

The Talking Neanderthals: What Do Fossils, Genetics, and Archeology Say?

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Did Neanderthals have language? This issue has been debated back and forth for decades, without resolution. But in recent years new evidence has become available. New fossils and archeological finds cast light on relevant Neanderthal anatomy and behavior. New DNA evidence, both fossil and modern, provides clues both to the relationship between Neanderthals and modern humans, and to the genetics of language. In this paper, I review and evaluate the available evidence. My conclusion is that the preponderance of the evidence supports the presence of at least a spoken proto-language with lexical semantics in Neanderthals.

Keywords: archeology; DNA; fossils; language; Neanderthal

1. Introduction

That modern humans have language and speech, and that our remote ancestors did not, are two incontrovertible facts. But there is no consensus on when the transition from non-language to language took place, nor any consensus on the species of the first language users. Some authors regard language as the exclusive province of anatomically modern humans [AMH] (Klein 1999, Skoyles & Sagan 2002, Crow 2005, Lanyon 2006, among others), whereas others argue that at least proto-language in some form, if not full modern language, can be found in some earlier species (Mithen 2005, Bickerton 2009, Corballis 2002, among others).

Neanderthals¹ have a key position in this debate, being a late major side branch in human evolution with human-like capacities in many other respects, notably a brain at least as large as ours. Their capacity for language or speech has been discussed in numerous papers over the years, stretching from Lieberman & Crelin (1971) over Schepartz (1993) to Benítez-Burraco *et al.* (2008) and Barceló-Coblijn (2011). The latter offers what is presented as a “biolinguistic approach” to the issue, but unfortunately the approach is neither comprehensive nor stringent.

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¹ Ever since Neanderthals were discovered in the 19th century, there has been a lively debate over whether they are a separate species from us or not — *Homo neanderthalensis* or *Homo sapiens neanderthalensis*? I am not going into the naming debate here, as the name *per se* is irrelevant to the topic of this article; instead I will call Neanderthals ‘Neanderthals’, and call the people indistinguishable from ourselves ‘anatomically modern humans’ [AMH].



In this paper, I will explore what fossil, archeological, genetic, and other evidence can, and cannot, say about Neanderthal language. A fuller discussion of many related issues can be found in Johansson (2005), and specific constraints on the timing of language emergence in Johansson (2011).

All modern human populations have language, obviously, and there is no evidence of any difference in language capacity between living human populations. Given that language has at least some biological substrate, parsimony (see Section 2.1) implies that the most recent common ancestor of all modern humans had language, and had all the biological prerequisites for language.

The fossil record of AMH goes back to nearly 200,000 years ago in Africa (MacDougall *et al.* 2005, Marean 2010). The molecular data likewise strongly support a common origin for all extant humans somewhere around 100–200,000 years ago (Cann *et al.* 1987, Ayala & Escalante 1996, Wood 1997, Bergström *et al.* 1998, Cavalli-Sforza & Feldman 2003, Fagundes *et al.* 2007, Atkinson *et al.* 2008). The relation between population divergence times and genetic coalescence times is non-trivial (Hurford & Dediú 2009), but it is hard to reconcile the genetic data with a common ancestor of all modern humans living much less than 100,000 years ago. This is consistent also with fossil and archeological evidence indicating that modern humans had spread across much of the Old World more than 50,000 years ago. It follows that the origin of the human language faculty is very unlikely to be more recent than 100,000 years ago (Johansson 2011).

This 100,000-year limit brings us back to a time when Neanderthals and AMH were living side by side, with similar material culture, and quite possibly encountering each other in the Middle East. Did only one of them have language, or both?

2. Methodological Issues in Reconstructing Neanderthal Capacities

As noted in just about every paper ever published on language in prehistory, language does not fossilize. Thus the evidence bearing on Neanderthal language is necessarily indirect, and bridging theories (Botha 2008) are required in order to make inferences about the presence or absence of language in an extinct species. A few general methodological issues are discussed in this section.

2.1. Parsimony

Parsimony as a general concept is basically the same as Occam's razor — do not multiply entities needlessly, keep theories as simple as possible, and in the choice between two alternative explanations that both explain the data prefer the simpler one.

In the context of inferring the evolutionary history of a group of organisms, parsimony has the more specialized meaning that the simplest history should be preferred, simplest in the sense of requiring the smallest amount of evolutionary change. The main use of parsimony is in choosing between several alternative hypotheses about the branching pattern of the family tree — the pattern minimizing the total amount of evolutionary change is to be preferred. The

general idea is quite old, but it was formalized and elaborated by Hennig (1966) under the label *cladistics*.

A byproduct of the use of parsimony in the choice of family tree hypothesis is that it also supplies inferences about the features of the common ancestor at each branching point of the tree.

Parsimony is based on the assumption that evolution is unlikely to repeat itself. In the case of complex features, dependent on multiple co-evolved genes, this is a highly reliable assumption. The evolution of a complex feature is a rare occurrence, so it is very unusual for the same complex feature to evolve twice in different organisms.² The corollary of this is that if we do observe the same complex feature in two related organisms, we can safely assume that it evolved only once, and that their common ancestor possessed it already (Byrne 2000). In the case of language, this means that any language-related features displayed by for example chimpanzees today, were most likely present already in the common ancestor of us and chimpanzees, and did not evolve for human-level linguistic purposes. All such features would be part of the FLB *sensu* Hauser *et al.* (2002).

This has the corollary that if chimps and modern humans share a feature, then all other species that are also descended from the common ancestor of chimps and modern humans, notably all extinct hominins (including Neanderthals), most likely also possessed that feature. In the absence of positive evidence to the contrary, we can thus safely assume that all features shared by chimps and modern humans were also present in Neanderthals.³

When we get to the genetic evidence, however, it should be noted that with the minor genetic changes that are typically analyzed in molecular phylogeny (DNA-based family tree reconstruction), the parsimony assumption is frequently violated. Random DNA changes happen often enough that evolutionary reversals and repetitions may add significant amounts of noise to the data. Worse: Non-random changes, mainly driven by natural selection, may add systematic bias that can skew the results in unpredictable ways. Edwards (2009) briefly reviews different ways in which this may happen, some of which likely apply to human evolutionary history.

For this reason, molecular phylogenetic reconstruction is an art nearly as much as a science, as it requires informed judgment on which data to include, what assumptions to make in the analysis, and how to interpret the results. The inferred human evolutionary history can appear quite different depending on which part of our DNA is used in the analysis, and caution is urged in interpreting the results of single studies; cf. Section 4.1 below.

The same applies to non-complex anatomical features, for example simple quantitative changes in the dimensions of some bone. Such features may also display substantial reversal and repetition, making them less informative about

² This does not mean that it never happens. Convergent evolution of the “same” complex trait in distantly related organisms does happen occasionally. Classical examples are the similar body shapes of dolphins, sharks, and ichtyosaurs, and the wings of birds, bats, and pterosaurs. But in complex traits it is rare enough, and recognizable enough, that parsimony remains a useful heuristic.

³ Note that this applies regardless of whether Neanderthals are classified as the same species as us or not (cf. Section 5 below). The inference is valid as long as Neanderthals are also descendants of the last common ancestor of chimps and us, which is indubitably the case.

phylogeny. Parallel evolution of the same feature in related lineages — homoplasy — is a non-trivial issue in primate evolution (Lockwood & Fleagle 1999).

2.2. *What is Language?*

Language is a complex concept, not easy to define in any stringent manner even in modern humans, and there is a regrettable lack of consensus among linguists, to the extent that the field can be called poly-paradigmatic (Zuidema 2005). The links between linguistic theory and neurological observables in the brain are also tenuous at best (Poeppel & Embick 2005, Deacon 2006, Fedor *et al.* 2009). This means it is prudent to avoid too theory-laden definitions of language and its components in a study such as this one.

