differences of skills involved in these two tasks. We suggest that a "functional" approach to percussive action, based on the distinction between functional parameters that characterise the task and parameters that characterize the agent actions and movements appears as a fruitful way to better understand what constraints have to be mastered to perform each task successfully and subsequently that nature of skill involved in both tasks.

Nut cracking and stone knapping differ in task conditions because conchoidal fracture of a stone core requires more precise movement control, and an asymmetrical use of both hands, characterized by the simultaneous control of at least two variables (reciprocal orientation of the core and of the trajectory of the hammer, which keeps varying during the sequences of blows).

Based on a movement science framework, we developed a methodological and theoretical approach to the motor and cognitive skills involved in percussive actions that should contribute to the on-going debate on the origin of percussive technologies.

Reference

Bril, B.,Smaers J., Steele, J., Rein, R., Nonaka, T., Dietrich, G., Biryukova, E., Hirata, S., Roux, V. (2012) Functional mastery of percussive technology in nut cracking and stone flaking: experimental data and implication for the human brain. *Philosophical Transaction of the Royal Society: Biology*, 367(1585), 59-74.

From percussion marks to identification of unknapped stone tools function in the Upper Paleolithic.

Sophie A. de Beaune

Jean Moulin Lyon 3 University & UMR 7041 "Archéologies et Sciences de l'Antiquité", Nanterre

Among the remains recovered from Upper Paleolithic living surfaces, an entire category of stone objects is rarely studied in detail. This category consists of blocks, cobbles, and "plaquettes", which were used in a rough state and which display traces of use such as use-polish or impact-marks from percussion. Some of these objects played roles as passive blanks: anvils, grindstones, mortars, palettes. Others could have played active roles: hammerstones, mulling stones, pestles, etc. These implements could have been used in tool manufacture (anvils, mallets, whetstones, etc.); in the treatment of vegetal materials and in food preparation (mortars, pestles, grindstones, mulling stones); in storing various ingredients (containers); in the preparation of pigments (ocher bowls, palettes, color grinders); in the treatment of hide or leather (smoothing tools); and in illumination (lamps). It is apparent, therefore, that these implements, although not very numerous at Paleolithic sites, probably played a fundamental role in the daily life of Upper Paleolithic people.

I will present here the methods I adopted to study these primitive tools and to identify the actions associated with them, their functions and the activities to which they were linked.

Stones on the move: The real life of a chimpanzee tool

Susana Carvalho[1,3], Tetsuro Matsuzawa[2,3]

1 Centre for the Advanced Study of Hominid Paleobiology, George Washington University, USA

2 Primate Research Institute, University of Kyoto, Japan

3 Leading Graduate Program in Primatology and Wildlife Science (PWS), University of Kyoto, Japan

One of the few characteristics thought to distinguish technological behaviour in early hominin (ca. 2.6 million years ago) from that our closest living relatives focuses on the long-distance transport of materials or tools by humans. Such implied advance planning would contrast with the opportunism of living chimpanzees transporting raw materials or tools over relatively short distances. But no one has ever looked to see how far these tools travel, and in what ways. This issue is of evolutionary importance because long distance transport remains one key difference between hominins and other apes that is supposedly linked to cognitive processing unique to hominins. The aim of this study is to test the hypothesis that the purported strategies of transport of resources by early hominins have been misconstrued and instead may be similar to the transport of objects by extant chimpanzees. We have devised a novel technology that tracks the movements of chimpanzee stone tools, in the forest of Bossou, Guinea. Such technology has never before been adapted and applied to inanimate objects. This research we enable us to understand the temporal and spatial dynamics of transport, on-site selection, use, and discard, and transport within and between chimpanzee sites. In this paper we will report preliminary results concerning the accuracy and robustness of this method, after ongoing laboratorial testing. This pioneering study will shed new light on the 'lives' of chimpanzee stone tools. It will provide a comparative context and criteria to enable a realistic assessment of where, when and how the behaviour of early hominins departs from that of our closest living relatives.

The development of percussive technology in the Levant: Insights from use-wear analysis of early Epipaleolithic tools.

