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Kissing cousins: interaction and interbreeding between Neandertals and modern humans

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KISSING COUSINS: INTERACTION AND INTERBREEDING BETWEEN NEANDERTALS AND MODERN HUMANS

by

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**Introduction**

When you think of Neandertals, what comes to mind? A hairy, gorilla-like animal dragging a club behind him? Even today, with over a century’s worth of research, this troglodyte image of our most immediate hominid relatives remains prominent in the mind’s eye of the majority of our modern population; it is difficult to imagine Neandertals as anything more than hairy, heavily browed brutes wearing leopard print loincloths and grunting incoherently at their comrades.\(^1\) Anthropologists and evolutionary theorists are trying to change this popular mode of thinking by placing Neandertals in a closer relational context to modern humans. Even with continued discoveries in the field and in the laboratory, people have trouble seeing that Neandertals, for a time, lived side by side with our early modern human ancestors and were not nearly as different from them as we might like to think.

In recent decades, attempts were made to determine how Neandertals fit into the path of human evolution and what their exact relationship is to modern humans: Are they our most immediate ancestors, or are they close cousins that remain outside our species (*Homo sapiens*)? These broad questions raise additional questions pertaining to evolutionary theories, geographical contexts, dates, the genetics of both modern humans and Neandertals, the cultural transitions between Neandertals and modern *Homo sapiens*, and the interactions that took place between these two coexistent hominid groups. I will not only review these topics, but also use them in order to focus on the very last one: interactions—cultural, physical, and genetic—between Neandertals and the

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\(^1\) See Image 1 Appendix E
modern humans who coexisted for a span of over 10,000 years within Europe and Western Asia (Trinkaus 1986: 97). In analyzing these interactions from archaeological, physical, and genetic evidence, I develop the thesis that Neandertals and early modern humans were able to interbreed and produce offspring. From this, I intend to determine what this evidence means for the placement of Neandertals in human evolution.

The discovery of the first identified Neandertal remains in 1856 in Germany (Trinkaus and Shipman 1993: 7) instigated intense debate as to their significance regarding the origin and evolution of humanity. It was the first fossil of an “ancient human”—a hominid bearing very similar characteristics to humans now but also with enough physical differences to be recognized as not modern—to be found in the western world. Although the fossilized cranium obviously did not belong to any modern 19th century European individual, many scientists of the time refused to concede that there could be an archaic, non-modern individual who was so physically similar to modern Europeans: that would imply a potential imperfection in the “superior” western world. The discovery occurred during a time when the general idea of evolution was still emerging and human evolution was not yet considered a legitimate theory. In 1859, not long after this discovery, Darwin published his *Origin of Species*, setting an evolutionary framework for scientists to view the natural world and, most importantly—for the field of anthropology, which had not yet developed—the history of mankind.

The debates this Neandertal discovery produced continue on through today with the emergence of new genetic, archaeological, and fossil data that
introduce new information for the consideration of paleoanthropologists. A simple description of these debates surrounding Neandertals is a rift between different schools of thinking regarding more recent human evolution—from *Homo erectus* to Archaic *Homo sapiens* to modern humans—in regards to the relationship between Neandertals and humans. Where do Neandertals fall in the ancestry of modern humans? Are they direct or indirect genetic contributors to our modern genome, if they even contributed at all? How exactly did they interact with their modern human neighbors and how can we determine these interactions from the archaeological record? These questions are all addressed and answered within the body of this thesis: Neandertals did, in fact, provide a small contribution to the gene pool of present day modern humans and, presumably, did so while simultaneously participating in multiple other non-sexual interactions that can be inferred from the archaeological record.

**History and Problem**

The two most prominent schools of human evolutionary thought are the Out of Africa evolutionary model and the Multiregional model of evolution:

“The Out of Africa model states that all living humans are descended from a recent and modern-looking common African ancestor that dates back to no more than 200,000 years, the Multiregional Evolution model stipulates that the living humans are descended from much more ancient and archaic-looking ancestors that are not exclusively localized in Africa” (Delisle 2007: 343).

