Retuning Cognition Abstracts

Tools, minds & culture: cognitive archaeology and the evolution of language

Anton Killin
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Cognitive archaeologists are in the business of inferring cognitive and cultural characteristics of past hominin societies from material traces, linking material objects to the cognitive and the cultural via midrange theory. In this talk I analyse this practice, focusing on research on the evolution of language and music. One common mode of reasoning in cognitive archaeology involves inferring from hypothesised minimal requirements (of, say, the manufacture of some artefact) to cognitive prerequisites. Another involves building inductive associations between cognitive features and material remains, often invoking several lines of evidence. The fact that humans require extensive training to develop competent knapping skills combined with Acheulean patterns of raw material selection suggestive of demonstration and error correction arguably takes us from tools, to teaching, to informational theory of mind, to partial evidence for the existence of protolanguage. Debate on such issues continues, but it is plausible that the major challenge to settling controversies is not a lack of material remains, but insufficient constraint from midrange theory: theories that connect material remains with cognitive and cultural traits. Whilst uncovering new archaeological evidence is always a plus, this talk emphasizes the need for further progress in developing and testing cognitive midrange theory.

How Cognitive Tools Transform our Cognitive Capacities in Mathematical Problem Solving (and Beyond): Cumulative Cultural Evolution and Enculturation

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In multiple domains, symbol systems, artefacts, and other cognitive tools enable and scaffold our cognitive processes and help us understand and shape our cognitive niche. Interactions with cognitive tools in that niche are realised by cognitive practices (e.g., arithmetic, reading, and writing), which are culturally evolved, socio-culturally distributed, and embodied. Competence in these phylogenetically recent practices transforms our cognitive capacities.

In this talk, we will explore two components of this cognitive transformation and their inter-relation: first, enculturation is characterised by the ontogenetic acquisition of culturally evolved cognitive practices. It provides cognitive agents with abilities to interact systematically with cognitive tools. Second, enculturation is an important precondition for further cumulative cultural evolution. This is because it equips cognitive agents with the competence needed for actively sculpting and modifying cognitive tools and practices in innovative ways, given certain epistemic needs and challenges. We will argue that these two components form a feedback loop that accounts for cognitive transformations on ontogenetic and phylogenetic time scales. Our theoretical considerations will be substantiated by an in-depth discussion of mathematical problem solving as an important example of tool-integrating cognitive practices.

The Second Cognitive Rubicon in Stone-Knapping: Late Acheulean Handaxes

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Hominins as early as about 3.3 million years ago (mya) appear to have begun controlled stone flake-making with well-made, intentionally struck flakes from cores. However, some view these assemblages as within the cognitive capabilities of extant apes and other primates. Even more recently, Wynn and Coolidge (2016) declared that a 'cognitive Rubicon' had been crossed at about 1.75 mya with Early Acheulean handaxes, where higher-order motor skills and cognitive abilities were a prerequisite for their construction, promoting these hominins from ape-like thinking to more human-like thinking. The present paper proposes a 'second cognitive Rubicon' was crossed at about 500,000 years ago with the development of Later Acheulean handaxes. The archaeological evidence for this second cognitive Rubicon tells a different story from Early Acheulean handaxes in terms of spatial cognition, indexical possibilities, aesthetics, and social cognition. Specifically, the second Rubicon is marked by the much more frequent appearance of S-twist handaxes, ovates (where the equatorial axis exceeds or equals the polar axis, producing a spherical shape), handaxes with natural holes within their perimeters, handaxes with intentionally included fossils, the use of variegated stone, zoomorphic handaxes, and overly large handaxes (gigantism). The specific nature of this second cognitive Rubicon will be discussed.

Inferring minds from material remains: what is the relationship between technological change and cognitive evolution?
Ross Pain
Australian National University

Archaeology attempts to infer behaviour in past societies from material remains. Cognitive archaeology attempts to infer the cognitive abilities of individuals in past societies from material remains. Cognitive archaeology faces a number of conceptual and methodological problems which threaten the reliability of its claims. In this paper, I examine the inferential framework employed by cognitive archaeologists, particularly with respect to transitions in technological complexity. I distinguish *minimal-capacity inferences* from *cognitive-transition inferences*. Minimal-capacity inferences attempt to infer the necessary cognitive prerequisites for the production of a technology. Cognitive-transition inferences use transitions in technological complexity to infer transitions in cognitive evolution. I argue that cognitive archaeology has typically used cognitive-transition inferences informed by minimal-capacity inferences, and that this reflects a tendency to favour cognitive explanations for transitions in the complexity of material culture. I then present a range of empirical evidence challenging cognitive explanations, and show that accepting this new picture renders cognitive-transition inferences informed by minimal-capacity inferences unreliable. I finish by arguing that those who reject cognitive explanations for transitions in technological complexity should use cognitive-transition inferences based on multiple lines of evidence.

