The Demise of the Neandertals: Was Language a Factor?

Ever since the first fossil hominids were found more than a century ago, anthropologists have debated how they are related to modern humans. Neandertals, in particular, have proved hard to place in an evolutionary scheme. Some investigators believe that Neandertals are direct ancestors of *Homo sapiens,* whereas others believe that Neandertals represent a divergent branch of hominids which died out about 45,000 years ago. In support of this latter hypothesis is a new and controversial conjecture, namely, that Neandertals, unlike other hominids considered to have lived at about the same time, could not articulate certain sounds necessary for rapidly spoken, complex language. This selective disadvantage, it is proposed, would have led to their demise.

The controversy concerning the hypothesis that Neandertals had limited articulative abilities and therefore became extinct is consistent with a long tradition of disputes over these hominids. According to W. W. Howells of Harvard University, anthropologists agree on only three statements about Neandertals: that they existed in Europe during the Würm glacial period, that similar hominids existed in the Near East, and that the cranial morphology of Neandertals differs from that of *Homo sapiens.* All other statements about Neandertals, Howells believes, elicit emotional reactions from anthropologists.

Among the many problems associated with studies of Neandertals is that of defining exactly which skulls are those of Neandertals. Some anthropologists believe that all hominids that lived from 45,000 to 100,000 years ago should be classified as Neandertals. Others restrict the definition of Neandertals to only certain hominids—those with cranial measurements similar to those of the original Neandertal skull found in the Neander Valley in Germany. Howells has recently concluded a statistical analysis of measurements of fossil skulls and finds that one group, which he defines as Neandertal, differs markedly from others of the same broad period of about 50,000 years. For example, he classifies the La Ferrassie, La Chapelle, and Shanidar skulls as Neandertal, but excludes the Skhuhl and Kafzeh skulls.

Another problem arising in the study of Neandertals is the inadequacy of the methods of dating these fossils. David Pilbeam of Yale University points out that it is impossible to obtain accurate radiometric dates on fossils from the Neandertal period because they are outside the range of carbon-14 dating techniques, and no other widely accepted techniques can yet be applied. Even if it is assumed that a Neandertal skull such as La Ferrassie is indeed different from a skull such as Skhuhl, there is no way to decide whether Skhuhl existed at the same time as La Ferrassie. Consequently, Pilbeam believes that it is as yet impossible to decide whether Neandertals evolved into or were replaced by other hominids.

The most recent controversial hypothesis about Neandertals—that they were at a selective disadvantage because they could not produce certain sounds —of necessity contains elements of speculation. Moreover, because this hypothesis draws on research from several diverse disciplines to provide a new explanation of the demise of the Neandertals, it has aroused a great deal of excitement, interest, and anger.

The hypothesis about Neandertal speech was proposed by a linguist, Philip Lieberman of Brown University in Providence, Rhode Island, together with an anatomist, Edmund Crelin of Yale University School of Medicine in New Haven, Connecticut. By comparing the skulls of fossil hominids to those of present-day human adults, human newborns, apes, and chimpanzees (Fig. 1), Crelin constructed a model of the vocal tracts of the fossil hominids. Lieberman then used a computer program to determine which sounds could be produced by such vocal tracts. Finally, by utilizing results from previous studies of language and speech comprehension, Lieberman and Crelin concluded that Neandertals (as defined by Howells's statistical analyses of skulls) could not have had a language that was spoken as rapidly or understood as easily as modern languages. However, they believe that other early hominids could have had such a language.

Lieberman suggests that chimpanzees, apes, newborn humans, and Neandertals are alike in that they cannot articulate certain sounds including the vowel sounds [a], [i], and [u] (as in not, see, and to). This is because, in contrast to those of adult humans, their larynxes, where sound is produced, exit directly into their oral cavities. They can modify sounds only by changing the shapes of their oral cavities, and so their vocal tracts consist of one-tube resonating systems. The vocal tracts of adult humans are two-tube resonating systems. An adult human has a pharyngeal cavity and an oral cavity. Sound produced in the larynx first enters the pharyngeal cavity and then the oral cavity. Sounds, then, can be modified by changes in the cross-sectional areas of the pharyngeal and oral cavities. The cross-sectional areas of these cavities can be independently manipulated.