The term “archaic-looking” used by Delisle refers to the appearance of physical traits that are not frequently seen in modern populations, such as facial prognathism and protruding brow ridges. Both of these models evolved from
earlier theories that were developed as a direct result of the discovery of Neandertals and other fossils of non-anatomically-modern individuals.

The initial evolutionary theories of the 19th century argued whether modern humanity evolved through Monogenic or Polygenic descent; that is, whether modern humans are “derived from a single or several sources” (Delisle 2007: 57). The “Parallel Evolution” theory was developed to explain similarities between humans and primates following the theory of monogeny versus polygeny. The theory stipulates that great apes and humans went through similar stages of evolution, but did not evolve from a common ancestor, regardless of what the physical similarities between them might imply (Delisle 2007: 98). Subsequent theories were those of linear and multilinear evolution. Linear evolution stated that there was only one evolutionary line and, therefore, only one genetic lineage contributing to the transition between living humans and our nonhuman primate ancestors; multilinear evolution suggests that our lineage consists of more branches of nonhuman primates and hominids that are not direct ancestors to modern humans, but are indirect genetic contributors (Delisle 2007: 128-129). The theories of linear and multilinear evolution derive from the initial theories of monogeny and polygeny, utilizing them as a basis to build on. Linear evolution implies evolution from a single group (monogeny), while multilinear evolution implies genetic similarities and contributions from multiple sources (polygeny). The Out of Africa and Multiregional evolutionary models are in turn built on
these evolutionary theories, retaining some of their elements while introducing others.

These theories present inherent biases, especially in how they were put into effect. In the mid to late 19\textsuperscript{th} century, scientists utilized monogeny, polygeny, linear, and multilinear evolutionary models in order to determine the evolutionary status of the different known modern races of the world. While these debates were held in an evolutionary context, they were also used to define race and to trace the history of the different modern races of the world from either one or multiple sources. Investigators were convinced that some races were more evolved than others, with the less evolved ones more closely related to our primate ancestors (Delisle 2007: 57-61). Thus, researchers of the mid-19\textsuperscript{th} century were using the newly developed evolutionary theories to support their own racist views against non-Western European races. It was determined that the Caucasian race was the race evolutionarily furthest from nonhuman primates and was consequently the most advanced, while the other non-white races of the world were significantly less advanced and, therefore, closer in an evolutionary perspective to our nonhuman primate ancestors. It is only more recently that a more rigorous, scientifically supported approach to human evolution could place the discoveries of early hominid remains throughout Europe, Asia, and Africa into less biased perspectives through the development of the Out of Africa and Multiregional evolutionary models.
Out of Africa Theory

Today, the Out of Africa model for modern human origins is probably the most well known theory due to its multiple sub-theories and supporting data from mitochondrial DNA analysis, which is discussed in the last section of this paper (titled “Genetics: Mapping and Comparing Genomes”). Three of the most vocal anthropologists who support the Out of Africa model are Dr. Ian Tattersall, Dr. Chris Stringer, and Dr. Paul Mellars, all of whom have been extensively active in evolutionary debates concerning modern human origins through the past three decades and that continue on into today.²

The Out of Africa model states that “H. erectus grade”, the predecessors of Neandertals, left Africa (where they originally evolved) and migrated across the Old World in different phases of evolution. The implication, then, is that there were multiple “exoduses” of Homo from Africa with the first around 1.8 million years ago with H. erectus and the last around 80,000 years ago with the dispersal of modern humans from Africa into the Levant (Anton and Swisher 2004: 272; see also Mellars 1989b). After many millennia following the initial exodus of H. erectus, another group of H. erectus grade hominids, known by Out of Africa scholars as H. heidelbergensis, left Africa and spread across Europe, expanding the paths blazed by H. erectus thousands of years earlier (Stringer and McKie 1997). The same process was repeated for the emergence of archaic H. sapiens (hereafter referred to as AHS). The Neandertals of Europe and Western Asia and the other AHS forms of southern and eastern Asia. Each new group of Homo that emerged from Africa physically displaced the preceding Homo groups

² See Table 1 Appendix A
in each region of the Old World after a significant period of coexistence. The
displacement occurred through competition for resources, violent encounters, or
simply by being better adapted for the environment than their predecessors. Out
of Africa can therefore be described as a model of physical species replacement
that does not involve or require genetic exchange (Stringer and Andrews 1998).
Physical replacement implies no genetic assimilation and, therefore, little to no
genetic exchange, which in turn implies an absence of evolution in the process of
replacement. Each group will have evolved separately prior to their coexistence
and to the events, such as climate change, that would have led to the population
replacement.

