

## CHAPTER 25

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# THE FOSSIL RECORD: EVIDENCE FOR SPEECH IN EARLY HOMININS

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BERNARD A. WOOD AND  
AMY L. BAUERNFEIND

THIS contribution reviews the fossil evidence for human evolution from the earliest hominins to the emergence of *Homo erectus*. We indicate the types of fossil evidence that can throw any light, no matter how dim, on the capacities for speech in extinct hominins, and summarize what these lines of evidence suggest about such capacities in the pre-*Homo erectus* taxa in the hominin clade.

### 25.1 THE HOMININ CLADE

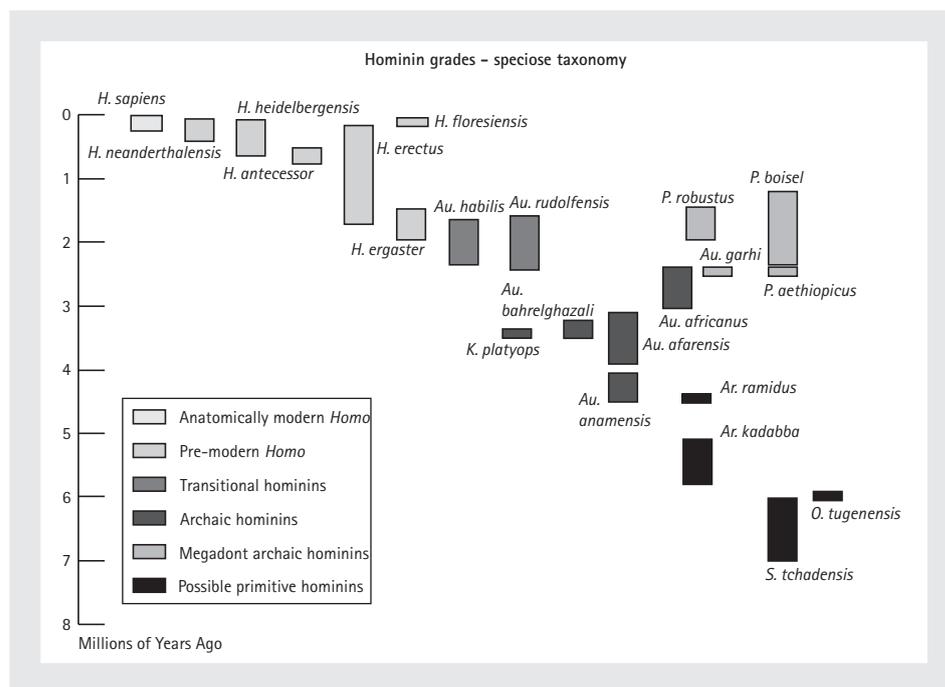
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Hominin is the vernacular for the tribe Hominini, which is the Linnaean term most researchers are now using for the twig, or clade, of the Tree of Life that contains modern humans but no other living taxon. So modern humans, and all the extinct creatures more closely related to modern humans than to any other living taxon,

are called hominins, and chimpanzees and bonobos (hereafter called chimps/bonobos), and all the extinct creatures more closely related to chimps/bonobos than to any other living taxon are called panins.

## 25.2 CLASSIFYING HOMININS

Unlike a clade, which reflects the *process* of evolutionary history, a grade is a category based solely on the *outcome* of evolutionary history. A clade is analogous to a *make* of car (all Ford cars share a recent common ancestor, the Model



**Figure 25.1.** Taxa recognized in a typical speciose hominin taxonomy. Note that the height of the columns reflects current ideas about the earliest (called the first appearance datum, or FAD) and the most recent (called the last appearance datum, or LAD) fossil evidence of any particular hominin taxon. However, the time between the FAD and the LAD is likely to be represent the minimum time span of a taxon, for it is highly unlikely that the fossil record of a taxon, and particularly the relatively sparse fossil records of early hominin taxa, include the earliest and most recent fossil evidence of a taxon.

T, not shared with any other make of car), whereas a grade is analogous to a *type* of car (SUVs made by Lexus, Porsche, and Land-Rover are functionally similar, yet they have different evolutionary histories and therefore have no uniquely-shared recent common ancestor). Taxa in the same grade eat the same sorts of foods and share the same posture and mode(s) of locomotion; how they came by those behaviours is irrelevant. Because the pattern of relationships among fossil hominin taxa remains unclear we sort the hominin taxa into grades and not clades (Figure 25.1).