In order to produce the sounds [a], [i], and [u], humans must constrict the middle of their vocal tracts (between the pharyngeal and oral cavities) while independently manipulating the cross-sectional areas of these cavities. Thus if Neandertals had larynxes that exited directly into their oral cavities, they could not produce the sounds [a], [i], and [u].

At least one of the vowel sounds [a], [i], and [u] is found in every known human language. Lieberman believes that listeners use these vowels to scale sounds produced by a speaker to the size of the speaker's vocal tract. For example, the word "bat" sounds quite different depending on whether it is spoken by a man, a woman, or a child. Yet the word is understood once the listener has some idea of the range of sounds that can be produced by the speaker. Lieberman cites two kinds of evidence in support of the hypothesis that [a], [i], and [u] are used to normalize sounds in the decoding of speech.

One kind of evidence for the use [a], [i], and [u] in the comprehension of speech is that these vowel sounds are the least sensitive to errors in articulation. Kenneth Stevens of the Massachusetts Institute of Technology finds that [a], [i], and [u], unlike other vowel sounds, are insensitive to changes in the position of the tongue. Speech decoding, then, would be most accurate if [a], [i], and [u] are used as normalization factors.

A second kind of evidence that [a], [i], and [u] are used for normalization is that these vowels are more easily understood than others. Several investigators have performed experiments in

which listeners heard lists of words. Each word in a list was spoken by a different person. Words that contained [a], [i], or [u] were almost always correctly identified, whereas words that lacked those sounds were frequently misunderstood.

Although they believe that [a], [i], and [u] are important to all modern language, Lieberman and Crelin do not claim that Neandertals necessarily had no form of vocal communication. However, the limited articulatory capabilities of Neandertals would have been disadvantageous because, Lieberman and Crelin believe, fossil hominids other than Neandertals did not have this linguistic handicap. For example, they propose that Broken Hill (Rhodesian man), which existed at the beginning of or before the Neandertal period, could have articulated [a], [i], and [u]. So could have Skhuhl and Kafzeh which, on the basis of the limited dating techniques, are considered to be contemporaries of Neandertals. Lieberman and Crelin postulate that one branch of hominids evolved toward rapidly spoken and sophisticated language while another branch, which includes the Neandertals, did not (Fig. 2).

Although many investigators are convinced by the evidence for Lieberman and Crelin's hypothesis, others remain skeptical. Arguments against the hypothesis, which are, for the most part, unpublished, include those based on anatomical, anthropological, and linguistic considerations.

The anatomical arguments against the proposed articulatory limitations of Neandertals are advanced by those who doubt that a correct model of the vocal tract of a fossil can be constructed from the physical characteristics of its skull. Crelin compared the base of the skull and the lower jaw of a fossil to that of apes, newborn humans, and adult humans. He claims that, although the fossils were often damaged, he was able to obtain sufficient information to make models of their vocal tracts. He and Lieberman stress that small errors in the models of vocal tracts will not affect their acoustic analyses.

Anthropologists have also criticized the hypothesis about Neandertals. Some anthropologists do not agree with Howells's definition of Neandertals. When Neandertals are defined as all hominids that lived between 45,000 and 100,000 years ago, Lieberman and Crelin's theory makes little sense. Howells, however, claims that the skulls he defines as Neandertal are so different from other

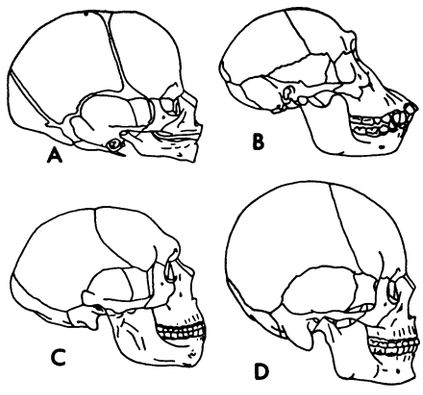

Fig. 1. Lateral views of skulls. The human adult skull differs from the others in several features, such as the inclusion of a chin and a skull base that is not flattened. (A) Skull of a human newborn. (B) Skull of an adult chimpanzee. (C) Skull of the La Chapelle Neandertal. (D) Skull of an adult human. [As drawn by Edmund S. Crelin]

skulls that Neandertals were probably not direct ancestors of modern humans.