Nevertheless, some definitions are needed, and we do have a core of real linguistic phenomena around which to define language. There is consensus that syntax is an important component, and on the reality of some syntactic patterns and generalizations, even if linguists disagree on their theoretical description (Számádo *et al.* 2009). There is also consensus that lexical semantics is an important component, though with similar theoretical disagreements, and also disagreements on whether there is a sharp division between syntax and lexicon, or not (Jackendoff 2011). Hockett (1960) compiled a longer list of 13 design features of language, about which there is also general agreement.

Many of Hockett's features concern the externalization of language. The normal modality of externalization among modern humans is vocal speech, but language can be used also in other modalities, notably sign language. In recent times, a large fraction of all language use is in a written modality. As language is usable in a variety of modalities, modality-specific features should not be part of the definition of language. But if language is used for communication, some form of externalization is obviously necessary. Likewise, language acquisition in the child would be impossible without externalized language in the environment. Chomsky (2010) argues that the computational core of the language faculty was used for purely internal purposes at first, with externalization coming at a later stage. This is a defensible conjecture, though I do not regard it as likely (cf. Lewis *et al.* in press). But such purely internal use of the computational machinery alone, unlike our everyday internal use of external language forms ("inner speech"), would fall outside my definition of language.

The relation between speech and language deserves some further comments. The conflation of speech and language is a common mistake in language origins studies (Botha 2009), and a substantial part of the literature on aspects of Neanderthal language actually concerns proxies for Neanderthal speech. It is clear from the modality-independence of language that the absence of speech does not entail the absence of language. But what conclusions can be drawn from the presence of speech (or proxies thereof)? Most mammals have some form of vocalizations, that we do not call 'speech'. I would argue that the label 'speech' is normally used for, and should be specifically reserved for, vocal externalization of language, not for non-linguistic vocalizations. Given that definition, the presence of speech trivially entails the presence of language. But that just moves

the problem one step: How do we infer the presence of speech, as distinct from other vocalizations? A major feature distinguishing speech from other primate vocalizations is its digital, combinatorial nature, with utterances formed from the unlimited combinability of a modest number of discrete phonemes. This places stringent demands both on the acoustic capacity of the vocal tract to form a sufficient number of distinct sounds, and on the ability to control the vocal apparatus with sufficient precision and rate. Proxies for the presence of enhanced vocal capabilities and vocal control are thus reasonable proxies for speech. Birdsong, however, shares many of these features with speech, and requires comparable vocal capabilities; it is possible to argue that the selection pressures driving the evolution of vocal capabilities in humans were due to birdsong-like activities somewhere along the human lineage, and that our vocal abilities were only later exapted for speech (cf. Mithen 2005). The force of the inference from vocal capabilities to speech to language thus depends on the plausibility of alternatives like singing.

In the context of Neanderthal language, there are further issues to be considered. We can all agree that the main communication system used by modern humans is language, pretty much by definition. Most of us also agree that the various communication systems used by non-human primates in the wild are *not* language (*pace* Kanzi). It is established far beyond reasonable doubt that humans evolved from ape-like ancestors. If we go back far enough in history, our ancestors were undoubtedly language-less by any reasonable definition. This means there must have been a transition from non-language to language during the course of human evolution. But there is little consensus on the nature of this transition — was it a sharp single-step leap (e.g. Piattelli-Palmarini 2010) or a gradual evolution in many small steps (e.g. Johansson 2005, 2006; Jackendoff 1999, 2011) — nor any consensus on at what stage to start applying the label ‘language’.

Chomsky (2010) and Piattelli-Palmarini (2010) appear to argue that unbounded Merge is the key defining component of language, and that the notion of some form of partial Merge evolving gradually is either incoherent or silly, leading to the conclusion that the transition must have been sharp. This argument has some force, but only if it is assumed that the conjecture of Hauser *et al.* (2002) that recursion is the *sine qua non* of language is correct. And even within this paradigm, there is no consensus that partial Merge is impossible. In contrast, Fujita (2009) proposes precisely a gradual evolution of Merge with precursor stages, connecting it with Action Grammar. Also Boeckx (2011), Progovac & Locke (2009), and Bolender *et al.* (2008) argue for a decomposable Merge, with the latter proposing that External Merge may have preceded Internal Merge. A sharp transition to perfect language is also problematic in the light of evolvability considerations (Kinsella 2009).

Outside the Chomskyan paradigm, there is no strong reason for postulating any limits in principle on the decomposability of language into different components that may have been added one after the other, and that may have been refined gradually, during the course of language evolution. Numerous proposals for such decomposition exists, for example Jackendoff (1999) or Johansson (2006).

As noted earlier in this section, I find it imprudent to use a theory-laden

approach to Neanderthal language, when there is no consensus on the underlying theory. This places me in the decomposability camp; I do not see any reason to exclude *a priori* the possibility that Neanderthals may have had a form of language that lacked some of the features of modern human language.

If we thus assume that a variety of communication systems are possible that possess some, but not all, of the features of human language, the next question becomes: What labels we should use for systems with different combinations of features. What is required for a system to deserve the label ‘language’? Should the label ‘proto-language’ be used and, if so, for what class of systems? Are more labels needed? For example, ‘semilanguage’ has also been proposed (Stade 2009).

One possible position is that the label ‘language’ should be reserved for full modern human language, with unbounded recursion and all the bells and whistles. But I would argue that this is neither proper nor in accord with actual usage of the word ‘language’. There are many restricted systems that we nevertheless call, and should call, ‘language’. Suppose for a moment that Everett (2005) is accurate in his assessment that Pirahã lacks recursion⁴ — would we then stop calling Pirahã a language? I don’t think so. Both Botha & de Swart (2009) and Givón (2009) consider various other restricted linguistic systems (pidgins etc.). While these systems may or may not be informative of the phylogeny of language, they do provide a proof-of-existence of partial systems that lack one or more component of full modern human language but nevertheless are functional communication systems with lexical and propositional semantics, in which people can and do manage coherent multi-propositional discourse. These systems also deserve the label ‘language’, in my opinion.

For me, the *sine qua non* of language is a symbolic communication system that is not fixed; extensibility is an integral part of the system. This amounts to the presence of something like lexical semantics, flexibly and learnably mapping forms to meanings. A system that lacks word-like units, or only has a fixed set of ‘words’ (e.g., vervet monkey alarm calls), is not language. A system that has units that are combined in syntax-like patterns, but that lacks a mapping to meanings, such as birdsong, is likewise not language.

A system possessing lexical semantics but not syntax I would call a proto-language. Piattelli-Palmarini (2010) argues that such a system is inconceivable, but his argument has merit only within a specific theoretical paradigm. From a less theory-laden perspective, semantics without syntax cannot be excluded *a priori*, and indeed forms the basis of various proposed proto-languages, for example Bickerton (2009). Note that with the definitions that I use, proto-languages are a subset of all languages, so when I talk about “some form of language”, this includes proto-language.

The question from the end of Section 1: “Did only one of them [AMH & Neanderthals] have language, or both?” thus becomes too black-or-white simplistic. A more reasonable question is what features of language we can find evidence for in Neanderthals.

⁴ There is considerable doubt about that assessment; see e.g., the counterarguments of Nevins *et al.* (2009).