The theory that each hominid group, from the earlier *H. erectus*
populations to anatomically modern *Homo sapiens* (hereafter referred to as Hss
for *Homo sapiens sapiens*), evolved solely in Africa and subsequently emigrated
implies that each group was a separate species within the genus *Homo*. This
implication emphasizes the physical difference among the hominid populations.
Colloquially, this idea is known as “splitting” and is characterized by a focus on
the morphological differences found in contemporaneous forms of the genus
*Homo*. “Splitting” discounts the similarities between these forms as being less
important than the differences. Consequently, “splitters” like Ian Tattersall
(Tattersall and Schwartz 1999) and Chris Stringer (Stringer et al. 1984) see
multiple contemporaneous hominid species in existence in different areas of the
Old World, a framework defined by Tattersall as the “multispecies” model for the
genus *Homo* prior to the extinction of AHS and the spread of Hss.
Neandertals, according to the Out of Africa view, evolved within Africa from a form of *H. erectus* and radiated from Africa into Europe and the Levant around 200,000 years ago (Tattersall and Schwartz 1999: 7117). Around the same time Neandertals left Africa, Hss had fully evolved within the continent but did not disperse from Africa into the Levant until at least 100,000 years after Neandertals had become established in their new environment. Hss then left Africa, just as Neandertals had, migrating up into the Levant and eventually into Europe, competing with the Neandertals for natural resources and ultimately pushing them to extinction (Stringer in Delisle 2007: 351).

Ian Tattersall, one of the most vocal proponents of Out of Africa, supports the claim that Neandertals and *Homo sapiens* both evolved separately from *Homo heidelbergensis* who, according to the theory, was a contemporary species of *Homo erectus* and, consequently, the last common ancestor between Neandertals and Hss (Tattersall 1995; see also Rightmire 1998). Tattersall and his fellow Out of Africa hypothesis followers are adamant that *H. sapiens* and Neandertals are not members of the same species (Tattersall 2000: 60). Elsewhere, Tattersall acknowledges the opposing argument—the Multiregional hypothesis—by saying, “many students of human evolution...still regard [Neandertals] as no more than a strange variant of our own species, *Homo sapiens*” (Tattersall and Schwartz 1999:7117). Still, he justifies his own claim that Neandertals are a separate species from *H. sapiens*:

For, as members of a distinct species, of a completely individuated historical entity, the Neanderthals demand that we analyze and understand them on their own terms...if we see them as mere sub specific variants of

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3 See Table 2 Appendix A
ourselves, we are almost obliged to dismiss the Neanderthals as little more than an evolutionary epiphenomenon, a minor and ephemeral appendage to the history of *Homo sapiens* (Tattersall and Schwartz 1999: 7117).

As a result of this view, Splitters have named the Neandertal species “*Homo neandertalensis*.” The consequent implications on the idea of interbreeding between modern *Homo sapiens* and Neandertals greatly depends on how the term “species” is defined as well as on the physical evidence in the archaeological record. Both of these topics are addressed in later sections of this thesis.

