Language Capabilities of *Homo erectus* & *Homo neanderthalensis*

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I. Introduction

This paper will review some of the recent literature on the language capabilities that have been attributed to *Homo erectus* and to Neanderthals. It has often been assumed that *Homo erectus* (or *ergaster*) appeared in Africa between 1.7 and 1.8 million years ago, while *Homo neanderthalensis* appeared later, in Europe, approximately 127,000 years ago—though many anthropologists do not always agree on how to classify early hominid species (Boyd & Silk 2000). Archaeological evidence has suggested that "the lineage leading to the Neanderthals had begun to diverge from other archaic populations by about 300,000 years ago" (Boyd & Silk 2000: 433). Anthropologists continue to debate whether modern humans descend from *Homo neanderthalensis.*

Nevertheless, the language capabilities of any hominid species prior to modern *Homo sapiens* would have been limited by the species' particular physiological properties. Limiting factors would have included brain size, fine control of breathing, as well as respiratory and vocal tract structure. These issues have been discussed thoroughly in the literature on language origins. More specifically, Deacon (1997), Tobias (1998), and Wynn (1998) have discussed the language capabilities of both *Homo habilis* and *Homo erectus* with respect to brain structure and respiratory control. MacLarnon & Hewitt (1999) have offered a more in depth survey of the respiratory control for several fossil hominid specimens. Laitman *et al.* (1996), Schwartz & Tattersall (1996), and Franciscus (1999) have debated the significance of the Neanderthal upper respiratory tract. And finally, Lieberman (1992, 1993) has argued that any speech production capabilities in *Homo neanderthalensis* would have been severely limited by the physiology specific to that species.

II. Limitations on the Mental Capabilities of *Homo erectus* & Neanderthals

Hominid brain size increased throughout the Pleistocene era, between 2 million and 300,000 years ago (Boyd & Silk 2000; Deacon 1997). In particular, Deacon (1997: 343) notes that "there is little disagreement among paleontologists that hominid brains first began to enlarge significantly in comparison to body size approximately 2 million years ago, with the appearance of the paleospecies designated *Homo habilis."* However, there may be some degree of overlap between specimens of *Homo habilis* and those which have been classified as its successor, *Homo erectus*. In fact, it has been observed that brain size varies significantly for many specimens classified as *Homo habilis;* thus, some of these fossils could be categorized with other *Homo erectus* specimens (Boyd & Silk 2000; Deacon 1997).

Based on fossil evidence, Deacon (1997) claims that primitive vocal abilities first arose in *Homo habilis*. That is, fossil evidence of brain and body size indicates that "human vocal skills first exceeded the capabilities of any living nonhuman primate at least 2 million years ago, in the hominid fossil species *Homo habilis,* since this species marks the first significant upward shift in relative brain size" (Deacon 1997: 251). Tobias (1998) also suggests that language-like abilities appeared during the time of *Homo habilis*; more specifically, he states:

> "*Homo habilis* was the first hominid in the fossil record to show the curiously human trait of marked brain enlargement (nearly 50 per cent greater than *A. africanus*), the human pattern of cerebral sulci (or fissures between convolutions), cerebral asymmetry, cerebral impressions coincident with the cortices of spoken language, Broca's area and the parieto-occipitotemproral region (including Wernicke's area)." [page 78]

Still, it is not clear that *Homo habilis* fossil brain evidence is sufficient enough to claim that this hominid had language-like skills.

Likewise, fossil brain evidence does not clearly indicate that *Homo erectus* had definite language abilities. Wynn (1998) argues that *Homo erectus* had

communicative abilities which were more similar to that of humans than to that of nonhuman primates. Wynn (1998: 78) states *Homo erectus* had "an 'intermediate' evolutionary status; in some respects it was like modern humans and unlike modern apes (reliance on tools, geographic distribution), while in other respects it was unlike modern humans (lack of ornamentation or art)." In a discussion of *Homo erectus'* tool use, Wynn (1998: 81) entertains the hypothesis that *Homo erectus* used tools along with vocalizations, or even gestures, in order to "produce directives (you do this) and commissives (I do this) about present and future action." This type of communication would have required *Homo erectus* to integrate "several cognitive domains, an ability apparently not possessed by chimpanzees" (Wynn 1998: 81).