2.3. *Which Types of Observables may be Informative of Neanderthal Language Features?*

When trying to determine whether Neanderthals had language, in the absence of direct evidence we need usable proxies for language, or for specific features of language. Criteria for a useful proxy include:

- (1) Among living species, the distribution of the proxy must coincide with the distribution of language. A feature that is shared between humans and language-less non-humans is not a useful proxy for language. This criterion eliminates large parts of the FLB, for example most aspects of sound perception, and also the much-hyped mirror neurons (see Section 3.4).
- (2) The state of the proxy in Neanderthals must be knowable; in practice, this means it must be a feature that is preserved in fossils or archeology. This criterion eliminates most soft anatomy, as well as those behaviors that do not leave archeologically visible traces.
- (3) There must be a sufficiently solid bridging theory connecting the proxy to language, so that the presence of the proxy entails the presence of language with an acceptable degree of certainty. Preferably, the entailment should be two-sided, so that the absence of the proxy likewise entails the absence of language. We must also be careful to distinguish proxies for language from proxies for specific features of language. Botha (2009) discusses this at some length, noting that the inference from symbolic behavior to syntactical language (e.g., Henshilwood & Marean 2003) is imperfectly supported. Another proxy that has been extensively invoked in the literature is vocal tract anatomy, but the connection from vocal tract anatomy to language is much less firm than has been believed (see Section 3).

2.4. *Which Null Hypothesis is Appropriate in Neanderthal Studies?*

One aspect of parsimony that can be sensitive in studies of human origins, is that any similarities between humans and other apes are most parsimoniously explained as having a common origin, and also a common mechanism (Hume 1739, quoted in de Waal 2009). But postulating that features of other apes, especially behavioral and cognitive ones, are basically the same as the corresponding human features, risks running afoul of another methodological principle: that anthropomorphism should be avoided in studies of animal behavior (Asquith 2011), and that animal behavior should be explained in the simplest possible terms, not postulating more advanced capabilities than is absolutely necessary (Morgan 1903). But yet other researchers argue that a similar principle, seeking the simplest explanation first, ought to be the norm also in the study of human behavior (Buchanan 2009).

It is important here to avoid unconscious bias in either direction, which can easily lead to circularity. Especially taxonomic bias — allowing conclusions from data to be colored by which species generated the data — can be a pitfall in language evolution research (d’Errico *et al.* 2009b, d’Errico & Henshilwood 2011).

This can be a problem both in archeology, where identical artifacts may be given different interpretations depending on whether they were manufactured by AMH or Neanderthals — or on whether the interpreter classifies Neanderthals as *Homo sapiens neanderthalensis* or *Homo neanderthalensis* — and in experiments with living subjects, where similar vocalizations are given different interpretations depending on if they are uttered by a human baby or by a chimp or a parrot.

In the case of hominins other than AMH this issue is a significant concern. Should we place the burden of proof on anybody arguing that they do have language or other human cognitive traits? Or should we regard them as fundamentally human, and thus shift the burden of proof to anybody arguing that they are not like us? The answer is not self-evident, and it would appear most prudent to proceed without a null hypothesis, judging the issue by the preponderance of the evidence, and keeping the possibility of bias firmly in mind.

3. Fossil Anatomy

Our habitual use of spoken language is reflected in certain aspects of our anatomy that can be studied in fossils. Speech adaptations can potentially be found in our speech organs, hearing organs and brain, and in the neural connections between these organs.

There are several issues to be considered before making inferences from either the presence or the absence of speech adaptations:

- Are the apparent speech adaptations actually adaptations, or are they byproducts of adaptation for other purposes — exaptations — or the result of non-adaptive evolutionary processes? The substantial choking risks associated with a permanently lowered larynx (Darwin 1859, D. Lieberman 2008)⁵ implies the existence of even larger benefits, otherwise loss of fitness would weed out any such mutations, which would argue for them being adaptations.
- Are the apparent speech adaptations actually adaptations to speech, or to some other form or aspect of vocalizations? As apes manage to vocalize just fine with their vocal apparatus, candidates here include only those human vocal activities that apes can't do. Apart from speech, singing (cf. Mithen 2005) and vocal imitation (cf. Lewis 2009) are possible activities that might have driven selection for better vocal abilities. Basically nothing is known about either musical or imitative abilities of Neanderthals, weakening any inference between vocal anatomy and language.
- The presence of speech, as discussed in Section 2.2 above, implies the presence of language, but not vice versa. As shown by sign language, it is perfectly possible to engage in communicative language use without speech, and it cannot be excluded that sign language (and thus our language

⁵ Clegg (2004) argues that the risk is evolutionarily negligible, but according to statistics from NSC (2009), the number of choking deaths in present-day U.S. is around 4,000 per year, which is far from negligible, higher than the number of deaths from e.g., drowning or fires.

faculty) preceded speech in phylogeny (e.g., Armstrong *et al.* 1995 or Corballis 2002). Furthermore, if Chomsky (2010) were correct in his conjecture that internal use of language preceded externalization, this would likewise entail language preceding speech in phylogeny. The presence of apparent speech adaptations in a fossil species would thus provide at least some support for the presence of language in that species. But the converse does not apply; the absence of speech adaptations does not imply the absence of language.

- The absence of speech adaptations in the vocal apparatus doesn't even imply the total absence of *speech* — with a human brain in control, a non-adapted vocal tract would be quite adequate for simple speech (Fitch 2005) — much less the absence of language.

Taken together, these issues mean that anatomical adaptations in the vocal apparatus are not highly informative about the presence or absence of language. At best, the presence of clear speech adaptations would add some modest level of support towards inferring the presence of language in a form that required a rich repertoire of vocalizations with fine-grained distinctions. It would not be helpful in determining other features of that language, like whether it had syntax or not.

3.1. *Speech Organs*

The shape of the human vocal tract, notably the lowering of the larynx already in infancy, is very likely a speech adaptation. Speech would not be totally impossible even with an ape vocal tract, but it would be less expressive, with fewer vowels available (P. Lieberman 2008, de Boer & Fitch 2010). The 1:1 proportion between the horizontal and vertical part of the human vocal tract, together with our abilities to manipulate the width of both the horizontal and vertical part independently, broadens the spectrum of articulatory possibilities (Aiello 1998, Lieberman & McCarthy 1999, Lieberman 2007b), enabling us to produce more distinct speech sounds. The risks associated with the permanent lowering of the larynx are substantial, as noted above, implying substantial selective pressure behind the changes in the vocal tract; a strong selective pressure towards richer speech abilities is one plausible driver of this apparent optimization of the vocal tract for speech.

Having the larynx permanently lowered is commonly believed to be unique to adult humans, but some other mammals do possess a lowered larynx (Fitch 2009), notably big cats (Weissengruber *et al.* 2002). Furthermore, the vocal tract in many living mammals is quite flexible, and a resting position different from the human configuration does not preclude a dynamically lowered larynx, giving near-human vocal capabilities during vocalizations (Fitch 2009). The reason for the lowered larynx in other species likely has to do with the lowering of voice pitch, making the animal appear larger than it really is. This is a plausible explanation also for the additional lowering of the larynx occurring in human boys at puberty — human females do find a deeper male voice more attractive, according to Collins (2000) and Feinberg *et al.* (2004, 2005). But sexual

selection for a deep male voice is hardly a plausible explanation for the larynx descent in toddlers of both sexes, especially as sexual selection on the female voice is in the opposite direction, towards higher pitch. Human males prefer female voices with higher than average pitch (Feinberg 2008, Jones *et al.* 2008), which implies that sexual selection on females works against the observed larynx descent. Whatever caused larynx descent in humans must be potent enough to override sexual selection in females. Speech adaptation remains the most likely cause here.