**Multiregional Theory**

The counter argument to the Out of Africa evolutionary model, the Multiregional evolutionary model, was developed to explain observations of morphological similarities between *H. erectus* in China and modern Chinese populations by Franz Weidenrich in the 1920s. It was first widely put into use to explain human evolution and modern origins by Milford Wolpoff in the eighties; Wolpoff himself coined the term “multiregional” (Wolpoff et al. 1988). The Multiregional Hypothesis can be described as a theory of evolutionary replacement, rather than physical replacement, as is suggested by the Out of Africa model. The most prominent and vocal proponents of the Multiregional model are Milford Wolpoff and Erik Trinkaus, both contemporaries of Stringer, Tattersall, and Mellars of the Out of Africa faction.\(^4\)

Chris Stringer, a proponent of the Out of Africa model, attempted to summarize the very basic aspect of the Multiregional theoretical model: “The essence of [the Multiregional model]…can be summarized as follows: the genes of living humans are derived from populations that lived in *different* [my

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\(^4\) See Table 1 Appendix A
emphasis] continents 150,000 years ago” (Stringer 2001: 72). This is too simple of an explanation, which leads to misinterpretations, such as the idea that the theory of Multiregional evolution is one of parallel or independent evolution of populations in different regions of the world or that the modern human species hails from multiple origins (Wolpoff et al. 2000) In 2000, however, Wolpoff, Hawkes, and Caspari published an article in order to clarify what, exactly, is implied by Multiregional evolution—which is \textit{not} multiple origins or parallel evolution, as it is often mistakenly described:

The multiregional hypothesis is that a network of genetic exchanges, promoted by but not necessarily dependent upon exogamy [interbreeding between two biologically different individuals] rules, provides a frame for population interconnections that allows for both species-wide evolutionary change and local distinctions and differentiation...because of the key role played by genetic exchanges in this model, multiregional evolution means that no human species, subspecies, or race can have multiple “independent origins” in different regions (Wolpoff et al. 2000: 130).

Wolpoff et al. vehemently emphasize that their theory of Multiregional evolution is directly based upon gene flow. Neutral features—that is, those physical traits that had no positive or negative impacts upon survival—became fixed in different geographic populations due to “isolation-by-distance” because the traits were ignored by natural selection, accounting for the regional variation we see in archaic and modern day populations. Non-neutral traits—those characteristics that would greatly impact the survival of an individual and/or a population—were widely distributed through all populations by genetic exchange in order to ensure the spread of positively selected, advantageous traits (Wolpoff et al. 2000: 130). The Multiregional model, therefore, requires a “network of genetic exchanges” in order to explain simultaneous (or almost simultaneous)
appearances of features in archaic populations as a “shared pattern of evolution” within a single, widespread species (Wolpoff et al. 2000: 130); this is counter to the Out of Africa idea that the simultaneous appearance of specific physical and genetic features in the archaeological record is a result of the dispersal of individual species into Europe and Asia from Africa.

The implication of the Multiregional model is that *H. erectus* populations evolved in Africa and left soon after, spreading to different regions in the Old World (Europe, Asia, and Africa) where they remained. In these regions, with genetic flow between populations, *H. erectus* evolved into Archaic *Homo sapiens* and then subsequently evolved into the modern *Homo sapiens* found in each region today: “…human evolution constituted of a single evolving polytypic species spread throughout the Old World and subjected to various evolutionary forces. While selective pressures and genetic drift created regional distinctions in various areas, gene flow between these areas maintained enough cohesion to avoid the breakup of this species” (Delisle 2007: 352).

Here, the idea is that the *H. erectus* populations remained in relative isolation from each other—relative being the key word. In order for this model to accommodate the genetic and physical evidences of regional genetic fixation in modern populations—the drifting of specific genetic traits to permanence within small groups—while taking into account the large number of similarities Hs have as a whole, gene flow must be taken into consideration. This is where *relative* geographic isolation comes into play. Within a large geographic region, eastern Asia or Europe for example, different populations would have had to participate
in genetic exchanges to ensure the survival of the species. The almost simultaneous evolution of the singular species occupying all of these geographic regions into *Homo sapiens sapiens* had to have occurred as a result of gene flow between these major geographic regions. According to John Relethford, a biological anthropologist, “less than one migrant per generation” is required in order to accommodate the interpreted rate of genetic flow between continents, both for neutral and selective traits (Relethford in Wolpoff et al. 2000: 134; see also Relethford 1998). This refutes allegations by Out of Africa supporters that an absurd increase in gene flow would have to occur over the large geographic areas of Europe, Asia, Africa, and Australasia in order to account for the genetic continuity and regional diversity found in archaic and modern populations.