Laure Dubreuil, Dani Nadel

Department of Anthropology, Trent University

In recent years, percussive technology has been used to inform the evolution of human cognition, especially with regard to the development of specific kinetics, techniques and knowledge enabling the transformation and exploitation of new resources. For instance, research on percussive technology has investigated early evidence for flour production, which is frequently perceived as an important step in the evolution of plant resource exploitation. This research has led to the rise of in-depth analyses of percussive tools. Among the various approaches now available, use-wear analysis offers a unique perspective on these problems because it may generate critical information on tool kinetics and the range of activities that were performed with the tools. In addition, use-wear analysis may shed light on manufacturing techniques, curation, recycling and discard behaviours, which are crucial for discussing the economic, social and symbolic contexts in which the activity was practiced. In order to better understand the evolution of percussive technology and the emergence of specific kinetic such as pounding or grinding, the present paper focuses on tools attributed to mobile hunter-gatherer societies in the Levant. Using materials from Ohalo II, a site dated to the early epipaleolithic period, we discuss how the use-wear data may produce valuable information about investment in tool manufacture, pounding and grinding activities, as well as discard strategies in prehistoric settings.

A new type of Acheulian anvil from Gesher Benot Ya'aqov, Israel

Naama Goren-Inbar, Nira Alperson-Afil, Gonen Sharon, Gadi Herzlinger

Hebrew University, Jerusalem

We report here on the identification and characterization of thin basalt anvils, a newly discovered component of the Acheulian lithic inventory of GBY. These tools are an addition to the array of percussive tools (percussors, pitted stones and anvils) made on basalt, flint and limestone.

The thin anvils were selected from particularly compact, horizontally fissured zones of basalt flows. This type of fissuring produces a natural geometry of thick and thin slabs. Hominins at GBY had multiple acquisition strategies, including the selection of thick slabs for the production of giant cores and that of cobbles for percussors. The selection of thin slabs was carried out according to yet another independent and targeted plan.

The fragility of the thin anvils dictated a limited range of functions. The use of the anvils is well documented on their surfaces and edges. Two types of rock damage are identified: those resulting from activities carried out on the surfaces of the anvils and those resulting from unintentional forceful blows (accidents de travaille).

Percussive activities that may have been associated with the thin anvils include nut cracking and the processing of meat and delicate bones, as well as plants. Additional detailed study incorporating experimental aspects is needed to assign specific damage patterns to different functions.

New tools with old techniques: the role of bipolar and passive hammer percussions in the development of earliest hominin lithic technologies

Sonia Harmand[1,2], Hélène Roche[2] Michel Brenet[3], Adrian Arroyo[4], Jason Lewis[1], Guillaume Daver[5], Sandrine Prat[2].

1.TBI, Stoney Brook University 2. CNRS, 3. Institut National de Recherches Archéologiques Préventives (INRAP). 4 Institute of Archaeology, UCL. 5. Université de Poitiers

The role of tool-use and stone tool-making in understanding the evolution of hominin technical behaviour has been studied extensively by archaeologists –who often favoured hard hammer direct percussion to obtain cutting edges, and by primatologists -who often emphasized on pounding activities to crack-open nuts. On the other hand, given the level of skill observed on the archaeological material of some of the Early Oldowan assemblages, there has been growing consensus on the probability that stone knapping comes before this techno-complex started to develop ca. 2.6 Ma. But did the earliest stone knapping develop naturally from pre-existing pounding behaviours, or did it appear de novo as direct hard hammer flaking for cutting edges? Although not driven by the same intention, the actions employed by nonhuman primates when engaging in pounding behaviours are biomechanically similar to the bipolar and passive hammer percussion techniques, but these have been little studied in replication experiments aimed at understanding the development of the earliest hominin lithic technologies. Initial results from a new experimental program are presented here, showing that bipolar and passive hammer percussions are expedient techniques for producing sturdy cutting flakes and trenchant cores, and that Pliocene hominins may have been more capable with these gestures than with direct hard-hammer percussion.

