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Archaic lithic industries: structural homogeneity

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Abstract

Some years ago, The Homogeneity to Multiplicity Model (HMM) was introduced as a structural framework for understanding the appearance and evolution of early stone tool techno-systems. Presently, the HMM provides an alternative and complimentary conceptual scheme with which to explain how and why particular morphotypes appeared and proliferated through time and space. This paper is especially dedicated to the very first stage of this model, Homogeneity, which refers specifically to the origins of human technologies in Africa more than 3 million years ago. Research on numerous ancient African and Eurasian stone tool assemblages provides empirical examples indicating that the oldest known hominin technologies most likely emerged out of a previous phase of long-term practice of percussive technologies. While primates and other animals make and use tools, only humans have evolved complex operative schemes involving chains of action that are intermediary to the primary goal of satisfying a survival-related desire; such as accessing or processing foodstuffs. Compared to other species, humans demonstrate total reliance upon toolmaking for survival. This adaptive strategy precludes elaborate and lengthy learning and socialization processes that are the very foundation of human material culture. The Homogeneity phase marks a turning point for humanity, from which our destiny would be irrevocably detached from that of all other animal species with which we share the planet. It characterizes the very basic structural nature of first toolmaking, with simple cores, flakes and percussion implements, which provided the foundational Potential to evolve towards Oldowan Variability.

Keywords: homogeneity, stone tools, technology, primate, percussive activities, culture

Introduction

The use of lithic materials is a known behavioral trait amongst hominins and other genera within the Primate order, not only in captivity, but also in nature.[1] Different kinds of activities involving stone are believed to have developed to facilitate animals in acquiring food resources from the environments in which they subsist(ed). Their use of rocks is (was) aimed at producing ‘structural catastrophe’ by altering the fixed morphogenic state of a given material (fruits, plants, bones, meat, skins, etc.), causing critical transitions.[2,47] Different kinds of rocks present a range of constituent properties (specific kinds of breakage planes, density, resistance, fragility, etc.) that render them more or less suitable for delivering blows capable of producing such catastrophic events, which we propose to be the essence of the first human lithic technologies. This basic concept forms the substratum that gave rise to the first recognizable human lithic reduction systems. Basic methods of stone use can be linked to a variety of percussive gestures such as, the projection of stones onto the ground, the hammering of stones against one another, or the use of stones for pounding intermediary materials on anvils.[3]

Percussive activities are largely acknowledged to be representative of the earliest stages of human technologies, while behaviors observed in ethnography and primatology render them palpably evocative of the basic developmental phases that likely preceded systematic flake production, in the framework of operational chains.[1,4–7] While it is not new,[8,9] the recognition of the significant role played by percussion tools in current works on prevalent sites in Africa and Eurasia[10–18] is continuing to underline the amplitude of their significance for enhancing our understanding of the origins of early human behaviors, leading up to the development of more complex stone tool types observed from the Acheulian onwards. This research is inevitably linked to the development of unique human cerebral features, which are presently considered to have gained in complexity in synchronicity with the evolution of technological systemics. In relation to other animals, expansion of the neocortex permitted by cerebral asymmetry and laterality in the human brain, and the ensuing elevated degree of cephalization, is indeed often attributed to human reliance upon toolmaking as a survival strategy. Cognition (or mental processing) demonstrated in object manipulation clearly involves problem solving that goes beyond reactive instincts or uncontrolled emotional responses. Recently, links between language and manual praxis have received support from cognitive neuroscience, with findings demonstrating that the brain’s linguistic areas (Broca and Wernicke) also play a role in many non-linguistic behaviors including tool use.[19] As toolmaking evolved through time, so did the need for longer and more complex demonstrative- and probably also linguistic -explanations, achieved through teaching.[20]

