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The emergence of technology: A cultural step or long-term evolution?

Eudald Carbonell [a], Marina Mosquera [b], Xosé Pedro Rodríguez [b,*]

[a] *Institut de Paleoecologia Humana i Evolució Social (IPHES), Universitat Rovira i Virgili, Tarragona, Spain* [1]
[b] *Universitat Rovira i Virgili, Plaça Imperial Tarraco, 1, 43005 Tarragona, Spain*

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Abstract

There are two hypotheses to explain the emergence of the technical behaviour: (1) a sudden and fast appearance across the African continent; (2) a long period of emergence and consolidation before it began to spread. We defend this second hypothesis and suggest that the hominid project started around 3 Myr ago, with a 'biofunctional' stage. Later than 2.5 Myr, the 'biomorphotechnical' stage began (Mode 1), and, at around 1.7 Myr, another stage emerged and developed: the 'biopotential' stage (Mode 2). All these stages consist of a two-part process: innovation/emergence, and socialization/generalization of a technical mode. ***To cite this article: E. Carbonell et al., C. R. Palevol 6 (2007).***

Résumé

L'émergence de la technologie : saut culturel ou longue évolution ? Deux hypothèses peuvent expliquer l'émergence du comportement technique : (1) subitement et rapidement à travers le continent africain ; (2) pendant une longue période d'émergence et de consolidation, avant sa propagation. Nous défendons cette deuxième hypothèse, et suggérons que le projet humain a commencé il y a environ 3 Ma, avec le stade « biofonctionnel ». Au-delà de 2,5 Ma commence le stade « biomorphotechnique » (mode 1) et, autour de 1,7 Ma, émerge un autre stade : le « biopotentiel » (mode 2). Tous ces stades comportent un processus en phases : innovation/émergence, puis socialisation/généralisation d'un mode technique. ***Pour citer cet article : E. Carbonell et al., C. R. Palevol 6 (2007).***

Keywords: Technical behaviour; Lithic tools; Socialization; Plio-Pleistocene; Dispersal

Mots clés : Comportement technique ; Industrie lithique ; Socialisation ; Plio-Pléistocène ; Dispersion

One of the most important issues in the current debate on the cultural evolution of hominids concerns lithic tools and when they emerged. We know that the earliest lithic industries have been found at the sites of Kada Gona (EG10, EG12, OG 6 and OG7) and Kada Hadar (Ethiopia), which date back to around 2.5 Myr (Fig. 1).

* Corresponding author.
E-mail address: josepedro.rodriguez@urv.net (X.P. Rodríguez).
[1] Unidad Asociada CSIC.

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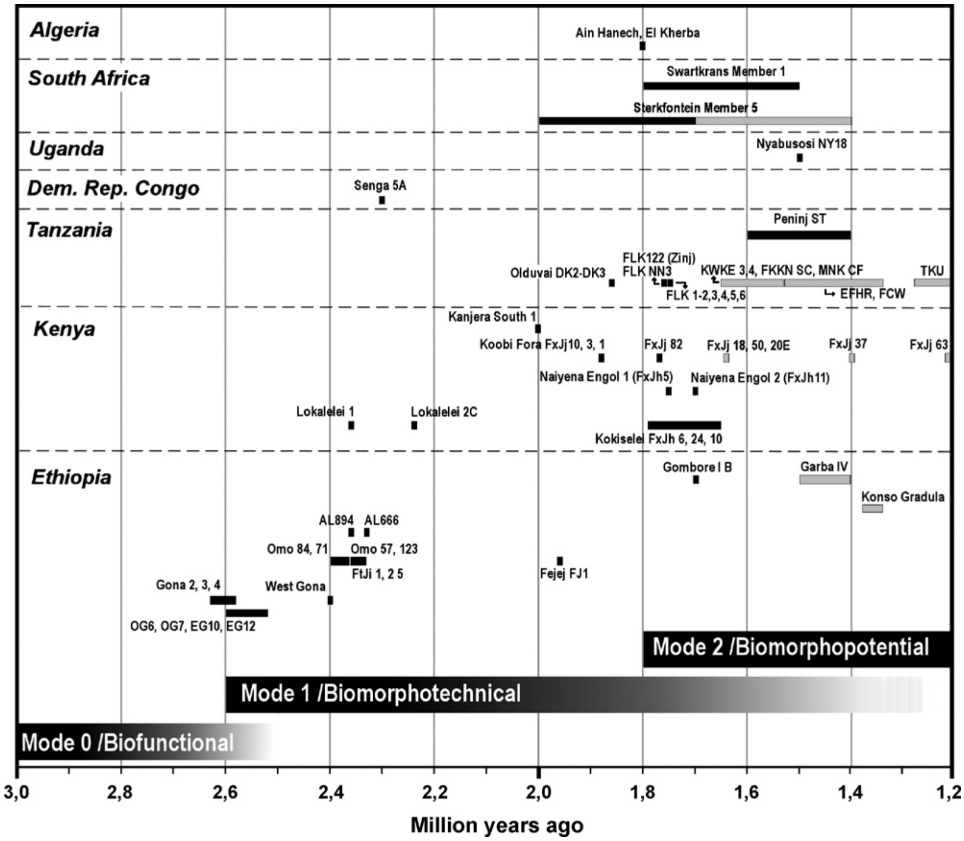