Object manipulation and action grammar in primates

Misato Hayashi

Primate Research Institute (PRI), Kyoto University

The skill of object manipulation is the common feature of primates including humans although there are species-typical manipulative patterns. Object manipulation can be used as a comparative scale of cognitive development focusing on its complexity. Nut cracking in chimpanzees has the highest hierarchical complexity among the tool use reported in nonhuman primates. Analysis on the patterns of object manipulation in naïve chimpanzees after nut-cracking demonstrations revealed the cause of difficulties in learning the nut-cracking behaviour. Various types of behaviours exhibited during nut-cracking context can be examined in terms of strategies applied in a problem solving situation focusing on their causal understanding or intentionality. Captive chimpanzees also exhibit complex form of combinatory manipulation which is the precursor of tool use. A new notation system of object manipulation was invented in order to assess grammatical rules in manipulative actions. The notation system enabled the direct comparison among primates including humans in a variety of object manipulation tasks.

Percussion Technologies among Recent Hunter/gatherers and Their Relevance to Early Hominins

Brian Hayden

Simon Fraser University

While large anatomical, cognitive, and temporal gulfs exist between the users of Lower Paleolithic and recent stone technologies, in some cases it seems that at least some of the problems and technological solutions were the same or similar. Thus, by studying recent percussive stone technologies and carefully considering their contexts, constraints, and kinds of problems they helped solve, helpful insights and models may be generated concerning how and why the first percussive stone technologies were developed. Some of the key considerations in making such comparisons include focusing on comparable environments, comparable modes of subsistence (including both hunting and gathering), comparable modes of transport and mobility, comparable use of stone materials, and comparable motor abilities. The percussive technologies used by Australian Aborigines and South African Bushmen provide some of the most useful comparisons to Oldowan percussive technology. From my experiences with Australian stone tool using groups, I argue that most of the objects identified as Oldowan "cores" by some archaeologists were more likely to have been chopping tools similar to ones used by Australian Aborigines. I also suggest that an earlier technology may have consisted of small bipolar core lithic scatters (difficult to identify or date), as well as unmodified blocks of angular stone. Early discard patterns of stone tools and debitage at residential sites also appear to be similar to recent hunter/gatherer patterns of discard.

Captive chimpanzee nut-cracking and Oldowan stone tools

Satoshi Hirata[1]; Tetsuro Matsuzawa[2]; Adrian Arroyo[3]; Stuart Robson[4]; Ignacio de la Torre[3]

1. Kumamoto-Sanctuary of Wildlife Research Center, Kyoto University; 2. Primate Research Institute (PRI). Kyoto University; 3. Institute of Archaeology, UCL; 4. Photogrammetry and Laser Scanning Department of Civil, Environmental and Geomatic Engineering. UCL

Experiments with chimpanzees are an avenue to understand the use of stone tools among non-human primates and to produce comparative frameworks with the archaeological record. We present here an experimental nut-cracking program with captive chimpanzees at the Kumamoto Sanctuary. These experiments followed standardised analytical protocols where rocks were microscopically analysed and 3D modelled before the nut-cracking activities. A second analysis was conducted after the nut-cracking experiments, in order to retrieve detailed use-wear formation data. Experiments were video-taped, allowing for a direct correlation between varying chimpanzee nut-cracking techniques and modification of rocks, which will be used as a reference to interpret the percussive tools from the Early Stone Age.

The influence of culture on tool selection in chimpanzees

Lydia V. Luncz, Christophe Boesch

Max Planck Institute for Evolutionary Anthropology, Department of Primatology

Differences in percussive tool use among neighboring chimpanzee (Pan troglodytes verus) communities have been shown to be group-specific and independent of ecological or genetic diversity, suggesting cultural transmission of this behavior. Immigrated females and philopatric males showed the same fidelity to group-specific behavior, indicating that dispersing females adapted to the behavior of their new community. This strong influence of cultural group behavior on individual tool selection raises the question whether unified behavior comes at a cost or a benefit for individual community members. In this study we compared the efficiency of selected tools used for Coula edulis nut-cracking among three neighboring communities in the Taï National Park in Côte d'Ivoire. We compared group nut intake per time unit and the number of strikes needed to open a nut. After controlling for key ecological factors such as nut hardness and hammer features, our findings revealed group dependent diversity in foraging efficiency. The two most efficient groups were more selective in their choice of tools, preferring non-abundant materials over those most commonly found. The third, least efficient group, in contrast, was more opportunistic in their tool choice, predominantly using hammers of the most commonly available material. These observations suggest that tool selection strategies have an effect on foraging efficiency. Our study shows that adapting to the cultural behaviour of a group can have implications on individual foraging success, demonstrating the importance of group belonging in chimpanzee communities.