Another anthropological argument opposing the theory that Neandertals were selected against on the basis of their articulatory deficiencies is that Neandertals are culturally indistinguishable from other hominids of about the same time. All these hominids made stone tools and, apparently, had burial rituals (they were buried along with artifacts and bones). Thus Neandertals, some anthropologists claim, suffered no disadvantage from their inability to articulate vowels.

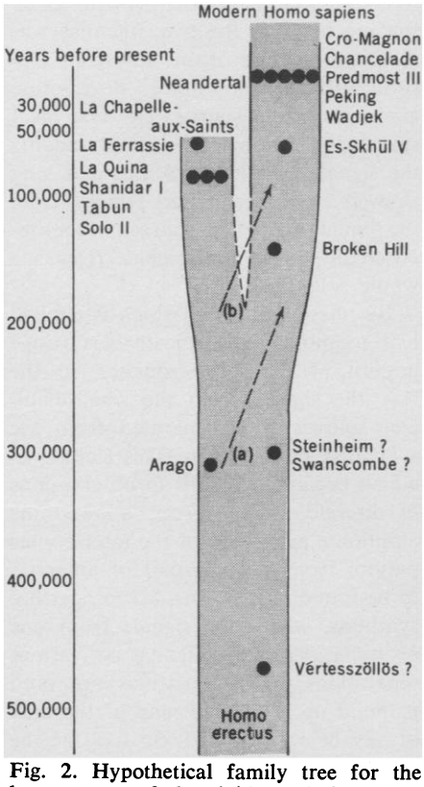

Fig. 2. Hypothetical family tree for the late stages of hominid evolution. The arrows represent possible lines of evolution involving the restructuring of the Neandertal vocal tract to that typical of present-day *Homo sapiens*. [From P. Lieberman (*1*)]

In response to arguments about Neandertal culture, Lieberman and Crelin say that it is impossible to infer the effects of articulatory limitations from cultural information. Moreover, at least one anthropologist, Glynn Isaac of the University of California at Berkeley, uses an argument about culture to support Lieberman and Crelin. Isaac points out that a cultural revolution took place after the Neandertal period. Cave paintings and other evidence of a substantially more complex society have been found. It is reasonable, he believes, to propose that the emergence of a superior language was the spur to this cultural revolution. The Neandertals, if they were linguistically deficient, would have become extinct when other hominids obtained this language.

Linguists have criticized Lieberman and Crelin on the grounds that [a], [i], [u] have not been proved to be used in the normalization of human speech to the size of the speaker's vocal tract. Lieberman responds that although complete and definitive experiments have not settled this issue, evidence at hand is consistent with his view. These vowel sounds are present in all known human languages and their frequency range can be used to predict the range of sounds a speaker can produce. In fact, [a], [i], and [u] have been used in computer programs to enable a computer to decode human speech. Moreover, the exclusion of [a], [i], and [u] from a vocal repertoire would greatly restrict the variation in words and thus the richness of any possible language.

Although many investigators remain skeptical of the arguments by Lieberman and Crelin, nevertheless Lieberman is confident that reason and evidence will soon supplant the emotional response to this hypothesis. Whether or not the theory is ultimately accepted, it has caused anthropologists to reexamine their concepts of Neandertals and has made many increasingly aware of the important role that the evolution of language may have played in the history of the human species.

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Additional Reading

1. P. Lieberman, *On the Origins of Language; An Introduction to the Evolution of Human Speech* (Macmillan, New York, in press).