The grades we use in this review of pre-*Homo* hominins are ‘possible hominins’, ‘archaic hominins’, ‘megadont archaic hominins’ (hominins with larger than expected chewing teeth), and ‘transitional hominins’. We use a relatively speciose taxonomic hypothesis, and we present the species within each grade in temporal order, starting with the oldest taxon. The hominin fossil evidence can also be arranged in fewer, more inclusive taxa, and these taxa are in bold type in Table 25.1.

**Table 25.1 Hominin species in a speciose taxonomy sorted into six grade groupings**

Grade	Species included in a splitting taxonomy
Possible primitive hominins	<i>S.<sub>1</sub> tchadensis</i> <i>O.<sub>1</sub> tugenensis</i> <i>Ar.<sub>1</sub> ramidus</i> <i>Ar.<sub>1</sub> kadabba</i>
Archaic hominins	<i>Au.<sub>1</sub> anamensis</i> <i>Au.<sub>1</sub> afarensis</i> <i>K.<sub>1</sub> platyops</i> <i>Au.<sub>1</sub> bahrelgazali</i> <i>Au.<sub>1</sub> africanus</i> <i>Au.<sub>1</sub> garhi</i>
Megadont archaic hominins	<i>P.<sub>1</sub> aethiopicus</i> <i>P.<sub>1</sub> boisei</i> <i>P.<sub>1</sub> robustus</i>
Transitional hominins	<i>H.<sub>1</sub> habilis</i> <i>H.<sub>1</sub> rudolfensis</i>
Pre-modern <i>Homo</i>	<i>H.<sub>1</sub> ergaster</i> <i>H.<sub>1</sub> erectus</i> <i>H.<sub>1</sub> floresiensis</i> <i>H.<sub>1</sub> antecessor</i> <i>H.<sub>1</sub> heidelbergensis</i> <i>H.<sub>1</sub> neanderthalensis</i>
Anatomically modern <i>Homo</i>	<i>H.<sub>1</sub> sapiens</i>

### 25.3 HOW DO YOU TELL AN EARLY HOMININ TAXON FROM A TAXON IN A CLOSELY-RELATED CLADE?

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There are many differences between the hard-tissues of living modern humans and chimps/bonobos. However, scientists searching in sediments from 8–5 million years ago (mya) for fossil evidence of the earliest members of the hominin clade must consider a different question. What were the differences between the *earliest* hominins and *earliest* panins? These are likely to have been much more subtle than the differences between contemporary hominins and contemporary panins.

The common ancestor of the hominin and panin clades was almost certainly not like either a modern human, or a chimp or a bonobo. Nonetheless, most researchers agree that the last common ancestor (LCA) of the hominin and panin clades was probably more likely to have been chimp/bonobo-like than modern human-like. If this logic is followed, then the skeleton of the LCA of chimps/bonobos and modern humans would most likely show evidence of still being adapted for life in the trees. For example, its fingers would have been curved to enable it to grasp branches, and its limbs would have been adapted to walk both on all fours and on the hind limbs alone. It would have had a snout, modestly-sized chewing teeth, prominent canines, and relatively and absolutely large upper central incisor teeth. Compared to the earliest panins, the earliest members of the hominin clade would most likely have had smaller canine teeth, larger chewing teeth, and thicker lower jaws. There would also have been some changes in the skull and postcranial skeleton linked with more time spent upright and with a greater dependence on the hind limbs for bipedal walking. These changes would have included, among other things, a forward shift in the foramen magnum (the aperture in the base of the skull where the spinal cord attaches to the brain), wider hips, habitually more extended knees, and a narrower, more stable, foot.

### 25.4 POSSIBLE HOMININS

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This group includes four taxa, *Ardipithecus ramidus*, *Orrorin tugenensis*, *Sahelanthropus tchadensis*, and *Ardipithecus kadabba*, which might be hominins.

#### **25.4.1 Taxon name: *Sahelanthropus tchadensis* (Brunet et al. 2002)**

Temporal range: ca. 7–6 mya.