The vocal tract itself is all soft tissue and does not fossilize, but its shape is connected with the shape of the surrounding bones: the skull base and the hyoid.⁶ Already *Homo erectus* had a near-modern skull base (Baba *et al.* 2003), but the significance of this is unclear (Fitch 2000, Spoor 2000), as other factors than vocal tract configuration, notably brain size and face size (Bastir *et al.* 2010), strongly affect skull base shape.

Hyoid bones are very rare as fossils, as they are not attached to the rest of the skeleton, but one Neanderthal hyoid has been found (Arensburg *et al.* 1989), as well as two hyoids from likely Neanderthal ancestors, attributed to *Homo heidelbergensis* (Martínez *et al.* 2008). All these hyoids from the Neanderthal lineage are within the range of variation of the hyoid of modern humans, leading to the conclusion that Neanderthals had a vocal tract adequate for speech (Houghton 1993, Boë *et al.* 1999, Boë *et al.* 2007, Granat *et al.* 2007), but see also Lieberman (2007a) and Fitch (2009). The vocal tract of Neanderthals could probably not have precisely the 1:1 proportions between vertical and horizontal part of the modern human vocal tract, due to their longer oral cavity and slightly shorter neck (Lieberman 2007a), but as noted by Fitch (2005) this is not strictly needed for speech.

The hyoid of *Australopithecus afarensis*, on the other hand, is more chimpanzee-like in its morphology (Alemseged *et al.* 2006), and the vocal tract that Granat *et al.* (2007) reconstruct for *Australopithecus* is basically apelike.

A puzzling aspect of larynx evolution in humans is the loss of the laryngeal air sacs that most of our primate relatives have, and that are especially well developed in great apes (Nishimura *et al.* 2007). Many mammals have similar air sacs in a variety of locations, but their function is not well understood (Fitch 2006). The sacs almost certainly play a role in the vocal communication of apes, but little is known of the details, and other explanations remain tenable (Nishimura *et al.* 2007). A possible function of the sacs is hinted at by the fact that the sacs make it possible to produce vocalizations that are both louder and lower in frequency than the same animal could produce without sacs (de Boer 2008, Hombert 2010). Louder and lower vocalizations make the animal seem bigger than it is, which may be advantageous in many contexts. But this does not make it less puzzling why humans lost their sacs. Hombert (2010) proposes that the lowered larynx replaced the sacs, as an adaptation to the ecological change from forest to open terrain during our evolution.

According to Hewitt *et al.* (2002), the enhanced breathing control that has evolved in humans (see Section 3.3 below) may have made the sacs superfluous.

⁶ And also the cervical column, but its shape is not to my knowledge invoked as a speech indicator.

Nevertheless, the loss of a vocal adaptation in such a vocal species as ours is odd (Fitch 2000). Possibly the results of de Boer (2010), that the simulated presence of air sacs make vowels less distinct, may point in the right direction?

As far as the fossil record is concerned, the apelike shape of the hyoid bone of *Australopithecus afarensis* is interpreted as consistent with retained air sacs (Alemseged *et al.* 2006), whereas Neanderthals, as noted above, had a humanlike hyoid.

3.2. *Hearing Organs*

As noted by Barceló-Coblijn (2011), Johansson (2005), and many others, basic acoustic processing, including such seemingly speech-related aspects as formant perception, is widely shared among primates. As with other such shared features, their presence in Neanderthals is highly likely but not highly informative (cf. Section 2.3).

Some fine-tuning appears to have taken place during human evolution to optimize speech perception, notably our improved perception of sounds in the 2–4 kHz range. The sensitivity of ape ears has a minimum in this range, but human ears do not, mainly due to minor changes in the ear ossicles (Martínez *et al.* 2004), the tiny bones that conduct sound from the eardrum to the inner ear. This difference is very likely an adaptation to speech perception, as key features of some speech sounds are in this region. The adaptation interpretation is strengthened by the discovery that a middle-ear structural gene has been the subject of strong natural selection in the human lineage (Olson & Varki 2004). These changes in the ossicles were present already in the 400,000-year-old fossils from Sima de los Huesos in Spain (Martínez *et al.* 2004), which are likely to be Neanderthal ancestors. In the Middle East, ear ossicles have been found both from Neanderthals and from early *Homo sapiens*, likewise with no meaningful differences from modern humans (Quam & Rak 2008).

Hawks *et al.* (2007) and Hawks (2008) present evidence of ongoing adaptive evolution in several hearing-related genes in modern humans. The functional significance of these genes is, however, unknown, as is their state in Neanderthals. That selection is still ongoing nevertheless indicates a quite recent change in selective pressures on human hearing, which Hawks (2008) connects with a recent origin of language.

3.3. *Neural Connections*

Where nerves pass through bone, a hole is left that can be seen in well-preserved fossils. Such nerve canals provide a rough estimate of the size of the nerve that passed through them. A thicker nerve means more neurons, and presumably improved sensitivity and control. The hypoglossal canal, leading to the tongue, has been invoked in this context (Kay *et al.* 1998), but broader comparative samples have shown that it is not useful as an indicator of speech (DeGusta *et al.* 1999, Jungers *et al.* 2003). A better case can be made for the nerves to the thorax, presumably for breathing control (Fitch 2009). Both modern humans and Neanderthals have wide canals here, whereas *Homo ergaster* had the narrow canals

typical of other apes (MacLarnon & Hewitt 1999, 2004), indicating that the canals expanded somewhere between 0.5 and 1.5 million years ago.

3.4. Brain

The general size and shape of the brain and the gross anatomy of the brain surface can be inferred from well-preserved fossil skulls (Bruner 2004). Neanderthal brains are at least as large as the brains of modern humans, but distinct in shape, lower and longer, whereas AMH brains are larger in the parietal area (Bruner 2008). The functional significance, if any, of this shape difference is not well understood, and there is no consensus in the literature. Bruner cautions that some brain shape differences may be constrained by differences in the facial and basicranial skeleton, rather than driven by neurological changes, but notes that the parietal area is less constrained. Frontal widening around Broca's area is shared between Neanderthals and AMH, going back to 2 Mya (Bruner 2007), which adds some support for Neanderthal language. But other apes have brain structures with the same gross anatomy as both Broca and Wernicke (Gannon *et al.* 1998, Cantalupo & Hopkins 2001), so the support is not strong.

The rewiring of neural circuits within the brain that really could be informative about language does not leave any fossil traces. Barceló-Coblijn (2011) invokes two different kinds of neurons, *von Economo neurons* and *mirror neurons*, as possibly informative about Neanderthal speech, and at least the mirror neurons are commonly invoked in the context of language origins as well (e.g., Arbib 2012). But the arguments of Barceló-Coblijn are not persuasive, for several reasons:

- There is no direct evidence — but especially in the case of mirror neurons a deplorable amount of speculation and hype — supporting a central role for these neurons in the human speech system, or for that matter any other aspect of our language faculty.
- Both kinds of neurons are present in apes and/or monkeys, who do not have either language or speech. Their presence in a species can therefore not be used to infer the presence of language or speech (cf. Section 2.3):
 - The von Economo neurons are shared between humans and other great apes (Nimchinsky *et al.* 1999), and it thus follows directly from parsimony that Neanderthals most likely had them as well — no need to spend several pages arriving at that conclusion, especially as their presence is uninformative.
 - Mirror neurons are known to be present in monkeys, who do not have language or speech. Mirror neurons are *not* known to be present in humans (Lingnau *et al.* 2009, Turella *et al.* 2009), who do have language and speech. This does not add up to a strong case for mirror neurons having any role in either speech or language origins.