Fig. 1. The most important Plio-Pleistocene African sites with lithic tools, classified according to chronology. Lithic industry from sites underlined with a black band is classified as belonging to Mode 1, whereas that of sites underlined with a grey band belongs to Mode 2 technology.
Fig. 1. Classification chronologique des sites archéologiques plio-pléistocènes africains ayant révélé une industrie lithique. Bandes noires : sites classifiés comme appartenant au mode 1 ; bandes grisées : sites appartenant au mode 2.

They are the earliest proof of operative intelligence in the worldwide Pleistocene fossil record [9–11].

Two hypotheses explain the emergence of technical behaviour. One of them states that exosomatic behaviour emerged suddenly, and spread extremely quickly, synchronically, across the African continent. This hypothesis is supported by our colleague, Prof. Henry de Lumley, whose proposals we were given numerous opportunities to debate [5,6]. The second hypothesis states that technical behaviour emerged over a long period and then consolidated before it began to spread.

As proponents of this second hypothesis, we argue that several lithic industries appeared before 2.5 Myr ago in Africa. In our opinion, artefacts were already being used, produced and socialised by hominids 2.5 Myr ago. Therefore, there must have been an earlier 'incubation period'. Furthermore, the features of *Homo* emerged synchronously with the development and socialization of technology. In our view, the process of lithic production derives from objects being used and handled. This adaptive behaviour, which has also been observed in some mammals, birds and insects, leads to more complex behaviours when the size of the brain increases, as occurred in our genus *Homo*. Therefore, before the lithic operative chains at the African sites were systematized, there may have been a background that facilitated this leap to exosomatic production, which then coevolved with *Homo*'s morphological features, and his increase in brain size.

However, even though these earlier industries must have existed, they are difficult to identify if we use the same criteria we currently use to determine what is anthropic and what is natural. It is possible that the first lithic morphotypes were the result of stones being used to crack nuts on anvils, which may have led to accidental flaking, as documented in the Gombe chimpanzees [8]. Some of the flakes with sharp edges may have remained as passive tools until hominids used them to carry out other activities.

What we find extremely difficult to believe is that the lithic sequences at sites such as Gona were produced spontaneously: although they are technically and morphologically very homogeneous, such complexity is not possible in a first stage of technology. Therefore, we suggest that the hominid's technical project started with a 'biofunctional' stage more than 2.5 Myr ago (Fig. 1). During this stage, hominids used objects with efficient morphologies, but did not consciously produce them, so they do not belong to a technical process that aimed to produce particular morphologies.

Around 2.5 Myr, the 'biomorphotechnical' stage began. This period is characterized by the emergence of sequential and conscious work on stones. This sequential work requires complete project programming, whose operative chain extends from the selection of raw materials to the production of the final morphology of the object and its use. In particular, the greatest efforts were necessary to produce dihedrals, the most operative geometric forms.

In our view, once the biomorphotechnical stage had been assimilated, the socialization of lithic tools among hominids was very rapid. This socialization accelerated slightly after 2.5 Myr ago: so all latitudes of the African continent may have contained lithic tools around this time. The same wave that spread lithic tools across Africa may have introduced them into Eurasia [4]. Therefore, we postulate that lithic industries will be found in the southern areas of Asia as early as 2.5 and 2 Myr [1].

Mode 1, the biomorphotechnical stage, moved away from structural homogeneity around 2 Myr when variability began to increase [5,7]. Around 1.7 Myr, another stage emerged and developed: the biopotential stage (Mode 2) (Fig. 1). It was at this stage that the number of morphologies considerably increased, and that large flakes were systematically produced and shaped so that they could be used as tools [2].

All these stages consist of a process in two parts: firstly, innovation and emergence, which open new doors and create new situations. This part of the process is then followed by a socialization stage. In our field, socialization, the generalization of a technical mode involves a change of stage [3]. However, some time elapses between emergence and socialization. For socialization to take place, a technical mode requires a period of growth and development, when new structures arise and converge towards the social transformation of a community.

From this point of view, we agree that technologies may socialize very fast, but they need time for hominids to systematically adopt them. Therefore, the concept of technical explosion – when morphologies and technical gestures diversify – must be analysed bearing in mind that it can only take place during the socialization period, not during emergence.

We believe, then, that the evolution of technical complexes is guided by a background *evolutionary continuum*. This continuum contains moments of acceleration that lead to emergences, some of which may interrupt the evolutionary rhythm if they are socialised. Therefore, the evolution and change of a technology may be explained from a punctuational point of view.

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