Wynn (1998: 79) notes that the brain of *Homo erectus* was similar in structure to that of humans, "and unlike that of apes." He goes further by stating that "the evidence of fossil brains suggests that *Homo erectus* may have had a vocal language" (ibid). Wynn looks to two specific regions of the brain for neurological evidence of spoken language, i.e. the lower left frontal lobe and the left parietal lobe. He notes that endocasts of *Homo erectus* suggest that the configuration of the Broca's area and Wernicke's area are human-like. However, he recognizes that the anatomy of the lower left frontal lobe, and the left parietal lobe "include, but are not coextensive with, Broca's and Wernicke's areas" (Wynn 1998: 78). Furthermore, the precise linguistic functions of these areas of the brain are not known. Thus, "we can safely conclude that those general areas of the *Homo erectus* brain are modern in shape, but must be more cautious about identifying the presence of speech production and comprehension areas" (Wynn 1998: 78).

There is also a great deal of speculation about the mental capacities of Neanderthals. It is generally recognized that the average Neanderthal brain was

larger in size than the average modern human brain (Boyd & Silk 2000). Still, Lieberman (1992: 409) notes that "it is also possible that the Neanderthal brain was not as well adapted to the control of the complex articulatory maneuvers that are necessary to generate rapid articulate human speech." Lieberman (1992) believes that Neanderthals may have had deficits in one of the "traditional language" areas, i.e. Broca's area. However, Deacon (1997) does not necessarily agree with Lieberman's claims, as Deacon maintains that *Homo neanderthalensis* specimens should be considered neurologically similar to modern humans. "They had a brain size slightly above modern values, and a slightly smaller stature, and so we can extrapolate that the internal proportions of their brain structures were consistent with a symbolic capacity equal to anatomically modern humans." (Deacon 1997: 372)

III. A Comparison of Respiratory Control in *Homo erectus* & Neanderthals

Relevant to a discussion of the speech production capabilities of early hominid species is an investigation into the changes in cognitive and physical features that would have been necessary before hominids were able to vocalize. Importantly, MacLarnon & Hewitt (1999: 352) note that "it is clear that the intricacies of human speech place demands on the neural control of muscles that are of a very different order from those of quiet breathing." Toward this end, the MacLarnon & Hewitt (1999) investigate the role of increased breath control in the evolution of human vocal abilities. They note that previous studies have suggested that *Homo erectus* did not have fine control of breathing. The conclusions from previous studies were based on investigations of the thoracic vertebral canal. According to MacLarnon & Hewitt (1999), Neanderthals have an expanded thoracic vertebral canal and possibly could have had fine control of breathing.

MacLarnon & Hewitt (1999) examined measurements of the thoracic vertebra for

nonhumans, adult humans, and fossil hominids. They found that "the thoracic vertebral canal of early fossil hominids was of similar relative size to that of extant nonhuman primates, and substantially smaller than that of modern humans" (MacLarnon & Hewitt 1999: 347). The fossil hominids examined included an early *Homo erectus* specimen (i.e. *H. ergaster*) as well as four Neanderthal specimens. While the thoracic vertebral canal of the *H. erectus* specimen was smaller than that of modern humans, MacLarnon & Hewitt (1999: 347) found that the thoracic vertebral canal of the Neanderthal specimens was "of similar relative dimensions to modern humans."

Since, the dimensions of the spinal cord inside the vertebral canal correlate with the size of the vertebral canal overall, "canal dimensions can be interpreted in terms of the size of the spinal cord" (MacLarnon & Hewitt 1999: 347). While modern humans have an increased level of thoracic innervation, the authors suggest that bipedal locomotion cannot accurately account for the increase. The thoracic innervation of *H. ergaster* is most similar to that of modern nonhuman primates, even though it has been shown that the Nariokotome specimen of *Homo ergaster* "was fully bipedal and had a flexible waist" (MacLarnon & Hewitt 1999: 348). Still, the thoracic spinal nerves do innervate the muscles that control breathing. The authors posit that "it is aspects of speech itself that required a significant increase in the innervation of breathing muscles" (MacLarnon & Hewitt 1999: 350). Air pressure below the larynx is controlled by the respiratory muscles, and it is this air pressure which "fuels voice production in the upper respiratory tract" (MacLarnon & Hewitt 1999: 350).

The authors cite copious evidence which demonstrates that control over air pressure below the larynx allows adult humans to not only utter long sentences, but also vary vocal intensity, as well as pitch and intonation patterns. They conclude that Neanderthals were able to exhibit enhanced breathing control. MacLarnon & Hewitt (1999) state that the level of thoracic innervation of Neanderthals is similar to that of modern humans. The results of this study lead the authors to further conclude that

"enhanced breath control, which is a necessary feature for fully modern language, therefore was not possible for earlier hominids up until at least 1.6 mya, the time of *Homo ergaster* (or early *Homo erectus*)."

Yet, there is no general consensus as to whether *Homo erectus* had fine control over respiration or the ability to vocalize. For example, Wynn (1998) does not believe that there is evidence that *Homo erectus* had control over the mechanisms used for breathing and respiration. He cites evidence which states that the innervation of the thoracic vertebrae in *Homo erectus* is similar to that of nonhuman primates. In this regard, Wynn's position is similar to that of MacLarnon & Hewitt (1999).