Physical characteristics in modern populations that are also seen in archaic human fossils within each region are, to name a few, large noses, protruding brow ridges, and shovel shaped incisors in Europe along with sagittal tenting (a very slight ridge running lengthwise on the midline of the top of the skull), shovel shaped incisors (incisors, both top and bottom, that are scooped on the inside presenting a more pronounced curve), and taurodontism (an elongation of the pulp and roots of molars deep into the bone of the jaw) in East Asia (Trinkaus 1986: 196). According to Milford Wolpoff, while these traits do not define Europeans, they are found in a higher frequency than can be explained away by a physical replacement model, “thereby linking these populations through time and making it very unlikely that the source populations of recent and modern Europeans are uniquely from Africa” (Wolpoff et al. 2004: 533). The holdover of these physical
characteristics from archaic to modern populations can be viewed as indicative of Multiregional evolution, when these traits drifted into a maintained presence— albeit at a reduced frequency—due to the regional continuity of the archaic population:

The distinct hominid evolutionary lines are not entirely independent from one another since they are bound by a network of gene flow which permits the sharing of some features...between geographical areas...the transition from *Homo erectus* to *H. sapiens* is a gradual one and is anything but a clean break (Delisle 2007: 352-353).

Where the Out of Africa model focuses on “splitting” the genus *Homo* into many different species based upon a range of morphological discrepancies, the Multiregional model tends to do just the opposite, “lumping” hominids found within the same chronological context together based upon overarching morphological similarities. The result is the creation of multiple sub-species and transitional forms within one or two species overall. In regards to Neandertals, “lumpers” like Milford Wolpoff and Erik Trinkaus claim that they are a sub-species of *Homo sapiens*. Therefore, modern humans are *Homo sapiens sapiens* and the extinct Neandertals are *Homo sapiens neandertalensis*. This makes Neandertals a regional variation of *H. sapiens*, which then places them in a contemporary species relationship with all other AHS forms throughout the Old World as well as in an ancestral species relationship with Hss.

According to Wolpoff, “the evidence of skeletal anatomy, mitochondrial DNA, morphology and genetics of speech, and archaeological evidence of behavior all suggest that Neandertals are indeed among the ancestors of some modern human populations”; however he later says that “This does not mean that
the modern humans are Neandertals, or that the Neandertals are the only ancestors of any group of modern humans…we show here that *the hypothesis that Neandertals are a significant part of the ancestry of Europeans* is well supported” (Wolpoff et al. 2004: 528; see also Frayer et al. 1994). It is the Multiregional model that provides the most theoretical evidence for interbreeding between Neandertal and modern *H. sapiens* simply by claiming that they are both of the same species, in addition to a dependence on gene flow in order to maintain legitimacy. Pairing this evolutionary claim with a definition of species, a comparison of culture and behavior in order to determine what the cultural interactions between Hss and Neandertals consisted of, and a comparison of physio-morphological and genetic data in order to establish potential sexual interactions, I am able to make my own claim—and verify the claim of anthropologists like Wolpoff and Trinkaus—that interbreeding did indeed occur between Neandertals and modern humans during their period of coexistence.

**The Problem**

“*Why take a stand on it when it will only lead to discussions and no one will have the final word?*” ~Svante Paabo (Gibbons 2011: 394).

Wolpoff introduced the idea of Multiregional evolution based on gene flow between two populations; in this case, a Neandertal population and one or more populations of AHS and Hss in order to explain Neandertal characteristics seen in modern populations:

The significant number of Neandertal traits extending into these later populations cannot be explained without gene flow between Neandertal and the subsequent populations of Europe—an observation based not on one or two individuals but on the details of many individuals from the European early Upper Paleolithic (Wolpoff et al. 2004: 533).
In order for Wolpoff’s hypothesis of gene exchange to be valid, we must assume interbreeding between Neandertals and modern humans over multiple generations, which can only occur if they are members of the same species.