Education by master-apprenticeship in stone-tool use in wild chimpanzees

Tetsuro Matsuzawa

Primate Research Institute, Kyoto University

The chimpanzees of Bossou, Guinea, use a pair of stones to crack open oil-palm nuts. This is a unique cultural behaviour of this community that is transmitted one generation to the next. My colleagues and I have conducted the longitudinal annual record of the behaviour since 1989. We have set up the outdoor laboratories to do the video-recording of the behaviour. We have focused on the acquisition process: the young chimpanzees reach to the first success at around 4 to 5 years old. This talk will focus on the learning process: That is called "Education by master-apprenticeship", characterized by the following three points. Firstly, the mothers and the adults have never actively taught. Secondly, the children have the strong and intrinsic motivation to make the copy of the behaviour. Thirdly, the mothers and the adults are highly tolerant to the children. Taken together, the learning process of stone tool use clearly shows the difference of humans and chimpanzees. The apes do not ape. The evolutionary origins of imitation will be discussed.

Percussive traces: The role of crocodile bite marks in archaeological assemblages

Jackson K. Njau

Department of Geological Sciences, Indiana University, U.S.A.

The Stone Age Institute, U.S.A.

Crocodiles are major predators of nonaquatic large mammals in modern African inland waters. Tooth marks inflicted on undigested bones, which are often lost in mud/ water or thrown off riverbanks, may reveal specific ecological context of archaeological landscapes. Neotaphonomic studies indicate that a powerful bite of a mature crocodile can produce distinctive damages on the skeleton of its prey (zebra to buffalo size). The impact of a forceful bite can inflict deep punctures that penetrate the cortical bone shaft without damaging the epiphyseal ends. Large punctures may be accompanied by deep longitudinal cracks and sometimes associated with removal of bone flakes off cortical surface. Depending on the angle of impact (tooth-bone contact) impressive tooth pits associated with microstriations can be generated on the bone surfaces. Some of the tooth-inflicted damages are associated with grooves and microstriations. This type of bone modification is notable in zooarchaeology and is usually related to percussion activities of hominins, in particularly breaking bones for marrow extraction. Emerging information from ongoing geological, paleontological and taphonomic research at Olduvai suggests that some of the notable hominin sites (such as DK, Bed I) were infested by crocodiles and therefore calls for caution in behavioural interpretation Oldowan hominins there.

Bipolar knapping in the Mesolithic site of Font del Ros (Iberian Southeastern Pre-Pyrenees)

Xavier Roda Gilabert, Rafael Mora Torcal, Jorge Martínez-Moreno

Centre d'Estudis del Patrimoni Arqueològic de la Prehistoria (CEPAP). Universidad Autònoma de Barcelona

Although the bipolar knapping technique has produced an extensive bibliography both in the ethnographic and archaeological literature, some questions remain unanswered, such as its possible functional context, and the characterization of the by-products. In the Mesolithic site of Font del Ros, percussive tools show specific marks associated to the reduction of poor quality rocks. These elements, together with the presence of splintered pieces, raise the possibility of this type of tools are related with bipolar knapping.

We present here the results of an experimental program in which vein quartz is reduced on anvils. Marks on cobble blanks and use-wear traces associated to this activity will be discussed. These results indicate that pitted stone cobbles are related with thrusting percussion, which can be considered as a key attribute to identify bipolar activities on hard materials.

How to select a nut-cracking-tool: a multifactorial strategy in wild chimpanzees

Giulia Sirianni, Roger Mundry, Christophe Boesch

Max Planck Institute for Evolutionary Anthropology, Department of Primatology

Tool use may embed understanding of physical action and recognition of functionally relevant properties of the physical world. Selection of tools for a given task, represents a suitable model to operatively test causal cognitive abilities and the ability to anticipate a task. Until now, selection of nut-cracking tools in chimpanzees has been investigated 1) in captive or natural experimental settings, where chimpanzees faced a narrow range of conditions or 2) in natural settings, by inferring patterns of selection from data on tool use, without a detailed control of the availability of raw materials in the spatial and temporal context.