Source(s) of the evidence: known from localities in Toros-Menalla, Chad, Central Africa.

Nature of the evidence: a plastically-deformed cranium, mandibles and some teeth; no postcranial evidence.

Characteristics and inferred behaviour: a chimp/bonobo-sized animal displaying a novel combination of primitive and derived features. Much about the base and vault of the cranium is chimp/bonobo-like, but the relatively centrally-placed foramen magnum is hominin-like. The large ridge above the orbits, the lack of a muzzle, small, apically-worn, canines, low, rounded, molar cusps, relatively thick tooth enamel and relatively thick body of the lower jaw suggest that *S. tchadensis* does not belong in the *Pan* clade. It is either a primitive hominin, or it belongs to a separate clade of hominin-like apes.

#### **25.4.2 Taxon name: *Orrorin tugenensis* (Senut et al. 2001)**

Temporal range: ca. 6 mya.

Source(s) of the evidence: the relevant remains come from four localities in the Lukeino Formation, Tugen Hills, Kenya.

Nature of the evidence: the 13 specimens include three femoral fragments, a fragmented mandible, and six dental specimens.

Characteristics and inferred behaviour: the femoral morphology suggests that *O. tugenensis* is bipedal, but the discoverers admit that much of the dental morphology is 'ape-like' (Senut et al. 2001: 6). *O. tugenensis* may prove to be a hominin, but it is equally likely to be part of the offshoot from great apes that included the common ancestor of panins and hominins.

#### **25.4.3 Taxon name: *Ardipithecus kadabba* (Haile-Selassie et al. 2004)**

Temporal range: 5.2–5.8 mya.

Source(s) of the evidence: Late Miocene fossils from the Middle Awash Valley of Ethiopia.

Nature of the evidence: six postcranial and 11 dental specimens.

Characteristics and inferred behaviour: the main differences between *Ar. kadabba* and *Ar. ramidus s. s. (sensu stricto)* are that the upper canine crowns of the former have longer crests, and that the P<sub>3</sub> crown outline of *Ar. kadabba* is more asymmetrical, and thus more ape-like, than that of *Ar. ramidus*. The proximal foot phalanx (AME-VP-1/71) combines an ape-like curvature with a proximal joint surface which is *Au. afarensis*-like and indicative of semi-arboreality. The ape-like dental morphology suggests that the case for *Ar. kadabba* being a primitive hominin is relatively weak.

#### 25.4.4 Taxon name: *Ardipithecus ramidus* (White et al. 1994, 1995, 2009)

Temporal range: ca. 4.5–4.3 mya (but some specimens could be as young as 3.7 mya).  
Source(s) of the evidence: the evidence for this taxon is a collection of ca. 4.4 million-year-old fossils, most recovered from a site called Aramis in the Middle Awash region of Ethiopia.

Nature of the evidence: the published evidence consists of two associated skeletons, one that includes a partial skull and especially good preservation of the hands and feet (ARA-VP-6/500), a piece of the base of the cranium, mandibles, associated dentitions, isolated teeth, two vertebrae, a first rib, fragments of long bones, and other isolated postcranial fossils.

Characteristics and inferred behaviour: the remains attributed to *Ar. ramidus* share some features in common with living species of *Pan*, others that are shared with the African apes in general, and several dental and cranial features that it is claimed are shared only with later hominins such as *Au. afarensis*. Thus, the discoverers have suggested that the material belongs to a hominin species (White et al. 2009). The new species was initially allocated to *Australopithecus* (White et al. 1994), but it was subsequently assigned to a new genus, *Ardipithecus* (White et al. 1995) which the authors suggest is significantly more primitive than *Australopithecus*. The body mass of the presumed female partial skeleton has been estimated to be ca. 50 kg (but there are reasons to believe that this may be an overestimate), the canines are less projecting than those of common chimpanzees, and the degree of functional honing is modest. The postcanine teeth are relatively small and the thin enamel covering on the teeth suggests that the diet of *Ar. ramidus* may have been closer to that of chimps/bonobos than to later hominins. Despite this specimen having ape-like hands and feet, the position of the foramen magnum and the reconstruction of the poorly preserved pelvic bone have been interpreted as confirmation that *Ar. ramidus* was an upright biped.