To assume this, we must define what a species is. Here I will give the basic evolutionary biological definition of species that has been fed to high school students since its creation: A species can be defined as a singular group of organisms in which individuals have the ability to mate within the group population and subsequently produce viable offspring (progeny that can in turn mate with other members of the same species and produce offspring) (DeSalle and Tattersall 2008: 39; Stringer and McKie 1997: 62). Using this definition, a species is ultimately able to pass favorable genes down through multiple generations to ensure the survival of the species. This insurance also pertains to evolution: Certain favorable physical adaptations that were developed in response to environmental stresses will be chosen through the process of natural selection over others and become fixed within the population.

Baker and Bradley provide a very similar yet more concise definition of a species:

We define a species as a group of genetically compatible interbreeding natural populations that is genetically isolated from other such groups…Recognition of species that are genetically isolated (but not reproductively isolated) results in an enhanced understanding of biodiversity and the nature of speciation as well as speciation-based issues and evolution of mammals (Baker and Bradley 2006: 643).

According to Baker and Bradley’s definition, genetic isolation refers to the purity of the species gene pool itself. If new genetic material is added to the gene pool
from an outside species, the mixed gene pool belongs to a brand new hybrid species. Genetic isolation does not forbid interbreeding between species. It just states that the product of said interbreeding will result in the formation of a new species of organism. Reproductive isolation on the other hand refers to the Out of Africa idea that species cannot interbreed and produce offspring. Biologically, the sexual encounter is infertile. Therefore, the gene pool of each species is not in danger of being mixed. Genetic and reproductive isolation are not mutually exclusive. A genetically isolated population can, if given enough time to evolve, become reproductively isolated. A reproductively isolated population is inherently genetically isolated and, therefore, its own species, which makes Baker and Bradley’s definition of species rather confusing.

Baker and Bradley fully condone the idea of hybridization and accept that there are instances in the natural world where hybrid offspring are not sterile and can reproduce:

There are also differences in levels of interbreeding (hybridization) between 2 genetic species. These can range from production of no hybrids to all sterile hybrids, to a hybrid zone (zones) that have all combinations of possible crosses with all individuals fertile and with no introgression being trivial beyond that zone…clearly, examples with extensive hybridization with fertile hybrids do not fit the definition “species are reproductively isolated from each other” (Baker and Bradley 2006: 646).

On the other hand, there are anthropologists who would maintain that reproductive isolation is the key factor in determining a species, a view that is attributed to have originated with “Ernst Mayer's biological species concept, which defines a species as a group of populations that interbreed with each other but not with other populations” (Sober ed. 2006: xix). Both of these definitions
of species emphasize the importance of realizing that a species is an isolated gene pool that exchanges characteristic traits of the species while breeding within the group. No genes are brought in from outside species.

The debate surrounding the development of a concrete definition of species becomes more convoluted as more genetic discoveries are added into the cauldron. The findings of fertile female mules and hinnies—which were considered to be the unviable offspring of horses and donkeys, two supposedly separate species (Rong et al. 1987)—and fertile offspring of a mix between a coyote and a beagle (Kennelly and Roberts 1969), just seem to add to the confusion. I therefore propose a simple definition of species that fits within the bounds of both evolutionary theories and, to an extent, Baker, Bradley and Mayer: Two separate species may interbreed, but they cannot produce viable offspring. Two different subspecies, however, are members of the same species and can therefore interbreed, conceive, and produce viable offspring that can be considered members of the same species as their parents (Sober ed. 2006).

The question, then, is whether or not there is evidence, physio-morphological and/or genetic, to suggest that the nature of relationships between Neandertals and early modern *H. sapiens* included interbreeding and the resultant production of hybrid individuals. The discovery and analysis of this evidence would, in turn, bring paleoanthropologists closer to understanding the complexity of the connections between Neandertals and early modern humans. If we are to determine the reality of these occurrences of interbreeding and hybridization, we must first determine their species statuses in relation to each other; or, if we look
at it the other way, the interpreted evidence that could point to interbreeding will help determine whether Neandertals and modern humans were members of the same species or not. The establishment of “species” is complicated, then, because it has to come out of a “chicken-versus-egg” argument: which should come first, species or evidence?