The relationship between these neurons and the human language faculty is an interesting enough topic in itself, once you get beyond the hype, but it is

irrelevant for the question of Neanderthal language. Any valid argument inferring speech or other aspects of language from neural features would have to be based on neural features that differ between humans and apes. The status of any such features in Neanderthals is unknown, apart from the gross brain anatomy mentioned above. Neural features that are shared between species with and without language remain uninformative.

In the traditional picture of language processing in the human brain, language is handled entirely in the left hemisphere, in a region centered on the classical areas identified by Broca and Wernicke in the 19th century. As shown by recent results from both neuroimaging and traditional lesion studies, this picture is a gross simplification, with language actually handled by much more complex networks spread out over a substantial fraction of the brain (Stowe *et al.* 2005, Fisher & Marcus 2006), including a modest level of right-hemisphere involvement (Fonseca *et al.* 2009). But the classical model does retain a kernel of truth, both in that the perisylvian region remains important, and in that language processing remains strongly asymmetric between the left and the right hemisphere, both quantitatively and qualitatively. Right hemisphere activity is commonly present in language tasks, but the left hemisphere is consistently *more* activated (see e.g., the numerous left-right image pairs in the review of Stowe *et al.* 2005). There is also a division of labor between left and right, in that core aspects of language like syntax, phonology and basic lexical semantics are strongly left-lateralized, whereas the right hemisphere plays a larger role in prosody, pragmatics, discourse handling, ambiguity resolution, non-literal meaning, and other ancillary tasks (Fonseca *et al.* 2009).

This lateralization of language processing may be connected with the anatomical asymmetries displayed by the human brain. But there is no clear-cut increase in general lateralization of the brain in human evolution — ape brains are not symmetric (Balzeau & Gilissen 2010) — and fossils are rarely undamaged and undistorted enough to be informative in this respect.

A possible alternative proxy for lateralization in the brain is handedness. Among apes there may be marginally significant handedness,⁷ but nothing like the strong population-level dominance of right-handers that we find in all modern human populations. As language is handled by the same brain hemisphere as the dominant hand in most people, the rise of handedness and the rise of language may possibly be connected. For makers of stone tools, handedness can be inferred from asymmetries in the knapping process, the use-wear damage on tools, and also in tooth wear patterns (Uomini 2009, Frayer *et al.* 2010), which may provide circumstantial evidence of lateralization, and possibly language (Steele & Uomini 2009). Evidence for a human handedness pattern is clear among Neanderthals and their predecessors in Europe, as far back as 500,000 years ago (Frayer *et al.* 2010), and some indications go back as far as 1 million years ago (Uomini 2009). To what extent conclusions can be drawn from handedness to lateralization for linguistic purposes is, however, unclear.

⁷ This is a long-debated issue; see, for example, Palmer (2002), Humle & Matsuzawa (2009), Llorente *et al.* (2011), Hopkins *et al.* (2011). The only clear outcome is that the population-level handedness in apes, if any, is less than 2:1 or so, unlike the 8:1 or more that is typical for human populations.

3.5. *Anatomical Conclusions*

In conclusion, the fossil anatomical evidence indicates that at least some apparent speech adaptations were present in Neanderthals. No single one of these indications is compelling on its own, but their consilience strengthens the case for some form of Neanderthal speech. What little we know about Neanderthal brains is at least consistent with the presence of language, but the support is quite weak.

4. Genes

During the 1990s, DNA amplification methods developed to the point where even the minute amounts of DNA preserved in fossils could be recovered and sequenced. The range is still limited to the past 100,000 years or so — beyond that the DNA is too deteriorated to be recoverable — and also limited to cool climates, but that is adequate to put Neanderthals within reach, as well as cave bears and mammoths and other Ice Age fauna. Neanderthal DNA can be used both for inferring the precise relationship between Neanderthals and modern humans, and for determining if any language-related genes in modern humans are shared with Neanderthals. The language-related gene that has received the most attention is FOXP2 (see Section 4.2 below), but it is far from the only one; there is in general a substantial genetic contribution to human language abilities today, with many genes involved (reviewed in Stromswold 2010), but the genetic details are not well understood.

4.1. *Neanderthal DNA Studies*

Early genetic evidence from fossil mitochondrial DNA in Neanderthals clearly supported their separateness from *Homo sapiens*, and indicated that the last common ancestor lived at least 400,000 years ago (Krings *et al.* 1999, Höss 2000, Beerli & Edwards 2002, Knight 2003, Caramelli *et al.* 2003, Hodgson & Disotell 2008, Endicott *et al.* 2010), though the limited number of individuals tested made it impossible to exclude a modest level of admixture.

A draft sequence of the full Neanderthal genome was presented recently (Green *et al.* 2010), in which substantial similarities were found between the Neanderthal sequence and modern Eurasians. Green *et al.* (2010) interpret this as strong evidence of gene flow from Neanderthals into the common ancestor of modern Eurasians, around 100,000 years ago, but caution is in order as it is extremely difficult to exclude contamination with modern human DNA during excavation and processing of the fossils (Lalueza-Fox 2009). Wall & Kim (2007) found evidence of both severe contamination and other problems in earlier work by Green *et al.* (2006). And even if the DNA data are taken at face value, their interpretation depends on what assumptions are made about for example, ancient population structure. Eriksson & Manica (2012) show that the data are compatible with scenarios without interbreeding, whereas Sankararaman *et al.* (2012) instead find further support for interbreeding as recent as 37,000–86,000 years ago. Firm conclusions should await replication.

4.2. FOXP2

When mutations in the gene FOXP2 were found to be associated with specific language impairment (Lai *et al.* 2001), and it was shown that the gene had changed along the human lineage (Enard *et al.* 2002), it was heralded as a “language gene”. But intensive research has revealed a more complex story, with FOXP2 controlling synaptic plasticity in the basal ganglia (Lieberman 2009) rather than language *per se*, and playing a role in vocalizations and vocal learning in a wide variety of species, from bats (Li *et al.* 2007) to songbirds (Haesler *et al.* 2004). Nevertheless, the changes in FOXP2 in the human lineage quite likely are connected with some aspects of language, even if the connection is not nearly as direct as early reports claimed. The deficiencies in people with the FOXP2 mutation appear to involve both motor-related speech problems, and problems with language itself (Fisher & Marcus 2006, Lieberman 2010). The language deficits appear similar to Broca’s aphasia (Vargha-Khadem *et al.* 2007), which would indicate that FOXP2 is involved with syntax.

Relevant for the issue of Neanderthal language is that the derived human form of FOXP2 is found also in fossil Neanderthal DNA (Krause *et al.* 2007, but see also Benítez-Burraco *et al.* 2008, 2012, and Coop *et al.* 2008). According to Enard *et al.* (2002), the selective sweep driving that form to fixation was quite recent, less than 200,000 years ago, but Diller & Cann (2009) identify flaws in the analysis of Enard *et al.* (2002) and show that the sweep likely took place as much as a million years ago or more, well before the split between *Homo sapiens* and Neanderthals.

The FOXP2 gene generated too much excitement and hype when it was discovered. In biology in general, there is no such thing as *the* gene for a complex trait, with a single genetic change conferring language, *contra* for example, Chomsky (2010);⁸ the relationship between genes and phenotype is much more complex and indirect (West-Eberhard 2003). But careful research has nevertheless produced a good case for FOXP2 being involved in the ontogeny of vocalizations in a variety of species, and for the changes in the human FOXP2 version having something to do with language. The presence of human FOXP2 in Neanderthals is by no means incontrovertible proof that Neanderthals had complex language (cf. Benítez-Burraco & Longa 2012), but it does add some additional weight to the case for Neanderthal language. But as FOXP2 apparently plays a role in both speech and syntax, the interpretation of its presence in Neanderthals is ambiguous.