## 25.5 ARCHAIC HOMININS

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This group subsumes two genera, *Australopithecus* and *Kenyanthropus*.

### 25.5.1 Taxon name: *Australopithecus anamensis* (Leakey et al. 1995)

Temporal range: ca. 4.5–3.9 mya.

Source(s) of the evidence: Allia Bay and Kanapoi, Kenya.

Nature of the evidence: the evidence consists of jaws, teeth, and postcranial elements from the upper and lower limbs.

Characteristics and inferred behaviour: the teeth of *Au. anamensis* are more primitive than those of *Au. afarensis*, but they also show some similarities to *Paranthropus* (see below). The upper limb remains are like those of *Au. afarensis*, but a tibia attributed to *Au. anamensis* suggests that its owner was an accomplished biped.

### 25.5.2 Taxon name: *Australopithecus afarensis* (Johanson et al. 1978)

Temporal range: ca. 4–3 mya.

Source(s) of the evidence: Laetoli, Tanzania; White Sands, Hadar, Maka, Belohdelie and Fejej, Ethiopia; Allia Bay, West Turkana and Tabarin, Kenya.

Nature of the evidence: *Australopithecus afarensis* is the earliest hominin to have a comprehensive fossil record including a skull, several crania, many lower jaws, and sufficient limb bones to be able to estimate stature and body mass. The collection includes AL-288, just less than half of the skeleton of an adult female, known as ‘Lucy’.

Characteristics and inferred behaviour: body mass estimates for *Au. afarensis* range from ca. 30–45 kg and its endocranial volume is estimated to be between 400–550 cc. This is larger than the average endocranial volume of a chimpanzee, but if the estimates of the body size of *Au. afarensis* are approximately correct, then relative to the estimated body mass the brain of *Au. afarensis* is not substantially larger than that of *Pan*. It has smaller incisors than those of extant chimps/bonobos, but its premolars and molars are relatively larger than those of chimps/bonobos. The pelvis and the relatively short lower limbs suggest that *Au. afarensis* was not adapted for long-range bipedalism, and the hand and the shoulder girdle retain

morphology that most likely reflects a significant element of arboreal locomotion. Footprints from Laetoli, Tanzania, suggest that the standing height of adult individuals in this early hominin species was between 1.0 and 1.5 m.

### 25.5.3 Taxon name: *Kenyanthropus platyops* (Leakey et al. 2001)

Temporal range: ca. 3.5–3.3 mya.

Source(s) of the evidence: West Turkana and perhaps Allia Bay, Kenya.

Nature of the evidence: the initial report lists the cranium of the specimen defining the species, or holotype, and the maxilla and 34 additional specimens, some of which may well belong to *K. platyops*.

Characteristics and inferred behaviour: the main reasons why KNM-WT 40000, the type specimen of *K. platyops*, was not assigned to *Au. afarensis* are its flat and wide face, and its relatively small but thickly enamelled molars. Its face is like that of the megadont archaic hominins (see below), but the chewing teeth of *K. platyops* are not enlarged. The new material bears some resemblance to *Homo rudolfensis* (see below), but the postcanine teeth of the latter are substantially larger than those of KNM-WT 40000.

### 25.5.4 Taxon name: *Australopithecus bahrelghazali* (Brunet et al. 1996)

Temporal range: ca. 3.5–3.0 mya.

Source(s) of the evidence: Koro Toro, Chad.

Nature of the evidence: the evidence is restricted to jaw fragments and an isolated tooth.

Characteristics and inferred behaviour: its discoverers claim that the thicker enamel of KT 12/H1 distinguishes it from *Ar. ramidus*, and that its smaller and more vertical mandibular symphysis and more complex mandibular premolar roots distinguish it from *Au. afarensis*. However, *Au. bahrelghazali* is most likely a regional variant of *Au. afarensis*.

### 25.5.5 Taxon name: *Australopithecus africanus* (Dart 1925)

Temporal range: ca. 3–2.4 mya.

Source(s) of the evidence: most of the evidence comes from two caves, Sterkfontein and Makapansgat, with other evidence coming from Taung and Gladysvale.

Nature of the evidence: this is one of the better fossil records of an early hominin taxon; the cranium, mandible and the dentition are well-sampled, as is the post-cranium, but the axial skeleton is less well represented in the sample.