In this study we aim at providing new insights into flexible tool selection in the complexity of the natural ecological framework. To this end, we observed tool-assisted cracking of Coula nuts by chimpanzees in the Täi National Forest (Côte d'Ivoire), while accounting for availability of potential tools at the specific nut-cracking site. We used GLMMs to estimate the probability of a given object to be selected as a nut-cracking tool by a chimpanzee, given a highly-dimensional set of contingent variables (i.e. physical properties of hammers, transport distance, ground or tree position of the anvil).

We showed that wild chimpanzees adjusted their preference for physical properties of nut-cracking hammers according to i) variation of other physical properties of the tools; ii) expected transport distance; iii) location of nut-cracking anvils on the ground or on trees.

Our results illustrate the fine flexibility of chimpanzees in selecting an appropriate tool for nut-cracking according to what was available and where in their natural context. We showed which variables chimpanzees take into account choosing a tool in order to optimize the profits of an ecologically relevant foraging activity.

Learning from capuchin monkeys' stone tool use

Elisabetta Visalberghi

Istituto di Scienze e Tecnologie della Cognizione, CNR

The EthoCebus research team has studied the behaviour of two groups of wild bearded capuchins for ten years (see the website, ethocebus.net) at Fazenda Boa Vista, in the northeast of Brazil. These monkeys use stone hammers and stone/wood anvils to crack very resistant palm nuts. Until a decade ago, this type of tool use was considered to be present only in our ancestors and the Western chimpanzees. Cracking hard foods using stone tools, as practiced by bearded capuchins, involves planning, decision-making, modification of species-typical action routines, modulation of action to accommodate variable materials and settings, and monitoring activity throughout the course of performance. I will illustrate these features on the basis of our field experiments and observational studies and I will discuss the ways in which our results might be relevant to design the scenarios in which stone tool use has emerged in the hominins and what can be learnt from capuchins.

The Nature of Percussive Technological Culture in Chimpanzees and Early Humans

Andrew Whiten

University of St Andrews

In the research literature there is a broad consensus that percussive technology in both chimpanzees and early humans has likely been dependent on socially learned, cultural transmission of the complexities involved. However both hypotheses have been challenged by some authors. In the case of chimpanzees, scepticism has been expressed about whether regional differences in behaviour are dependent on cultural transmission, or instead explicable through genetics or ecologically shaped individual learning. In the case of early humans, we simply do not have direct evidence of social learning. In this paper I describe how our experimental studies cast light on these issues, providing support for the cultural hypotheses.

Our controlled experiments with chimpanzees have shown that individual learning of nut-cracking by juveniles is not adequate and that instead, young chimpanzees will learn the skills socially; moreover, since these were East African chimpanzees who do not nut-crack in the wild, a genetic explanation for pan-African differences in this percussive skill can be rejected. Further experiments focused on the mechanisms of cultural transmission of percussive and other forms of tool use have implicated a 'portfolio' of learning processes that include both imitation of aspects of action patterns and emulation of key results.

Further, controlled experiments examining the role of different factors in the social transmission of flint-knapping by human participants have emphasized that even in the case of making simple Oldowan sharp flakes, more sophisticated social learning modes, notably teaching, make a great difference to transmission fidelity.

I finally address the phenomenon of cumulative cultural evolution, which developed through the stone age, even if initially at an inordinately slow pace. Some authors argue that the key explanation for the emergence of cumulative culture was the rise of imitation. I summarise our further experimental work,that challenges this and tackles the question of what factors inhibit, or instead facilitate, cumulative culture.