Meanwhile, methodologies developed to study the functional meaning of percussion tools in Oldowan toolkits[21–24] are enlightening us about the range of activities that might have been within the operative capacity of first representatives of human ancestry. There is much debate for the classification of lithic industries prior to the onset of the Early Acheulean (HMM= Diversity phase),[25] especially concerning industries over 2 million years old. Over the years, pre-Acheulian lithic assemblages have been designated by different names (Pre-Oldowan, Oldowan, pebble culture, cobble toolkits, Mode 1). In reference to the African archeological record of lithic type, we consider toolkits up to a chronology of ~2.5 - 2 Ma (Lower

Pleistocene) as fitting within the Variability stage of the HMM (which we shall most conveniently term heretofore 'Oldowan').[26] Additionally, the denomination 'Mode 0' has come into use to define the stage preceding the appearance of these toolkits. Presently, it refers to hypothetical lithic sets with low techno-morphological flexibility and lacking recognizable systemic. This short article is intended to define the nature of this assumed techno-complex at the conceptual level, following the HMM[25,26] and to clarify how to objectively define this type of record.

Approach and development

Rocks undergo different kinds of breakage when they are projected against hard earth or other objects, like wood or other stones. Breakage patterns are dependent upon both, the power of the thrust and, the petrographic features of the rock matrix (crystalline, stratified, fine-grained). In the context of early hominin stone use, accidentally chipped edges and/or fragments presenting freshly opened surfaces certainly provided novel configurations that could have been contemplated at first, and then found to be useful for a range of percussion-related activities such as: cutting (sharp or sinuous edges), scraping (notches or denticulate edges), digging (dihedrals or trihedrals) or pounding (localized convexities). Because lacking intentional manufacture, the products left behind from this active phase are extremely difficult to identify in the archeological context. In seeking to grasp their evasive veracity, comparisons are drawn between this conjectural lithic record, and that which occurs in places where chimpanzees have moved or used cobbles and rocks to break nuts or fruits in order to access the edible parts.[27,28] However, chimpanzees manipulating rocks in this way have not been found to practice any recognizable strategy that could be useful to establish the beginnings of the Oldowan which, contrastingly, reflects relatively complex and sophisticated technical operational chains.[29,30] This is because casual products obtained by projection or pounding do not translate a strategic objective in the same way that by-products of a reduction sequence do. While the latter are true products of a planned action of percussion, the former only manifest the final goal of a (generally subsistence related) action, such as obtaining of food.

The first link in the operative chain of an Oldowan lithic record is, therefore, the result of an action aimed at a specific function (tool-making), whose secondary objective (obtaining food) would only have come into play subsequently, as a new link in a given chain of action. These links are themselves connected to a basal (root) link, which involves the selection of a rock with features that render it adequate for performing the desired task. Therefore, in the Oldowan context, seemingly simple cores and flakes in fact reflect a multidimensional reflection-action chain, beginning with this selection process, which has been proven to have, in some cases, involved relatively complex assessments of both mechanical and geometrical clast features.[12,13,31] Contrastingly, in Mode 0, the first (action) and second (aim) are combined into a single accomplishment without secondary links to achieve the desired objective (ex. obtaining food).[32] Homogeneity advances from this random (or opportunistic) state, establishing the raw material selection process and moving into action by beating or projecting stone with the purpose of manufacturing an object. By separating these stages into discrete linkages, hominins finally established the first procedural operative schemes and developed Homogeneity out of the functional operative theme and into a technical operative theme (Figure 1).

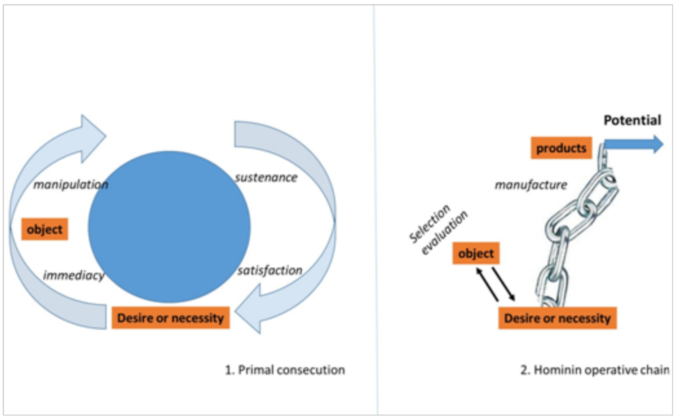

Figure 1 Action schemes in object manipulation: (1) animal and (2) early hominin. Primal consecution is represented as a closed system based on immediacy and primary satisfaction of a sustenance-related need. Contrastingly, the hominin operative chain is sequential and open. It involves more complex conceptual and activity links, like selection/evaluation in the early stages of raw material gathering, and manufacture as a productive aim. The human action chain is open to innovation by virtue of its productivity of potentially novel morphotypes.