Characteristics and inferred behaviour: *Australopithecus africanus* was capable of walking bipedally, it had relatively large chewing teeth, and apart from the reduced canines the skull is relatively ape-like. Its mean endocranial volume is ca. 460 cc. The Sterkfontein evidence suggests that males and females of *Au. africanus* differed substantially in body size but probably not to the degree they did in *Au. afarensis*.

## 25.6 MEGADONT ARCHAIC HOMININS

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This group includes hominin taxa that some include in the genus *Paranthropus*, together with *Australopithecus garhi*. The genus *Paranthropus*, which subsumes *Zinjanthropus* and *Paraaustralopithecus*, was reintroduced when cladistic analyses suggested that three of the species included in this section formed a clade. The term ‘megadont’ refers to the absolute size of the postcanine tooth crowns, but some individuals assigned to other pre-*Homo* hominin taxa (such as *Au. africanus*) have teeth nearly as big as the taxa (e.g. *Paranthropus robustus*) referred to here.

### 25.6.1 Taxon name: *Paranthropus aethiopicus* (Arambourg and Coppens 1968; Chamberlain and Wood 1985)

Temporal range: ca. 2.5–2.3 mya.

Source(s) of the evidence: Shungura Formation, Omo region, Ethiopia; West Turkana, Kenya; Malema, Malawi.

Nature of the evidence: the evidence for this species includes a well-preserved adult cranium from West Turkana (KNM-WT 17000), and mandibles (for example, KNM-WT 16005) and isolated teeth from the Shungura Formation, but no post-cranial fossils.

Characteristics and inferred behaviour: similar to *Paranthropus boisei* (see below) except that the face is more projecting, the cranial base is less flexed, the incisors are

larger, and the postcanine teeth are not so large or morphologically specialized. However, there is only one relatively complete *P. aethiopicus* cranium, and Smith's (2005) warnings about making taxonomic inferences based on small samples should be heeded.

### 25.6.2 Taxon name: *Australopithecus garhi* (Asfaw et al. 1999)

Temporal range: ca. 2.5 mya.

Source(s) of the evidence: Bouri, Middle Awash, Ethiopia.

Nature of the evidence: a fragmented cranium and two partial mandibles.

Characteristics and inferred behaviour: *Au. garhi* combines a primitive cranium with large-crowned post-canine teeth. However, unlike *Paranthropus* (see above), the incisors and canines are also large and the enamel lacks the extreme thickness seen in the latter taxa. An associated skeleton combining a long femur with a long forearm was found nearby, but it is not associated with the type cranium and these fossils have not been formally assigned to *Au. garhi*.

### 25.6.3 Taxon name: *Paranthropus boisei* (Leakey 1959; Robinson 1960)

Temporal range: ca. 2.3–1.4 mya.

Source(s) of the evidence: Olduvai and Peninj, Tanzania; Omo Shungura Formation and Konso, Ethiopia; Koobi Fora, Chesowanja, and West Turkana, Kenya.

Nature of the evidence: there are several skulls (the one from Konso being remarkably complete and well-preserved), several well-preserved crania, and many mandibles and isolated teeth.

Characteristics and inferred behaviour: *Paranthropus boisei* is the only hominin to combine a massive, wide and flat face, large premolars and molars, small anterior teeth, thick enamel, a modest endocranial volume (ca. 480 cc), and a mandibular body that is thicker than that of any other hominin. The fossil record of *P. boisei* extends across about one million years of time during which there is little evidence of any substantial change in the size or shape of the components of the cranium, mandible, and dentition.

#### 25.6.4 Taxon name: *Paranthropus robustus* (Broom 1938)

Temporal range: ca. 2.0–1.5 mya.

Source(s) of the evidence: Kromdraai, Swartkrans, Gondolin, Drimolen, and Cooper's caves, all situated in the Blauuwbank Valley, near Johannesburg, South Africa.

Nature of the evidence: some of the cranial remains and dentition are well preserved, but most of the crania and mandibles are crushed or distorted.

Characteristics and inferred behaviour: the brain, face, and chewing teeth of *P. robustus* are larger than those of *Au. africanus*, yet the incisor teeth are smaller. What little is known about the postcranial skeleton of *P. robustus* suggests that the morphology of the pelvis and the hip joint is much like that of *Au. africanus*.