In contrast to the position taken by Wynn (1998), Deacon (1997) suggests that *Homo erectus* had some control over the mechanisms required for breathing control. More specifically, Deacon (1997: 252) states that a young male *Homo erectus* specimen, "with a relative brain size intermediate between modern apes and modern humans," could have plausibly "had an intermediate level of cortical control over respiration, supported in part by an increase in cortical projections to thoracic motor neurons as well as to other higher respiratory centers." However, Deacon (1997: 252) acknowledges that "the modern human level of control over vocalization and respiration did not evolve overnight." With respect to the upper vocal tract, the ability to articulate may have "always in advance of laryngeal capabilities" (Deacon 1997: 252).

IV. The Upper Respiratory Structures of *Homo neanderthalensis*

The analysis provided by MacLarnon & Hewitt (1999) suggests that Neanderthals were able to control breathing. While fine control over breathing is an important element in speech production, aspects of the Neanderthal vocal tract and upper respiratory system may have limited *Homo neanderthalensis'* ability to speak. Compared to Neanderthals, the larynx of modern humans is low in the throat (Boyd & Silk 2000). Laitman *et al.* (1996) point out that previous studies have "emphasized that

some Neanderthals (such as the "Classic" western European specimens) would have exhibited a larynx slightly higher in the neck than that of modern humans, with these Neanderthals having a more limited oropharyngeal segment with a greater proportion of the tongue occupying the oral cavity" (10544). The positioning of the larynx in modern humans affects the size and the shape of vocal tract. More importantly, the positioning of the larynx helps us produce a full range of sounds.

Laitman *et al.* (1996) cite anatomical evidence which suggests that Neanderthal respiration occurred primarily through the nasal passages. The aspects of Neanderthal respiration and the positioning of the larynx in this species, leads Laitman *et al.* (1996: 10544) to conclude that "Neanderthals could not have produced the same array of sounds that living humans can." Schwartz & Tattersall (1996) draw attention to autapomorphies in the internal nasal region of Neanderthals, or what Laitman *et al.* (1996: 10543) refer to as "specializations of internal nasal morphology." In particular, Schwartz & Tattersall (1996) discuss three features of the Neanderthal internal nasal region which they believe are evidence that *Homo neanderthalensis* is distinct from *Homo sapiens.* Laitman *et al.* (1996) claim that the evidence provided by Schwartz & Tattersall (1996) is significant in that "the three traits they describe clearly suggest a morphology that is different from ours and appears designed to subserve specialized functions." However, according to Franciscus (1999), the claims that Neanderthals had a unique nasal morphology are questionable. Franciscus is also skeptical of the claims, made by Laitman *et al.* (1996), which suggest that the evidence provided by Schwartz & Tattersall (1996) is indicative of a "specialized anatomy" for the Neanderthal respiratory tract (Franciscus 1999: 1808).

Franciscus (1999) notes that the three nasal specializations cited by Schwartz & Tattersall (1996) were based on a small sample of specimens. Franciscus (1999) also notes that many of the specimens that Schwartz & Tattersall examined were damaged or otherwise incomplete. In his analysis, Franciscus (1999) includes a more

comprehensive study of "the internal and external nasal region of over 200 Pleistocene adult and subadult fossil hominids." The results of this survey do not support the results of the study conducted by Schwartz & Tattersall (1996). Franciscus (1999: 1808) concludes that "the type of 'radical reorganization' of internal nasal anatomy envisaged by Schwartz & Tattersall for the Neandertals is theoretically implausible." Moreover, Franciscus (1999) states if *Homo neanderthalensis* is to be considered a separate species from *Homo sapiens,* other anatomical structures should be examined.

V. The Supralaryngeal Tract of *Homo erectus* & *Homo neanderthalensis* compared

According to Deacon (1997: 372), "even if we accept the more extreme reconstructions that place the Neanderthal larynx very high in the throat, we can hardly doubt that they possessed a symbolic communication system every bit as sophisticated as their anatomically modern contemporaries." However, Lieberman (1992, 1993) provides several reasons why Neanderthal speech could not have been the same as modern human speech. Lieberman does not claim that Neanderthals lacked speech capabilities altogether; rather, he asserts that Neanderthals were incapable of producing the vowels [i], [a], and [u]. In addition, it is likely that Neanderthals were unable to produce unnasalized speech. Thus, according to Lieberman (1992: 409), "the sounds that Neanderthals could not have made because of their supralaryngeal vocal-tract anatomy have functional properties that enhance speech perception." Lieberman (1992: 409) further asserts that production of unnasalized speech sounds "enhances the perceptual recovery of the formant frequency patterns that make human speech a rapid means of communication."