Therefore, if there are no intentionally produced first generation Negative Bases (BN1G= cores), nor any second generation Positive Bases (BP2G= flakes or blanks), but only accidental products, we can say that homogenous assemblages do not represent any conscious technical approach to using stone as a fundamental element for the regulation of energy in a given environment. The Homogeneity phase began when rocks were consciously reduced using sequenced unifacial blows in the aim of obtaining flakes that would offer an intermediary advantage to obtaining/processing plant and/or animal materials. The existence of cores and flakes is requisite to a truly conscious operative chain. Hence, when we say that the first techno-complexes are homogeneous, this means that they are representative of basic unifacial knapping aimed at producing flakes of indeterminate formats. The products (or morphological codes) acquired through this type of action, are characterized by their random production and lack of standardization. Furthermore, in this type of reduction process, it is impossible to distinguish dissimilar strategies, pre-planned dimensional or configurative features that would indicate that the hominins of the Late Pliocene and Early Pleistocene were applying complex design and multifunctional codes, or that they adapted their products in relation to specific or singular tasks.

Normally, cores attributed to such homogenous assemblages would all have a similar appearance and lack truly bifacial, trifacial and multifacial configurations. Such structures did, however, emerge (inadvertently), as hominins accrued their mechanical experiences by testing the morpho-technical range of repetitive recurrent percussion applied to stone (HMM= Variability).[26] These innovative new morphotypes thus materialized later, out of the existing techno-morphological flexibility of unidirectional stone knapping systems. As hominins gained in their mechanical understanding of flake production, the Potential within existing techno-structures enabled them to develop the Variability within the stone reduction strategies that we attribute to the Oldowan.[26] According to the HMM, the homeostasis of the Homogeneity paradigm was broken when the potential of unidirectional systemic was most fully explored, through repetition, as the same gestures began to be used sequentially in different ways. Cutting peripherally into core volumes, for example, offered novel strategies to obtain flakes of different sizes and shapes, spurring the move from simple unidirectional knapping systems into new structures of stone reduction (*sic*. orthogonal knapping). This shift occurred in Africa some 2.6 million years ago,[30] or earlier.[33] In subsequent stages of stone knapping described by the HMM (Diversity, Multiplicity)[25,34], hominins continued to obtain an ever-widening range of formal representations attributable to basic geometrical forms with which we are all familiar (dihedral, trihedral and pyramid, cubic, spherical).

Conclusion

Pliocene and Lower Pleistocene hominins established technological innovation of low variability based on sequential unidirectional stone reduction gestures. This, basic operative chain, referred to in the HMM as Homogeneity, most likely emerged out of age-old percussive activities (imperceptible in the archeological record), from the observation of rock residues inadvertently generated by accidental stone breakage. As percussive gestures were reproduced, incrementally modified, and mastered, functional flake forms, including sharp edges; dihedrals and other forms, came to be intentionally produced. These rudimentary geometrical configurations were valued for their highly functional potential; notably the modification of plant and animal materials to acquire nutrients. New, oriented modes of percussion thus came to be practiced with relative dexterity and intentionality on stone, leading (conceivably intuitively or even mechanically)[35] to the first hierarchical flake extraction methods by means of natural (non-prepared) platform management. For the first time, primates produced flakes with useable lateral or transverse edges from systematized cores. These are the oldest recognizable relics of hominin techno-systems, and they mark the beginnings of the human creative process of testing and knowledge accumulation-transmission of mechanical materials' properties, probably at the origin of symmetry and other innovations that mark the Early Acheulian (HMM= Diversity phase).