The Acheulean Handaxe: A Thing About Which We Have No Idea
Maria Salazar
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The program of cognitive archaeology requires a well-developed theory of how the human mind engages and interacts with the material world. Lambros Malafouris, a leading proponent of Material Engagement Theory (MET), holds that the mind is not encapsulated within the body or reducible to the brain but, instead, is extended through objects with which a subject acts in the world. In "Knapping Intentions and the Marks of the Mental," Malafouris applies MET to the problem of intention and design in the Acheulean handaxe enigma, suggesting that the solution to the enigma rests in a complete overturning of the assumptions most archaeologists hold concerning the ontology of objects. In this paper, I focus on the efficacy of MET in providing a solution to the handaxe enigma and consider whether a traditional, Aristotelian hylomorphism might yield the same type of solution sought after by Malafouris.

Catching Time: How Stone Age trapping technologies constructed novel human relationships with resources, landscapes, and cognition

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Traps and snares (remote capture technologies [RCT]) were likely in use by at least the Middle Stone Age (MSA), appearing alongside other emergent technologies such as hafting and composite tools (Wadley, 2010). Beyond numerous subsistence benefits, what can the evidence for the adoption of RCT tell us about human cognition in prehistory?

Assessment and experimentation with some ethnographically common trapping technologies demonstrates some common rules necessary to ensure success. Significant among these is that they rely on statistical probability, requiring large quantities of traps and systematic distribution and rotation to ensure returns.

This distribution and rotation of traps on the landscape would have created a novel Enactive Interface by which humans would have engaged with their environment and material culture. This means that RCT may have helped scaffold emergent conceptual structures in understanding material agency, numeracy, causality, and time through this embodied relationship in a manner that may have drove cognitive and cultural changes over time. This presentation analyses the implications of those changes.

Tools, skills, and the organization of the mind

Daniel Burnston
Tulane University

On *faculty-based* views, including "massive modularity" views, suggest that distinct parts of the mind have distinct domains of information and of application – they represent distinct aspects of the world, have distinct internal operating principles, and underlie distinct behaviors. Dual systems views are more general, positing a distinction between "System 1" and "System 2" cognition, where the former is implicit, fast, subconscious, and heuristic, while the latter is explicit, deliberative, conscious, and rule-based.

Neither of these views is sustainable, and thinking about why they fail allows us to consider how best to divide up and study the mind. I propose that studying cognizing with *tools* inspires a skill-based approach to cognition, on which distinct representational and procedural resources are brought to bear, at least potentially, for any reasoning task. I discuss the case of mathematical reasoning, which is distinctive for its demandingness and the abstract, formal nature of its domain. In contrast to modularity and systems views, I argue that mathematical reasoning is highly mediated by external tools and perceptuomotor resources. This supports a view of the mind as comprising a set of skills shaped from a combination of both internal and external representational resources.

Ratchetting Cognition: Technology, Cultural Learning, and Representational Decision-Making in Human Evolution

Armin Schulz
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Exactly how to characterize the nature and evolution of distinctively human cognition is still a matter of some dispute. However, it is widely accepted that this characterization needs to appeal to three key facts: (a) humans have the ability and disposition to learn from others; (b) humans have the ability and disposition to rely on mental states with rich representational contents to make decisions, and (c) humans have the ability and disposition to make tools. What is not yet clear exactly how these three elements— technology, cultural learning, and representational decision-making—work together so as to explain the nature and evolution of specifically human cognition. Making progress in answering this question is the goal of this paper. Specifically, the paper argues that cultural learning, representational decision-making, and technology "ratchet up" human cognition: cultural learning makes possible improvements in representational decisionmaking, which allow for the manufacture of technology that allow for yet further improvements in representational decision-making.