As is well known, the gene sequence of protein-coding genes such as FOXP2 is by no means the sole determinant of the features of an organism. To begin with, most of our DNA is regulatory, involved in a complex network regulating the time and place of expression of the minority of protein-coding DNA (ENCODE 2012). Furthermore, all DNA expression both takes place in, and is

⁸ “Evolution in the biological sense would then be restricted to *the* mutation that yielded the operation Merge along with whatever residue resists explanation in terms of the strong minimalist thesis, [...]” (Chomsky 2010: 61, emphasis added). Chomsky has sometimes argued that his postulated saltational origin is an abstraction and idealization (cf. Fujita 2009), but why then talk explicitly about single mutations?

instrumental in shaping, a developmental context, differences in which may have major effects on the actual developmental outcome (West-Eberhard 2003).

Concerning FOXP2, the expression pattern of this gene and its orthologs is similar across a wide variety of vertebrates (Fisher & Marcus 2006). Looking more generally at the expression patterns of many genes in the developing brain, the patterns are stable enough to be phylogenetically informative even within hominoids (Uddin *et al.* 2004), though some additional evolutionary changes have taken place within the human lineage, with a fairly small number of regulatory changes having major effects on brain development (Nowick *et al.* 2009). We have no direct information on Neanderthal gene expression patterns, but given the comparative evidence available, it would be both unparsimonious and purely speculative to propose, as Benítez-Burraco & Longa (2012) seem to do, that FOXP2 might do something totally different in Neanderthals than in modern humans.

5. Interbreeding or Not — Does It Matter for Neanderthal Language?

Neanderthals may or may not have been a separate species from us, but as already noted in footnote 1, I do not regard this as an interesting question in this context; the answer will depend as much on your choice of species definition as on the biological facts of the matter. But a related and more interesting question is whether and to what extent Neanderthals and AMH interbred and exchanged genes when they met, and whether this had any lasting genetic impact on the surviving human population — us.

As noted in Section 4.1 above, the genetic evidence is not unanimous, with multiple mitochondrial studies supporting separateness, but the single report of the full genome supporting interbreeding.

The fossil evidence is likewise not unanimous. On one hand, the last surviving Neanderthals appear ‘pure’, with no visible admixture of AMH features (Hublin *et al.* 1996, Hublin & Bailey 2006), and the earliest AMH in Europe more resemble Africans than Neanderthals, as observed in body proportions by Holliday (1997, 1999) and in general morphology by Tyrrell and Chamberlain (1998).

On the other hand, there is a report of a fossil find of a possible Neanderthal/AMH hybrid child in Lagar Velho, Portugal (Duarte *et al.* 1999, Zilhão 2002, Bayle *et al.* 2010), which would argue for a closer relationship between the two if its hybrid status were confirmed. Archaic features in some early modern human fossils in Europe may possibly also be interpreted as evidence of hybridization (Rougier *et al.* 2007, Trinkaus 2007, Soficaru *et al.* 2006). But a fossil with similar ‘hybrid’ features has also been found in South Africa (Grine *et al.* 2007) where hybridization with Neanderthals is unlikely.

What would the implications be for Neanderthal language if interbreeding took place? Or if it didn’t?

- *No interbreeding*: No strong inference should be made from the lack of interbreeding *per se*; it may simply be the case that Neanderthals died out before AMH moved in, so that the two never actually encountered each other. Or they may have been reproductively incompatible for any number

of reasons unrelated to language. But if it is found that the preponderance of the evidence supports Neanderthal language, a lack of interbreeding would entail that we can infer from parsimony that language ought to have been present already in the common ancestor of Neanderthals and AMH, more than 400,000 years ago.

- *Interbreeding*: If the results of Green *et al.* (2010) are correct, a substantial amount of interbreeding took place. And since their results indicate the presence of Neanderthal genes among us today, a significant number of hybrids must have become reproductively successful members of the AMH population. Furthermore, since their results also indicate that Neanderthal genes are present in Eurasians but not in Africans, the interbreeding must have taken place after the time of the last common ancestor of all modern humans, which means that the AMH populations involved in interbreeding must have had a fully modern language faculty; cf. Section 1 above.

I would argue that it is highly unlikely that a person without language would be reproductively successful in a group where everybody else had language. This implies that the hybrids most likely had a functioning language faculty. It follows either that Neanderthals also had a language faculty, or that a genetic endowment heterozygous for the relevant genes is sufficient. The evidence from FOXP2 does not support the latter possibility, as the language impairment caused by FOXP2 mutations was identified in heterozygotes, but in other language-relevant genes the modern-human version may nevertheless be dominant.

Furthermore, the existence of the hybrids entails that a number of pure-bred Neanderthals found reproductive success with AMH partners.⁹ What conclusions can be drawn from this? That depends on the mating system and social context of early modern humans, about which we have very little evidence. In a system with long-term pair bonds and a social context where both men and women are expected to be active participants in their peer groups, the Neanderthal partner would have to be socially accepted in the AMH group — unlikely without Neanderthal language abilities — but with a different mating system, for example a strongly patriarchal one, or just simply a Neanderthal and an AMH having sex (consensual or not) during a chance encounter in the forest, no social acceptance is necessarily entailed.

Evidence of successful interbreeding would thus add some modest weight to the case for Neanderthal language, despite some caveats about heterozygotes and mating systems. But it is not clear what form of language is supported. From modern human societies, there are plenty of examples of outsiders marrying into a group and becoming reproductively successful despite a rudimentary pidgin-level grasp of the community language; this may be taken as evidence that a capacity for proto-language is adequate.

⁹ If both the results of Green *et al.* (2010) and the mitochondrial studies are taken at face value, the interbreeding would have been between Neanderthal men and AMH women. But taking unreplicated results at face value would be imprudent; the evidence is nowhere near solid enough for such conclusions.

6. Archeology

Language use in itself is not archeologically visible, but other forms of symbol use may be visible, and may be used as indicators that some level of semiotic abilities had been reached. Invoking ancient art, including pigments and personal ornaments, as indicators that the artists were capable of symbolic thought, or even as an indicator that language had evolved, is fairly common (Mellars 1998, Henshilwood & Dubreuil 2009). Ceremonial burials and music are sometimes also considered. The precise connection between e.g., ornaments and specific forms of language is, however, not worked out in detail, and not well supported (Botha 2008).

Non-symbolic aspects of behavior have also been invoked as proxies for language, including the somewhat vague notion of 'modern human behavior', referring to the whole package of behavioral traces left by typical Upper Paleolithic populations. Some hunting techniques that require complex planning and mental time travel, such as snares and traps, may also be evidence of modern human cognition (Wadley 2010), and a possible proxy for the displacement characteristic of human language. Camps & Uriagereka (2006) and Balari *et al.* (2012) propose a specific connection between language and the ability to tie knots, as grammar and knot theory have the same level of computational complexity, but Lobina (2012) finds this unconvincing. The knots would in that case be a proxy specifically for syntactic abilities, unlike the other proxies discussed in this paper.

But any inferences from archeology to mental and cognitive abilities are fragile. Notably, all living human populations have effectively the same mental and cognitive abilities, including language, but there are vast differences in what kind of archeologically visible traces different cultures would leave behind. Some cultures produce large and salient artifacts in durable materials like stone; others have a material culture dominated by perishable materials like plant fibers. It would be an error to infer the presence of language only in the stone-using culture but not in the fiber-using culture.