The Palaeolithic record on ground stone technology: Methodological lessons from late Palaeolithic and Neolithic sites in the Near East

Katherine Wright

Institute of Archaeology, University College London

In the Near Eastern Palaeolithic record, abraded stone artefacts ('ground stone' tools) have been traditionally seen as rare occurrences in sites dating to before the glacial maximum. By the terminal Pleistocene and early Holocene, abraded stone artefacts ('ground stone' artefacts) proliferated in the Near East, in terms of assemblage sizes, raw material diversity and techno-typological complexity. By the early Neolithic, such artefacts were part of a large-scale expansion in stone technologies, an expansion that affected the growth of other craft production technologies. However, in recent years it has become increasingly clear from sites in the Near East, Africa and elsewhere that ground stone artefacts have a much deeper history in the Palaeolithic. This paper reviews the Palaeolithic ground stone data in the Near East in light of new methodologies for definition, recognition and recovery of ground stone artefacts from prehistoric sites. These methods suggest that the widely-presumed relative rarity of ground stone artefacts in Palaeolithic sites may need to be re-evaluated and may be a problem of excavation methods that overlook the full range of stone artefacts put to use by Palaeolithic groups. Such methods include accurate definition of 'ground stone' artefacts; careful investigation of seemingly 'unworked' stones from sites; intensive examination of diverse types of use wear; identification of fragmented artefacts; and identification of unfinished ground stone objects. Case studies of ground stone assemblage analysis from Palaeolithic and Neolithic sites in the Near East highlight these issues. However, the basic pattern of a Late Pleistocene proliferation of large assemblages of typologically diverse abraded stone tools still seems to hold, at least in the case of the Near East. Explanations for this proliferation are suggested.

Percussion, embodiment, and cognitive evolution

Thomas Wynn

University of Colorado Center for Cognitive Archaeology

One can conceive of early hominin technological evolution as being bounded by two 'end' conditions. The beginning condition is percussive technology as practiced by several non-human primates; the ending condition is Mode 2 biface technology with imposed shape and curation. The archaeological record indicates that for most of this long period hominin cognition remained very apelike. How, then, did the very un-apelike features of Mode 2 technology evolve? What resources did percussion itself bring to cognitive evolution? Using knowledge of non-human primate and Mode 1 percussive technology, and a theory of embodied/extended cognition (Clark, 1997; Malafouris, 2013), it is possible to understand this two-million-year process as one in which percussion itself played an active role in generating shared attention and shared gestures (Davidson & McGrew, 2005) (e.g., at Lokalalei (Delagnes & Roche, 2005)), associated developments in Theory of Mind, and ultimately the Mode 2 concepts of 'tool' and perhaps even 'self.'

References

Clark, A. (1997). *Being there: Putting brain, body, and world together again*. Cambridge, MA: MIT Press.

Davidson, I., & McGrew, W. C. (2005). Stone tools and the uniqueness of human culture. *Journal of the Royal Anthropological Institute*, 11(4), 793-815.

Delagnes, A., & Roche, H. (2005). Late Pliocene hominid knapping skills: The case of Lokalalei 2C, West Turkana, Kenya. *Journal of Human Evolution*, 48, 435-472.

Malafouris, L. (2013). *How Things Shape the Mind: A Theory of Material Engagement*. Cambridge, Mass.: MIT Press.

**POSTER* Theory-of-Mind and technological transmission: the impact on tool standardization*

Cory Marie Cuthbertson

Centre for the Archaeology of Human Origins. University of Southampton

I will present the planning stages of an experiment involving the training of modern knappers that addresses the author's hypothesis that tool standardization will increase when technology is transmitted by means that involve Theory-of-Mind (such as intentional teaching). This could be due to learners' ability to predict the knowledge states of the teacher, and therefore have access to a more accurate understanding of the knowledge the teacher is trying to transmit. When technology is transmitted by mimicry, however (in the experiment this would be controlled for by students learning from a video recording), it is anticipated that there will be less standardization and more variability introduced to experimental assemblages, as the learner will not theorize about the knowledge states of others, and will be more prone to deviate or innovate their techniques. Humans are cultural animals that interact with material culture such that our minds are both extended and distributed (Malafouris 2013); stone tools, and material culture more generally, can therefore be seen as 'cognitive fossils'. It is with this justification that we can look to things like assemblage variability and ask questions about cognition and language. Many different variables affect the form of lithic assemblages; function, raw material selection, completeness of manufacture sequence, group size, skill, and stylistic variation are just some of these contributing influences. This presentation will consider the effect of one factor on tool standardization, the mode of technological transmission, by producing an experiment that controls for as many of these other variables as possible. By developing methods of assessing cognitive ability by analysis of stone tool assemblages, it is the long term goal that early stone tool assemblages will contribute empirical knowledge about the cognitive abilities of Palaeolithic hominids.