Cognitive Gadgets: Bringing Cognitive Science to Cultural Evolution

Cecilia Heyes
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High Church evolutionary psychology casts the human mind as a collection of cognitive instincts - organs of thought shaped by genetic evolution and constrained by the needs of our Stone Age ancestors. This picture was plausible 25 years ago but, I argue, it no longer fits the facts. Research in psychology and neuroscience - involving nonhuman animals, infants and adult humans - now suggests that genetic evolution has merely tweaked the human mind, making us more friendly than our pre-human ancestors, more attentive to other agents, and giving us souped-up, general-purpose mechanisms of learning, memory and cognitive control. Using these resources, our special-purpose organs of thought are built in the course of development through social interaction. They are products of cultural rather than genetic evolution, cognitive gadgets rather than cognitive instincts. In making the case for cognitive gadgets, I'll suggest that experimental evidence from computational cognitive science is an important and neglected resource for research on cultural evolution. Moves towards an embodied or '4E' approach to cultural evolution are in tension with effective use of this resource, and at risk of perpetuating a focus on physical rather than social cognition.

How handwriting changes the brain to affect cognitive development.

Karin Harman James
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Human communication through the written symbol is a relatively new skill in the history of our species. Handwriting, however, capitalizes on existing brain circuits that are extremely efficient at coupling sensory information with motor acts. In essence, handwriting facilitates learning symbol systems by using existing brain pathways for sensori-motor integration. In this presentation I will outline research that shows that writing symbols by hand facilitates visual recognition through the linking of sensory systems to motor systems - a linking that the human brain is prewired to capitalize on. Learning by typing the symbols does not produce the same links – linking requires the stroke-by-stroke production of a symbol with the concomitant variability that such production fosters. This in turn provides the perceptual system with the variable input necessary to learn the symbol category. We interpret our experimental findings as having a profound impact on how we think about learning in general, and how various types of learning change brain circuits in different ways.

Made to Know: Science as the Social Production of Knowledge by a Complex Adaptive System

Jacob Foster
UCLA, Sociology

Institutionalized social learning can lead to cumulative cultural evolution and collective intelligence. Science is perhaps the signature example of this distinctly human strategy for collectively producing knowledge. In this talk, I develop a view of science as the social production of knowledge by a complex adaptive system. Using data from millions of scientific papers, I illustrate how scientists' research choices are shaped by the tension between tradition and innovation, which generates a distributed algorithm for directing their collective attention. I then show how this distributed algorithm leads to more (and less) efficient collective discovery. In science, these distributed algorithms are "programmed" and maintained by scientific institutions. To clarify our understanding of these institutions, I describe a simple formal model of scientific problem choice and use it to show that taken-for-granted features of scientific institutions (like the publication of partial results) can have unexpected collective consequences on the pace of knowledge production. I draw together these results using ideas from computational learning theory to suggest how scientists' strategies, though objectively adapted to social goals and human limitations, nonetheless support robust collective creation of knowledge about the natural world. In other words, I argue that the production of collective knowledge is made possible by the distinctive cultural technologies of science—which also produce limits to that same knowledge. I conclude by briefly considering the implications of "machine knowers" for the production of humanistic knowledge—and the ominous possibility that even limited machine knowers could produce insurmountable limits to human understanding.

The social limits of understanding, discovery and invention

James Evans
The University of Chicago, Sociology

I explore how social connection between researchers, scientists, engineers and citizens place soft but strong limits on what a collective can know, discover, and invent. This includes empirical demonstrations of how centralized networks decrease the truth value of collective certainty in crowds and techno-sciences, how large teams shrink the search space of science and technology, and how flocking correlates investigations, slows discovery and limits the size of future understanding. I then show how the complex systems of science, technology and society generate productive social disconnection to accelerate advance through maintaining crossable boundaries between disciplines, ideologies, technologies and how this increases the value of ultimate recombination.

Bashing Rocks from the Olduvai Gorge to the Nihewan Basin

Colin Allen
University of Pittsburgh, History and Philosophy of Science

The nineteenth century Scottish metaphysician William Hamilton offered this definition of instinct: “An instinct is an agent which performs blindly and ignorantly a work of intelligence and knowledge.” As tempting as it is for us to read this ironically, Hamilton did not intend it so; he thought that the intelligence and knowledge behind animal instincts was supernatural. Later, the American naturalist Lewis Henry Morgan, who conducted an intensive study of beavers before turning to anthropology, objected that Hamilton's definition prematurely blocked inquiry into the capacities and intelligence of animals. Treating relatively recent events in human prehistory as the cognitive equivalents of a quantum leap similarly and unfortunately tends to foreclose investigation of the skillful cognitive achievements of earlier hominins. But what can we reasonably infer about the intelligence and knowledge of our ancestors whose chimpanzee-sized brains made them a formidable presence from the shores of an ancient lake in East Africa to the shores of another in East Asia? And how might our investigation of these earliest known hominins inform our understanding of the drivers of human cognitive evolution?