A more proper methodology would be to consider the full range of archeological traces left behind by different cultures of known language users, and compare with the full range of archeological traces left behind by different species of non-language users. The archeology of known language users stretches from the minimal tool kits used by, for example, Tasmanian aborigines (Roebroeks & Verpoorte 2009), to the pyramids of Egypt and Maya. The archeological traces of known non-language users, such as non-human primates, are for the most part non-existent; chimpanzee nut cracking is an exception, as traces have been recovered both in pseudo-archeological excavation studies of known sites of chimpanzee tool use (Mercader *et al.* 2002, McGrew *et al.* 2003), and as real archeological finds of 4,300-year-old chimpanzee tools (Mercader *et al.* 2007). If the archeology of an unknown population falls within the range of modern human archeology, this would support the presence of language (and modern human cognition in general) in the unknown population, whereas if its archeology is no more complex than that of chimps, the absence of language is supported. Intermediate cultural complexity leaves the issue undecided.

This methodology may in principle be applied to any proposed archeological proxy for language, be it symbols or knots or just general tool-kit complexity. If the archeology of Neanderthals contains at least as much traces of the proxy as the minimal amount present in any modern-human archeological context, this would support the case for Neanderthal language.

But the issue of which potential archeological language proxies are actually valid indicators of language remains open and contentious. Instead of relying on any single one, a more prudent approach is to see if there is a common pattern to be found among multiple proxy-candidates.

6.1. *The Revolution that Wasn't*

The archeological record has frequently been invoked as support for the late, sudden appearance of language, due to the perception of a technological and creative revolution around 40–50,000 years ago (e.g., Binford 1989, Klein 1999, Bar-Yosef 2002, Li & Hombert 2002, Skoyles & Sagan 2002).

This was originally construed as a revolution taking place in Europe. The supposedly sudden appearance of advanced art and advanced tools in the caves of Europe about 40,000 years ago was often, and is still sometimes, taken as evidence of a cognitive leap (Klein 2008), indicating the origin of language. However, the appearance of a sudden dramatic 'cultural revolution' around 40,000 years ago has turned out to be largely an illusion caused by the former predominance of European sites in the documented archeological record, and possibly some Eurocentrism among archeologists (Henshilwood & Marean 2003). AMH did indeed invade Europe rather suddenly about 40,000 years ago, bringing along an advanced toolkit — but that toolkit had developed gradually over the course of more than 200,000 years (McBrearty & Brooks 2000, d'Errico *et al.* 2003, Van Peer *et al.* 2003, McBrearty & Tryon 2006, Marean 2010). Some aspects, such as blade technology (Johnson & McBrearty 2010), and possibly pigment use (Watts 2010), go back as far as 500,000 years. Discoveries of works of abstract art (Henshilwood *et al.* 2002, Texier *et al.* 2010), pigment use (Barham 2002, Henshilwood *et al.* 2009, Watts 2009), and personal ornaments (Bouzouggar *et al.* 2007, d'Errico & Vanhaeren 2009, Henshilwood & Dubreuil 2009), all substantially older than 40,000 years, add further support to the long timescale of McBrearty & Brooks (2000). The African evidence is mostly from the southern part of the continent, but some finds have also been made in North Africa (d'Errico *et al.* 2009a).

There was indeed a substantial and rapid increase in the *frequency* of modern human behavior in the Early Upper Paleolithic, but that increase may well be caused by demographic factors (Zilhão 2007, Cartmill 2010) rather than any cognitive changes. Norton & Jin (2009) suggest that symbolically organized behavior may not become evident until the population is dense enough to require group-distinguishing ornaments.

The notion of a biologically based sudden late revolution is untenable, not only because of the earlier record in Africa, but also because the proposed time postdates the last common ancestor of modern humans, and people were already dispersed over most of the world at that time. Even if the revolution were purely cultural, it would still have taken a significant amount of time for any cultural

innovation to spread to the whole population (Raimanova *et al.* 2004).

But the origins of symbol use and other modern behaviors can also not be regarded as a straightforward ‘Out of Africa’ matter (d’Errico *et al.* 2009b, Conard 2010), with modern behavior originating together with modern anatomy in Africa and then being carried with the AMH exodus. As reviewed in the next section, there is quite enough evidence of early modern behavior among Neanderthals to make such a simple model untenable.

Also in Asia, there is some evidence for a gradual origin of modern behavior and continuity between Middle and Upper Paleolithic industries, notably in Siberia (Derevianko 2010), where the Denisova hominin was found (Dalton 2010, Krause *et al.* 2010, Yuan & Li 2010). In Denisova a number of ornaments were found in the same strata as the hominin remains, including a beautifully worked bracelet (Derevianko *et al.* 2008), in a largely Mousterian-like context.¹⁰ Likewise in South Asia there is no discontinuity marking the arrival of modern behavior (James & Petraglia 2005). The relevant record in East Asia is plagued by dating uncertainties, but symbolic behavior may go back as far as 130 kya (Norton & Jin 2009). Some evidence of early pre-40k symbolic behavior has also been found in the Middle East (Mayer *et al.* 2009). Many aspects of the ‘behavioral modernity’ package are thus found not just in the Upper Paleolithic, but also in the earlier Middle Paleolithic record in Africa, Europe, and Asia (d’Errico *et al.* 2003).

There is also possible evidence for simple art that actually predates the appearance of both Neanderthals and AMH (Marshack 1997, Bednarik 2003), in Acheulean cultural contexts. But all such finds are highly contested, and there is no consensus on whether they are art, or just rocks with a funny shape.

6.2. Neanderthal Culture and Mind

The extent to which Neanderthals had a human mind, human cognition, and human culture remains controversial — see Moro Abadia & Gonzalez Morales (2010) for a discussion of the conceptual and definitional issues involved. Throughout most of their existence, Neanderthals used Mousterian tools, a Middle Paleolithic industry comparable in archeologically visible complexity both with Middle Paleolithic *sapiens* in Africa, and with recent Tasmanian aborigines (Roebroeks & Verpoorte 2009). Late Neanderthals are associated with the Châtelperronian culture, a Middle-Upper Paleolithic “transitional” industry. There is fairly good evidence of Neanderthals using adhesives for hafting tools (Mazza *et al.* 2006, Pawlik & Thissen 2011, Cârciumaru *et al.* 2012). The adhesives themselves are non-trivial to make, requiring a multi-step process involving careful control of temperature, implying sophisticated Neanderthal cognition (Koller *et al.* 2001). Furthermore, in known Stone Age cultures hafting typically does not rely on adhesives alone, but also on tying, which requires knots — cf. the arguments of Camps & Uriagerreka (2006) — but there is no direct evidence of knot-making among Neanderthals.

¹⁰ According to Zilhão (2010), the stratigraphy in the cave is disturbed, making the context of the bracelet uncertain.

Different exploitation patterns of the fauna have been invoked as indicators of cognitive differences, with both specialization and diversification contradictorily taken as signs of modern behavior by different authors, with little consensus on how exploitation patterns should be interpreted (Schepartz 1993). There is in any case no strong evidence that exploitation patterns actually differed significantly between Neanderthals and coeval AMH (Britton *et al.* 2011).

There is some evidence of ceremonial burial of (and presumably by) Neanderthals (Trinkaus & Shipman 1993; d'Errico *et al.* 2003, 2009b), which might imply a human level of awareness of self and others, but the evidence is still contested (Gargett 1999, Davidson 2003), and there is no clear evidence of grave offerings in Neanderthal graves — whereas among Upper Paleolithic AMH ceremonial burials are both common and unambiguous (Formicola *et al.* 2001).