Even though *Homo neanderthalensis* probably had a supralaryngeal tract unlike that of modern humans, according to Lieberman (1993: 174) "the classic Neanderthal supralaryngeal vocal tract would have allowed speech." Still, it is the structure of the Neanderthal supralaryngeal tract which would have prevented *Homo neanderthalensis*

from producing the range of speech sounds that modern humans are capable of producing. Lieberman (1992: 410) notes that the Neanderthal tongue "is largely contained within the oral cavity." This is significant, as this positioning of the tongue would have prevented Neanderthals from "accomplishing the abrupt changes in airway shape that are necessary for producing the vowels [i], [u], and [a] and from sealing off the nasal cavity from the rest of the supralaryngeal airway" (Lieberman 1992: 410). In this way, vowel production would have been limited and only nasalized speech would have been possible for Neanderthals.

Lieberman (1992, 1993) disagrees with studies which claim that Neanderthals could produce human-like speech based on the presence of a hyoid bone. Lieberman notes that the supralaryngeal airway of modern humans is not defined by the presence of the hyoid bone, as has been previously suggested. In fact, the hyoid bone of modern humans is similar in size to the hyoid bone of pigs. "The metrical similarity between pig and human hyoids, furthermore, indicates that hyoid bone morphology is not related to the position of the hyoid and the shape of the supralaryngeal vocal tract" (Lieberman 1993: 174). Thus, presence of a hyoid bone in Neanderthal specimens does not suggest that Neanderthals had a supralaryngeal tract similar to that of modern humans.

With respect to the supralaryngeal tract, it is also important to consider the structure of the basicranium or base of the skull. It is known that the size of the basicranial hump differs within all primates (Boyd & Silk 2000). A noticeably high basicranial hump in adult humans makes room for the modern human vocal tract, and a long vocal tract is crucial in the production of a wide range of sounds. Modern humans are also distinguished from previous hominid species based on the presence of a flexed basicranium.

The size of the basicranium for *Homo erectus* was in between that of an ape's and a modern human's. Wynn (1998) suggests that the basicranium of *Homo erectus* may

have been slightly more flexed than that of an ape. This could have allowed *Homo erectus* to vocalize somewhat. However, Lieberman (1993: 174) states that "the unflexed basicranium that marks the supralaryngeal vocal tracts of living primates is a primitive feature of australopithecine and *erectus* hominids." Regardless, Boyd & Silk (2000) state that the basicranial hump of *Homo neanderthalensis* is smaller than that of *Homo erectus,* and Lieberman (1993) supports their observation. Though, Lieberman (1993: 174) specifically states that "classic Neanderthal fossils retain the primitive condition—an unflexed basicranium and a supralaryngeal vocal tract ill-suited to speech production." Again, Lieberman believes Neanderthal speech production would have been limited.

VII. Summary

This brief review of the literature on language origins has shown that there is no general consensus about the language capabilities of *Homo erectus* and *Homo neanderthalensis.* It seems reasonable to assert that human-like speech abilities could have emerged as the hominid brain began to increase in size. A marked increase in brain size began at least 300,000 years ago, well after the appearance of *Homo erectus* in Africa. Deacon (1997: 344) states that "the increase in brain size in hominid evolution is an important record for both of the relative ease with which symbols were able to be acquired by a given fossil species, and of the prior effects of selection on this ability." It is Deacon (1997: 253) who suggests "vocal abilities were enhanced continuously" as hominid brain size began to increase over the last 200,000 years.

Wynn (1998) posits that *Homo erectus* may have had language-like abilities, though both Wynn (1998) and MacLarnon & Hewitt (1999) doubt it would have been possible for *Homo erectus* to have had fine control over breathing. Deacon (1997: 358) disagrees with Wynn and MacLarnon & Hewitt on this point, also stating that the speech of *Homo erectus* "would not have had either the speed, range, or flexibility of

today," though "it would have at least possessed many of the consonantal features also found in modern speech."

In addition, MacLarnon & Hewitt (1999) believe it would have been possible for Neanderthals to have had fine control over respiratory mechanisms. The structure of the Neanderthal respiratory tract and supralaryngeal tract is still a matter of some debate in the literature. According to Franciscus (1999), it is not clear that claims made by Schwartz & Tattersall (1996), suggesting Neanderthals had a distinctive nasal morphology, are indeed valid. Lieberman (1992, 1993) posits that Neanderthals could have produced a limited range of human-like sounds, albeit nasalized sounds, based on the structure of their upper respiratory and supralaryngeal tracts.

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