

Major transitions and mosaic evolution in the hominin lineage

Robert A Foley

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Supplementary information: commentary and sources on information in Figure 5.

Figure 5 presents a summary of evidence for ‘transitions’ in the hominin fossil and archaeological record. The entries on the diagram illustrate currently observed first appearances, and so provide an overview of how different traits appear at different times. The primary purpose of the figure is to indicate how traits appear across hominin evolution as a whole, although there is a clustering at three periods (shaded). See main text for a discussion of these.

As with any palaeobiological and archaeological data there are many cautions to be observed. Dates are often either controversial or have low resolution (for example estimates of population coalescence from genetics may have wide margins of error); traits may occur at one point, and then not for a considerable subsequent period (for example, the Lomeckwi tools at 3.3 Ma are followed by more than half a million years with no further evidence for tool making). Such gaps may be due to lack of evidence, or because the trait only occurred ephemerally. Some observations are disputed (for example that DK1 is evidence of a structure); and there are many further traits which could be usefully included (for example, bone technology, evidence for pigment use, etc.), or traits broken into finer categories (scavenging versus hunting, for example). Finally such data are always liable to new discoveries or changes in dates.

Within these caveats, the figures are designed to provide major patterns relating to the question addressed in the paper, major patterning in transitions, rather than a fine-grained analysis.

Figure 5 is constructed from a variety of sources. Much of the information is ‘standard’ information available in major summary texts such as Klein[1]. Further details are provided below

A. Hominin taxa:

First appearance (FADs) for major groups (skull icons) and for species (grey circles).

Primary sources used were [2-9]

B. Terrestrial adaptations:

T1 - The pre-australopithecine evidence for bipedalism is ambiguous, partly due to a very sketchy record, and partly due to the fact that the earliest hominins display arboreal

traits as well as some aspects of bipedalism. The key specimens are *Sahelanthropus tchadensis* [10], *Orrorin tugenensis* [11,12] and *Ardipithecus ramidus* [13].

T2 – There is general acceptance that with *Au. Anamensis* there is strong evidence for habitual bipedalism in all australopithecines and paranthropines, although there are significant differences from that seen in *Homo* [14].

T3 – Evidence for the striding bipedalism similar to modern human locomotion is observed in WT15000 [7].

T4 – DK1 at Olduvai Gorge was claimed by Leakey as a possible shelter structure, and this remains a possibility, although it has been heavily challenged [15].

T5 – Evidence for base camps, home bases, settlements, etc. in the Early Pleistocene has proved elusive. This may be a property of taphonomy, as cave sites are rare. Claims can be made for a number of sites that by the Middle Pleistocene some form of base was present [16].

T6 – Neanderthals and modern humans show full patterns of residential mobility, although it is ecologically variable [17].

T7 – Bramble and Lieberman [18] endurance running as a key adaptive element of human locomotion.

C. Foraging behaviour:

F1 – Cutmarks on bones dated to more than 3 Ma may indicate at least some processing of animal resources, although this evidence has been disputed. [19]

F2 – Substantial evidence for meat processing/butchery/scavenging/hunting becomes increasingly common from 1.8 to 1.5 Ma [20]. There is one cited evidence for use of aquatic resources, otherwise absent for most of the Pleistocene [21].

F3 – With the development of prepared core flake technologies, it is argued that hafted projectile use becomes more significant in hominin foraging behaviour [22,23];

F4 – Modern humans, and most probably Neanderthals as well, display complex and specialised foraging such as specialist hunting, plant resource modification, systematic use of aquatic resources, and foraging similar to living hunter-gatherers.

D. Food processing:

P1 – Enlargement of the molars is a major trend in early hominin evolution [24,25]

P2 – The paranthropines (also known as robust australopithecines) are considered to be megadontic as their main trait, and this is first seen in *P. aethiopicus* [26]

P3 – With the appearance of *Homo*, there is a reversal in evolutionary trends in dental size, one that continues throughout the Pleistocene [24].

P4 – Cooking has been claimed as a significant factor in food processing [27], although the date of its inception has been controversial. The earliest evidence for fire is Wonderwerk Cave in South Africa { Anonymous:8zaYMCKY }, and ephemeral for much of the Lower Pleistocene, but more substantial later (P5) [28].

E. Stone Technology:

M0.5 – earliest evidence for fracturing of stone (Lomekwian) [29];

M1 – Mode 1 technologies (Oldowan) [30];

M2 – Mode 2 technologies (large cutting tools, bifaces); M2.5 – more regular and refined production of bifaces [31]; it has been thought that there is a substantial difference between the earliest bifaces, and the more refined forms found after 1 Ma (M2.5 in the diagram).

M3 – Mode 3 technologies (prepared core) [32];

M4 – Mode 4 technologies (blades); although blades occur early in the African MSA, Mode 4 is considered to be characteristics of the punch struck blades associated with the Upper Palaeolithic [33].

Mode 5 technologies (microliths). These are largely post Pleistocene, but the early presence of them in the Howiesons Poort and India has been viewed as evolutionarily significant [34]

F. Brain size:

(<http://www.genetic-inference.co.uk/blog/2010/04/crunching-the-data-on-human-brain-evolution/>)

G. Body size:

Data from Figure 2 (in kg).

[35]. See also Jungers et al, this volume.

H. Life history:

L1 – Early hominins show evidence of differences in life history strategy from extant apes (see Dean, this volume, for most recent evidence);

L2 first evidence of a shift towards the life history strategies of modern humans [36];

L3 – modern human life history patterns shown in early modern humans, but distinctive patterns observed in Neanderthals [37,38].

I. Sexual dimorphism:

S1 - Reduced canines observed in *Ardipithecus ramidus* [39]

Sexual dimorphism of hominin taxa shown in percentage of female body weight. Only those samples for which there are grounds for thinking they are a population are used. A - *A. afarensis*; D - Denisovans; Ap - Atapuerca; N - Neanderthal; S - *H. sapiens*. [40]

J. Cognition and culture:

C1 – KNM-WT15000 does not show language-based adaptations in its thoracic vertebrae [41]

C2 – the African Middle Stone Age has been identified as the beginning or regional patterns that can be considered to be some form of cultural or etho-linguistic tradition. [42], There is also evidence for language present at that time – see Dediú for an appraisal [43].

C3 and C4 – From the end of the Middle Pleistocene there is diverse evidence for cumulative cultural processes and complex behaviours. See Marean this volume for discussion of some of these issues, and Marean [44,45] and Henshilwood and colleagues [46-48] for the critical South African evidence;

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