Neanderthals apparently cared for their elderly and crippled members, as fossils have been found of Neanderthals with healed injuries and chronic diseases, who must have lived for years with impaired ability to fend for themselves (Trinkaus & Shipman 1993, Lebel *et al.* 2001). Similarly, one pre-Neanderthal child with a disfiguring birth defect survived for several years about half a million years ago (Gracia *et al.* 2009, Hublin 2009). There have, however, also been several cases reported of apes with similar disabilities surviving in the wild for extended periods (Hublin 2009). Are the other apes compassionate enough to help, or are the disabilities not as disabling as we think? The inference from surviving cripples to behavioral modernity may not be reliable; see also the counterarguments of DeGusta (2003) and Cuozzo & Sauter (2004).

Fragments of what may have been musical instruments have also been found associated with Neanderthals (Turk *et al.* 1995), but d'Errico *et al.* (2003) argue that the Neanderthal 'flutes' are most likely just carnivore-damaged bones.

A stronger case for Neanderthal symbolic behavior can be found in their artefacts. Objects of the same type that are interpreted as evidence of symbolic behavior when found in an AMH context, have also been found associated with Neanderthals in Europe (Zilhão 2007, Langley *et al.* 2008, d'Errico 2008, d'Errico *et al.* 2009b, Watts 2009, Zilhão *et al.* 2010, Peresani *et al.* 2011, Morin & Laroulandie 2012), as well as objects that can reasonably be interpreted as art, mainly engravings (Appenzeller 1998, d'Errico *et al.* 2003, Wynn & Coolidge 2004, d'Errico *et al.* 2009b). There are no cave paintings that can be unambiguously assigned to Neanderthal artists, but the recent dating results of Pike *et al.* (2012) are intriguing in this respect; one painting in Spain has a minimum age beyond 40,000 years, which is just barely compatible with the arrival of AMH in the region but a more comfortable fit with the residence period of Neanderthals.

Ornaments appear to be mainly a fairly recent development among late Neanderthals, mostly found in Châtelperronian contexts. Whether Neanderthals may have copied such modernities from encroaching AMH (Mellars 2005) or developed them independently (d'Errico 2003) has been debated, and Higham *et al.* (2010) question the dating of some of these Châtelperronian finds, casting some doubt on the Neanderthal association (Mellars 2010), but see also the response by Caron *et al.* (2011). And there are also finds, notably the painted shells of Zilhão *et al.* (2010), that are unaffected by these critiques, as they predate the arrival of AMH by a fair margin. Pigment use by Neanderthals likewise goes

back at least 200,000 years (d’Errico *et al.* 2009b). Unlike the predominantly red pigments used by their contemporaries in Africa, the ones found in Neanderthal contexts are mainly black. Possibly this can be connected with the likely whiter skin color of Neanderthals compared with African *Homo sapiens*, making black pigment more salient against pale Neanderthal skin (Gilligan 2010).

These finds are simpler and less frequent than the ornaments and figurative art of later Upper Paleolithic AMH in Europe (e.g., Bahn & Vertut 1997 and Conard 2003). However, the apparent symbol explosion in Aurignacian Europe is not echoed by AMH everywhere. Some undeniably modern human populations (e.g., Tasmanians) left archeological records resembling those created by Middle Paleolithic Neanderthals (Roebroeks & Verpoorte 2009). The Australian archeological record in general shows a remarkable shortage of the kind of evidence taken as indicators of modern behavior (Brumm & Moore 2005), from which it can be concluded that demographic, ecological and energetic factors, rather than cognitive differences, may explain the sparseness of the Neanderthal artistic record. It can also be concluded that sparseness of archeological evidence for modern cognition is not evidence of absence.

Sparse as they may be, the traces of symbol use among Neanderthals nevertheless exist, and are adequate to infer a symbolic capacity comparable to that of coeval AMH (d’Errico *et al.* 2009b), and well within the range of archeologically visible symbol use by known language-using cultures. This adds substantial support to the case for Neanderthal language in some form, consistent with the anatomical evidence. More specifically, the archeological evidence of symbol use would entail the presence of an ability to handle symbols and map them to meanings, which would support the presence of lexical semantics which requires similar abilities, but does not tell us anything about syntax (cf. Botha 2009).

7. Conclusion

Both fossil and DNA evidence of speech adaptations in Neanderthals or earlier hominins, and archeological indications of symbolic behavior in Neanderthals, support the presence of some form of Neanderthal language. Note, however, that the anatomical evidence outside the brain concerns proxies for speech, whereas the archeological and to some extent the genetic evidence concerns proxies for features of language. These are not synonymous, as discussed in Section 2.2. Language need not have started in a spoken modality; sign language may have been the original language (e.g., Corballis 2002). The presence of speech supports the presence of language, but not vice versa.

My conclusion concerning the speech capacities of Neanderthals is basically in agreement with that of Barceló-Coblijn (2011), though he expresses it as “Neandertals were probably able of vocalizing voluntarily, with communicative intentions and in a sophisticated way” (2011: 286) and “had a physical structure which would not disable them in order to emit articulate sounds, very similar to that we modern humans produce when talking” (2011: 322) instead of calling it ‘speech’, and our routes to that conclusion differ somewhat.

It remains a controversial issue whether the Neanderthals were actually a

separate lineage, or just a subspecies of *Homo sapiens*, and whether there was any significant admixture when modern humans replaced Neanderthals in Europe (Herrera *et al.* 2009, Sankararaman *et al.* 2012), or possibly earlier (Green *et al.* 2010). But a modest amount of admixture near the time of Neanderthal extinction would not materially affect the argument here, as both the speech adaptations and the “symbolic” archeology predate the proposed time frame for admixture, and at least the speech adaptations likely predate even the common ancestor of Neanderthals and AMH. And if Neanderthals and modern humans did mix and interbreed freely at some point, so that Neanderthals were assimilated rather than replaced, this in itself would argue against any major differences in cognitive and communicative abilities.

While the evidence I have reviewed does indicate the likely presence of language in some form in Neanderthals, Barceló-Coblijn (2011: 322) does not draw the same conclusion. This may be because he did not review the archeological evidence, and because his article focused mainly on speech, but also because of his stated belief that “these [syntactic/morphological] capabilities are essentially bound to computational capacities proven until now only in *H. sapiens*”. But the fact that it is only in *H. sapiens* that such capacities have been proven *among extant species* is not informative of the capacities of the non-extant Neanderthals, and should not be used as an argument against Neanderthal language.

But even though there is enough evidence to conclude that Neanderthals likely had some form of language, there is little evidence indicating just how complex their language may have been. The evidence from speech indicates that they likely had a spoken language that was complex enough to require fine-grained vocal distinctions. The evidence from symbolic archeology indicates that they had the capacity to handle symbols, which supports the presence of lexical semantics. The interbreeding data is inconclusive, but if the genetic data supporting interbreeding is confirmed, this would support the presence of at least proto-language in Neanderthals. There is no real evidence one way or the other concerning syntactic abilities. Taken together, this means that Neanderthals had at least a spoken proto-language; whether they had syntactic language can be neither confirmed nor refuted.

As discussed in Section 2.2 there is no consensus in the linguistic literature on whether language is an all-or-nothing affair (e.g., Piattelli-Palmarini 2010), or whether intermediate stages of proto-language are possible (e.g., Johansson 2005, Mithen 2005, Bickerton 2009). As noted above, a fair case can be made for Neanderthal language being complex enough to require fine-grained vocal distinctions, and rich enough to support at least a modest symbolic culture. This in itself need not imply anything like modern grammar; a proto-language like that envisioned by for example Bickerton (2009) is quite enough to explain the Neanderthal data. But if Piattelli-Palmarini (2010) were correct in that no intermediate proto-language is possible, that either you have unbounded Merge or you don't have language at all, this would entail that Neanderthals most likely did have a fully human language faculty, as the total absence of any form of Neanderthal language is difficult to reconcile with the data.

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