### 25.7 TRANSITIONAL HOMININS

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Some researchers have suggested that *H.<sub>1</sub> habilis* and *H.<sub>2</sub> rudolfensis* may not belong in the *Homo* clade, but until we can generate sound phylogenetic hypotheses about the relationships among these taxa and other hominins it is not clear what their new generic attribution should be. For the purposes of this review, these two taxa are treated as transitional hominins, for they combine some of the features of archaic hominins together with features seen in *Homo erectus* grade hominins.

#### 25.7.1 Taxon name: *Homo habilis* (Leakey et al. 1964)

Temporal range: ca. 2.4–1.4 mya.

Source(s) of the evidence: Olduvai Gorge, Tanzania; Koobi Fora, Kenya; Omo (Shungura) and Hadar, Ethiopia, East Africa; perhaps also Sterkfontein, Swartkrans, and Drimolen, South Africa and Chemeron, Kenya

Nature of the evidence: mostly cranial and dental evidence with only a few postcranial bones that can with confidence be assigned to *H. habilis*.

Characteristics and inferred behaviour: the endocranial volume of *H. habilis* ranges from ca. 500 cc to an upper limit closer to 600 cc. All the crania are wider at the base than across the vault, but the face is broadest in its upper part. An earlier inference that *H. habilis* was capable of speech was based on links between endocranial morphology and language comprehension and production that are no longer valid (Holloway 1983; Corballis 2003).

### 25.7.2 Taxon name: *Homo rudolfensis* (Alexeev 1986; *sensu* Wood 1992)

Temporal range: ca. 2.4–1.6 mya.

Source(s) of the evidence: Koobi Fora and perhaps Chemeron, Kenya; Uraha, Malawi.

Nature of the evidence: several incomplete crania, two relatively well-preserved mandibles and several isolated teeth.

Characteristics and inferred behaviour: *Homo rudolfensis* and *H. habilis* show different mixtures of primitive and derived, or specialized, features. For example, although the absolute size of the brain case is greater in *H. rudolfensis*, its face is widest in its mid-part, in contrast to the aforementioned *H. habilis* whose face is widest superiorly. Despite the absolute size of its brain (ca. 725 cc), relative brain size (brain mass as it relates to estimates of body mass) of *H. rudolfensis* is not substantially larger than those of the archaic hominins. The more primitive face of *H. rudolfensis* is combined with a robust mandible and mandibular postcanine teeth with larger, broader, crowns, and more complex premolar root systems than those of *H. habilis*.

## 25.8 CATEGORIES OF HARD-TISSUE EVIDENCE RELATED TO THE GENERATION OF SPEECH

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Holloway's (1983) classic review considered four categories of neuroanatomical evidence for spoken language: (1) brain size; (2) evidence for the reorganization, or enlargement, of Broca's area; (3) evidence for brain reorganization involving the temporal cortex and the enlargement of the parietal ~~lobule~~ at the expense of the visual cortex, and (4) petalial asymmetries.

Holloway admitted that with respect to providing evidence about speech capabilities '(brain) size is problematic and always has been' because intra- and interspecies comparisons do not yield a clear correlation between brain mass and speech production or cognitive functioning (1983: 111). Broca's area is located along the inferior frontal gyrus of the anterior prefrontal cortex and is thought to play a role in the production of spoken language (Damasio and Damasio 1989). Broca's area is generally enlarged in the left hemisphere of most modern humans (Amunts et al. 1999), and though present in apes, this lateralization occurs less frequently (Holloway 1996; see also Hopkins and Vauclair, this volume). A recent survey of extinct and extant hominins showed that asymmetrical enlargement occurs in

*Homo* taxa (*H. rudolfensis*, *H. erectus*, *H. heidelbergensis*, *H. neanderthalensis*), but it is absent in *Au. afarensis* (de Sousa and Wood 2007). However, doubt has been cast on the wisdom of using endocranial morphology as a proxy for identifying functional regions of the cortex (e.g. Holloway 2009). The evidence for brain reorganization is controversial because it focuses on a dispute about the location of the impression for the lunate sulcus on the endocranial casts of archaic hominins (see Wilkins, this volume). Lastly, petalias, or asymmetries in the cortical hemispheres of the brain, once thought to be peculiar to modern humans (and thus a sound way of imputing functions such as spoken language) have been identified in samples of higher primates other than modern humans (Hopkins and Marino 2000).