References

Malafouris, L. 2013. How things shape the mind: a theory of material engagement. Cambridge, MA: MIT Press.

**POSTER* The possibilities of tracing idiosyncrasy within percussive technologies*

Frederick Foulds

Durham University

The percussive technologies involved in the production of stone tools are, by their very nature, reductive. As a result, the actions and goals of the knapper are embedded in the production of flakes and the scar patterns upon the surface of resulting tools. This is considered important for understanding the behaviour of individual hominins and how they are intertwined with others around them and their wider societies. It has also been suggested that, through an analysis of the chaîne opératoire and in depth study of individual artefacts, idiosyncrasies may be discovered that enable us to trace particular knappers or social groups.

Grounded in the recent theoretical approaches to the individual in Palaeolithic archaeology (Gamble 1999, 2007), this poster presents results from an in depth analysis of idiosyncrasies in stone tool manufacture. It asks whether the individual is truly a viable unit of analysis in a quantifiable sense. By studying both experimental and archaeological Lower Palaeolithic refitting sequences and handaxes, it demonstrates the level to which the individual can be viewed within Palaeolithic material culture, what factors prevent such an approach, and outlines avenues for future research. Moreover, it highlights possible evidence for socially mediated knapping templates from Acheulean sites and, hence, provides further contributions to the perennial debate into the sources of variability in the Lower Palaeolithic material record.

**POSTER* Comparing stone tool use in wild monkeys, apes and hominins*

Michael Haslam, Hannah Mosley

School of Archaeology, University of Oxford

The three wild primate taxa known to use stone tools (western chimpanzees: Pan troglodytes verus, bearded capuchin monkeys: Sapajus libidinosus, and Burmese long-tailed macaques: Macaca fascicularis aurea) provide behavioural data suitable for analogy with Plio-Pleistocene hominins. Of these, the two monkey species have received less attention to date. Here we present recent observations on the function, selection, transport, use-wear, and archaeological recovery of wild macaque and capuchin stone tools. We then draw on these and other data from the ERC-funded Primate Archaeology project (primarch.arch.ox.ac.uk) to identify useful ways of comparing percussive stone tool use in all known stone tool using primate groups. Based on our survey we suggest that (i) each primate taxa leaves a distinct and recoverable archaeological signature, (ii) chimpanzee and capuchin stone tool use likely began in the Middle Pleistocene at the earliest, and (iii) Australopithecus groups probably selected and transported stone tools to pound encased foods on stone anvils from at least 3.4 million years ago in East Africa.

**POSTER* Lithic percussive technologies and skill learning processes in the Paleolithic sites: Implications for the evolution of learning*

Jun Takakura

Archaeological Research Center, Hokkaido University

Since the 1990's, much attention has been focused on the skill learning behaviors of lithic production at the Upper Paleolithic sites in Europe, in order to reveal the cultural transmission process among prehistoric modern humans (e.g. Pigeot et al., 1990). Recently I have demonstrated that various learning behaviors for acquiring skill relevant to lithic production, based on the analyses of numerous obsidian refitted artifacts, were recognized at the Upper Paleolithic sites in Northern Japan (Takakura, 2013). Thus, these results enable us to understand how we can elucidate the skill learning processes from the archaeological record empirically. From a comparative perspective, an examination of the skill learning behaviors relevant to lithic percussive technologies at the Paleolithic sites may provide a new insight into the evolution of learning in Paleolithic hominins. The goal of this paper is to present an updated synthesis of the various researches for the skill learning behaviors conducted at the Eurasian Paleolithic sites. This review includes meaningful definition of "expert", "novice", "instruction", "exercise", and "trial and error", as a means of examining variability in the archaeological record. In addition, this paper briefly discusses the evolution of the lithic percussive technologies in homonins by paying attention to the hierarchal organization of the lithic reduction sequences, and shows its implications for the evolution of learning.

References

Pigeot, N. 1990 Technical and social actors: Flintknapping specialists at Magdalenian Etiolles. *Archaeological Review from Cambridge* 9: 126-141.