From the capacity to use rocks to crush, pound, break or cut, were born the skills needed to generate truly human operational sequencing, by sharpening aptitudes to build up complex chains of linked cause-action-reaction. This complexity in the chain of action, leading from the selection of appropriate rocks to the application of a suitable percussive gestures aimed at manufacture (production) of flakes and core-tools with systemic evolutionary potential, that were used and discarded, distinguishes hominin toolmaking habits from those observed in primates and numerous other species.[36] Throughout this accretion process, formal realities came to be preferentially produced (such as dihedrals, towards and into the Acheulian) when they were found to be useful for obtaining and processing nutrients and, eventually, came to act as hallmarks of specific cultural belonging. The operational field of these ancient lithic industries was, however, initially very homogeneous; i.e. it did not present the techno-morphological Variability required to transform it into culture through learning and socialization until around 2.6 Ma. From this point, technological developments observed in Oldowan stone toolkits, subtle as they may appear, gave way to formal Variability as hominins experimented with recurrence of unifacial knapping and discovered platform preparation and orthogonal knapping strategies, leading to a long period of technological equilibrium.

As in any (past, present or future) techno-system, periods of homeostasis are inevitably broken when innovative Potential contained within a given cultural entity, defined as techno-morphological flexibility, triggers the transition to the next phase. The move from the Oldowan to the Acheulian, as the HMM has already demonstrated, occurred when Potential within the orthogonal knapping systems matured into new referent morphotypes (HMM= Diversity phase: Developed Oldowan or Early Acheulian)[25]. Thereafter, hominins created a range of complex volumetric systems to produce Large Flakes,[37–39] increasing their technological concepts to include bifacial forms and to shape different kinds of large cutting tools. Throughout this growth process, Potential was continuously renewed, increasing even more the progression of branching evolutionary expansion (Figure 2). But more than this, the growing substratum of technological knowhow and the formal realities resulting from it, were needfully transmitted from one generation to the next through ever more complex and localized systems of socialization, creating similarities and differences in learning amongst peoples and finally incurring (from the Acheulian) the first land-based identities linked to morphologies and methods. During the ensuing Multiplicity phase, this process was amplified exponentially as hominins continued tenaciously exploring the techno-social consequences of the changes materialized into the Late Acheulian during the upper Middle Pleistocene.[34] In sum, the Mode 0 industries are the ones that do not show Variability. They are homogeneous, there is no clear methodological diversity or size ranging, nor is there true configuration of cores and flakes. The capacity to model stone according to a desired morphology and of adapting models to specific tasks, as well as that of modelling stone in accordance to an abstract mental template (e.g. symmetry) only appeared later, in the Oldowan and Acheulian techno-complexes.[40–49]

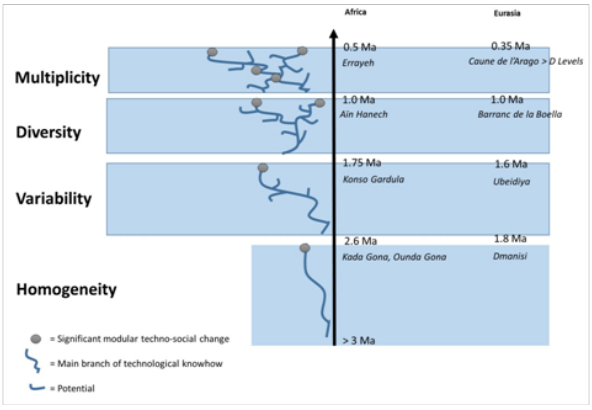

Figure 2 Schematic illustration of the branching evolutionary Homogeneity to Multiplicity Model with representative sites for each phase: Kada Gona and Ounda Gona,[44,45,46] Dmanisi,[13] Konso Gardula,[38] Ubeidiyah,[40] Aïn Hanech,[43] Barranc de la Boella,[42,48] Errayeh,[41] Caune de l'Arago D levels, [49]."

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Conflict of interest

Author declares that there is no conflict of interest.

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