Since 1983, others have suggested that in addition to endocranial morphology, the fossil hominin record potentially provides other lines of evidence about the *production* of speech. These include hard-tissue evidence of: (1) ‘extra’ neurons in the thoracic spinal cord that would allow for fine control of the muscles of respiration; (2) ‘extra’ neurons that facilitate the type of fine control of the muscles of the tongue that is involved in speech; (3) the type of supralaryngeal vocal tract (including the form and location of the hyoid) that is suitable for the production of the types of complex sounds integral to complex spoken language; see MacLarnon, this volume.

Examination of the thoracic spinal cord across primates suggested that its cross-sectional area is correlated with the cross-sectional size of the vertebral canal in the thoracic region (MacLarnon 1995; this volume), and when the canal sizes were adjusted for body weight, only the relative size of the thoracic canals of modern humans and Neanderthals were larger than their body sizes would predict (MacLarnon and Hewitt 1999). However, experience with other systems suggests it is very unlikely that these types of broad across-primate allometric relationships are valid for a much narrower allometric context, such as that within the hominin clade. The initial results of attempts to infer the size of the hypoglossal nerve (the motor nerve to most of the extrinsic and all of the intrinsic muscles of the tongue) from the size of the hypoglossal canal (Kay et al. 1998) seemed promising, but closer examination (DeGusta et al. 1999) revealed flaws in this approach; see MacLarnon, this volume.

The supralaryngeal vocal tract (also called the SVT) is made up of two tubes. The horizontal tube is formed by the mouth and the oropharynx, and the vertical tube runs from the soft palate to the vocal folds (note the oropharynx is common to both tubes). Stevens’ (1972) theory of quantal speech requires the tubes to be equal in length, and both need to have mechanisms capable of making substantial changes to the size of the lumen of each tube in order to produce the full range of sounds found in the speech of modern humans (Lieberman et al. 1972). However, reliable estimation of the length of the two components of the SVT from hard-tissue evidence alone is close to impossible. The hyoid bone is located

above the larynx and is the attachment site for the strap muscles of the neck and for the stylohyoid ligament. The size and shape of the hyoid belonging to a juvenile *Au. afarensis* specimen from Dikika, Ethiopia is like that seen in African apes, *prima facie* evidence that this species was unlikely to be capable of modern human-like vocalizations (Alemseged et al. 2006).

Although each of these lines of evidence seemed to offer considerable potential as proxies for linguistic competence in extinct hominins, the reality is that for one reason or another none of them have lived up to their initial promise. Readers should refer to MacLarnon's chapter, this volume, for an in-depth review of the anatomical specializations connected with speech production.

Evidence related to the *perception* of speech in archaic hominins has also expanded beyond endocranial morphology to a consideration of the external and middle ears. The external ears of chimpanzees are both longer and smaller in cross-section (the external auditory meatus of modern humans [mean = 115mm<sup>2</sup>] is more than twice that of chimpanzees [mean = 45mm<sup>2</sup>]), and the longer canal may help amplify low-to-mid frequency sounds. What is known of the size of the external auditory meati of early hominins prior to *Au. afarensis* suggests that they are also chimp-sized. Middle-ear ossicles have been recovered at Swartkrans and Sterkfontein (an incus, SK 848 belonging to *P. robustus*, from the former, and a stapes, belonging to *Au. africanus* and *H. habilis*, from the latter). Moggi-Cecchi and Collard (2002) showed that there was a marked similarity in size between the footplates of the early hominin stapes and the stapes belonging to the living great apes, and that they were both substantially smaller than those of modern humans. But what, if anything, this implies about the speech capabilities of *Au. africanus* (and *H. habilis*) is unclear.

## 25.9 CONCLUSION

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It is tempting to try to wring evidence about speech capabilities from the fossil evidence, but to cut a long and often confusing story short, the fossil evidence for archaic hominins contains little, or no, reliable evidence about the speech capabilities of these taxa. Even if it is possible to make broad functional inferences across a wide range of primates, it is imprudent to assume the same inferences can be made across a much narrower range of taxa such as those in the hominin clade.

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