Takakura, J. 2013 Using lithic refitting to investigate the skill learning process: Lessons from Upper Paleolithic assemblages at the Shirataki sites in Hokkaido, Northern Japan. In *Dynamics of Learning in Neanderthals and Modern Human 1: Cultural Perspectives*, edited by T. Akazawa, Y. Nishiaki, K. Aoki, pp.151-171, New York: Springer.

**POSTER* Survey of Animal Percussive Technologies*

Natalie T. Uomini

Department of Archaeology & Department of Psychology, University of Liverpool

and Cognitive Archaeology Program, University of Colorado Colorado Springs

In order to understand the evolution of percussive technology and stone tool-making in human evolution, it is useful to explore the range of technologies found in other animals. Since Beck (1980), our knowledge of animal tool-use has come a long way (Burghardt et al., 2011). Primates are the best-studied in terms of percussive technology. However, many other animals also use stones to pound and smash things. These animals come from a surprisingly wide variety of phyla and classes as diverse as ants, wasps, birds, fishes, and mammals. This poster presents a new project that will make a systematic cross-species comparison of percussive technology in all known animals. The existing known species are presented in a cladogram, with images from the latest research. Data are classified in different ways in order to expose patterns in behaviour, raw material selection, percussive gestures, and cognition. This poster hopes to show how the percussive technology of animals can help shed light on the origins of stone tool-making in primates and human evolution.

References

Beck, B.B. (1980). *Tool Use in Animals*. Garland STPM Publishers, New York.

Burghardt, G.M., Shumaker, R.W., Walkup, K.R., Beck, B.B. (2011). *Animal Tool Behavior: The Use and Manufacture of Tools by Animals*. Johns Hopkins University Press, Baltimore.

**POSTER* Bashing it Out: Understanding and Measuring the Mechanics of Compression*

Adam van Casteren

Max Planck Weizmann Center for Integrated Archeology and Anthropology

Research has indicated that the selection of tools by primates to evoke fracture under compression is a function of the raw materials found in the environment, tool features, tool mobility and food characteristics. There is a growing body of research that is dedicated to the first three factors but mechanical knowledge of the foods being processed is often limited. This is a shame as nuts and seeds are sometimes far from simple structures, regularly displaying a delicate balance of protection from predation whilst still retaining the ability to germinate with ease. Using a hammer and anvil places a food item in compression, the same basic mechanics as those found during mastication but using dynamically applied loads, rather than static ones, and generally producing a greater force. At first glance it would appear that compression in biological cellular solids or structures is a rather simple affair. However, the process can be considered a little more complex, with three distinct stages: an initial linear elastic stage, followed by a plateau and then a densification of material. Here we present methods that can be accomplished in the field for measuring the mechanical properties of nuts and seeds that can be processed percussively by extant apes. We briefly discuss the implications and subtle structural nuances that may be revealed by a more quantitative analysis of food mechanical properties.

**POSTER* Synchrony and motoric matching in chimpanzee observational learning of percussive nut cracking*

Andrew Whiten[1], Delia Fuhrmann[1], Andrea Ravignani[2], Sarah Marshall-Pescini[1,2]

1 University of St Andrews. 2 University of Vienna

The percussive technology of both early hominins and chimpanzees is well described. By contrast the social transmission process is naturally difficult to establish in the former, but fortunately it is open to direct experimental investigation in the latter. We have exposed young East African chimpanzees, who unlike those in the West do not display nut cracking in the wild, to proficient nut cracking by chimpanzee and human models. Results confirmed that observation of such models allows such naïve chimpanzees to acquire the skill, demonstrating the East/West contrast is not based on innate, genetically shaped differences. Here we report additional, frame-by-frame video analyses of coordination observed between learners and the expert nutcracker they watched. A series of specialized time series statistical analyses demonstrated synchrony and expert-to-learner causality in cracking actions (Fuhrmann et al., 2014). Given that the learner had to hand no hammer or nuts, these coordinations suggest the existence of motoric matching between the two, rather than the mere emulative learning of environmental affordances that some authors have suggested non-human social learners are limited to.

Reference

Fuhrmann, D., Ravignani, A., Marshall-Pescini, S. & Whiten, A. (2014). Synchrony and motor mimicking in chimpanzee observational learning. *Scientific Reports*, 4, 5283.