

Morphological analysis of vocal communication in *Homo naledi*

John Hawks^{*1,2}

*Corresponding Author: jhawks@wisc.edu

¹Department of Anthropology, University of Wisconsin-Madison, USA

²Centre for the Exploration of the Deep Human Journey, University of the Witwatersrand, South Africa

Most considerations of the fossil record relevant to human language have relied upon a simplified view of human origins. Many reviews have considered *Australopithecus*, *Homo erectus*, Neanderthals, and modern humans as stages, arguing that cranial anatomy and material culture provide evidence of symbolic language only in modern human contexts (Hauser et al., 2014). Others have emphasized that Neanderthals had adaptations consistent with spoken language (Johanson, 2015).

Discoveries of the last two decades have markedly increased the level of data and diversity of species known in the hominin record. Diverse species of *Homo*, including *Homo floresiensis* (Brown et al., 2004) and *Homo naledi* (Berger et al., 2015), persisted into the later Pleistocene with small brain size, but with endocast form similar to modern humans in some important ways. Here I focus on the anatomy of *Homo naledi* relevant to vocal communication and language. The current fossil record of this species now numbers more than 2000 fossil fragments, representing a minimum of 25 individuals from four localities within the Rising Star cave system of South Africa (Berger et al., 2015; Hawks et al., 2017; Brophy et al., 2021; Berger et al., 2023). The remains from the Dinaledi Chamber have been placed between 335,000 and 241,000 years ago (Dirks et al., 2017). The context of the fossil material suggests that *H. naledi* was making repeated use of the dark zone of this cave system, which may have entailed some cultural tradition or transmission of knowledge across individuals and generations (Berger et al., 2023).

The endocast volume of *Homo naledi* crania ranges from 450 ml to 610 ml, overlapping with *Australopithecus* and early *Homo* species. Endocasts of three *H. naledi* individuals preserve evidence from the left prefrontal cortex relevant to the morphology of Broca's area. They show that *H. naledi* had a

configuration similar to modern humans and other recent fossil *Homo* (Holloway et al., 2018), although different from some early *H. erectus* fossil endocasts (Ponce de Léon et al., 2021). No hyoid bone fragments have yet been identified, but fossil ear incudes are known and are similar in some ways to the morphology to the *Paranthropus incus* (Elliott et al., 2018). Some past work has considered the basicranial form to be relevant to vocalization ability, and reconstruction of the basicranium of *H. naledi* shows a morphology that is broadly similar to early *H. erectus* with a somewhat greater degree of basicranial flexion. The auditory canal of *H. naledi* diverges from those of *Australopithecus* or *Paranthropus* in size and shape, with greater similarity to other Middle Pleistocene *Homo* in shape and a smaller size that may reflect scaling with skull size.

Fossil evidence has many weaknesses as a test for vocal behavior, and the most important anatomical correlates of language in the brain do not leave a fossil trace. However, *H. naledi* presents an anatomical picture that is nearly as complete as that known for Neanderthals, and more complete than *H. erectus*, in a Middle Pleistocene context when early *H. sapiens* was also extant. The anatomy suggests that this species had some features that are associated with vocal communication in recent humans and are not found in early *H. erectus*. These features may reflect either homology or convergence depending on the phylogenetic hypothesis used.

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