The Out of Africa theory places Neandertals and modern humans into different species groups: \textit{H. neandertalensis} and \textit{H. sapiens}, respectively; the Multiregional theory names them as subspecies to each other: \textit{H. sapiens neandertalensis} and \textit{H. sapiens sapiens} respectively. The answer to the question concerning whether or not Neandertals and early modern humans were of the same species, however, depends on which concept—genetic isolation or reproductive isolation—an anthropologist favors and whether or not they accept the simple definition of species: that two different species cannot interbreed to produce viable offspring, but two subspecies can. Svante Paabo might be very smart in stepping away from the debate and just dealing with the evidence until enough evidence is collected to make a more definitive judgment. (See the quote under the above section heading).

The Out of Africa model suggests that Neandertals were distant relations to modern \textit{Homo sapiens}—cousins, if you will. Their coexistence and interactions would have been those of two different groups with similar characteristics but varying adaptations competing within the same environment for the same resources: as of 1998, “some three dozen valid occurrences” of coexistence have been uncovered in Europe and dated to between 37,000 and
32,000 years ago (Howell 1998: 21). This corresponds with the chronological data that were analyzed concerning the amount of time in which modern humans and Neandertals coexisted within the same geographical areas:

It appears unlikely that the most recent Neandertals in western Asia are much older than ca 50 kyr BP [circa 50,000 years before present] or that those from central Europe are older than ca 45 kyr BP. Given that the earliest anatomically modern humans in those regions probably date to ca 40 kyr BP and ca 36 kyr BP respectively, a transitional period of no more than ca 10 kyr appears likely (Trinkaus 1986: 197).

While these chronological dates are, well, dated (excuse the pun)\(^5\), Trinkaus’s idea remains the same: more than ten thousand years are needed to see a full transition from one group to another, whether it is by genetic assimilation, external population pressure, etc., especially if interbreeding is taking place and genes are being exchanged among populations.

Here, however, Trinkaus is not taking into consideration that within the context of the Multiregional model, gene flow will have occurred between earlier Neandertal populations. The Neandertals dated to around 50,000 years old and younger that he describes in the quote above are termed “classic Neandertals” because they all bear the complete set of Neandertal characteristics. Neandertals from between 200,000 and 50,000 years ago have varied frequencies of classic traits, but not to the extent that classic Neandertals do (Brose and Wolpoff 1971: 1156). Earlier Neandertals, according to the Multiregional theory, would have participated in genetic exchange with other AHS forms throughout the Old World, maintaining the network of gene flow for tens of thousands of years before we see an appearance of modern traits outside of Africa.

\(^5\) See Table 2 Appendix A
Tattersall presents quite nicely one of the additional concerns of the Out of Africa model, specifically the idea of interbreeding as a result of coexistence and interactions. A skeletal discovery in Portugal, which is discussed in much greater detail later, of a young child with both distinctive Neandertal and Hss traits has led to the claim that not only is the child a hybrid, but it is also potentially a product of multiple generations of fertile offspring mating with each other:

[Cidalia Duarte] proposed that the skeleton of a 4-year-old child, recently unearthed at the 24,500-year-old…site of Lagar Velho in Portugal, represents not merely a casual result of a Neandertal/modern human mating, but rather is the product of several millennia of hybridization among members of the resident Neandertal population and the invading Homo sapiens…But, by anyone’s reckoning, long-term hybridization of this kind would indicate that the two populations belonged to the same species (Tattersall and Schwartz 1999: 7117).

To Tattersall—and to most Out of Africa supporters—Neandertals belonged to a species distinct from Hss. According to the definition of species presented above, only two individuals from the same species can hope to produce viable offspring. Therefore, according to Out of Africa, long-term and even short-term hybridization—which can be determined based upon the distribution, integration, and prominence of the distinguishing traits of both groups—between Neandertals and early modern humans could not have existed because the offspring of any initial interbreeding would be sterile, unable to produce offspring themselves and, therefore, fail to pass on their newly mixed genetic packages. Archaeologists would not discover any evidence for this interbreeding in the archaeological record, if we take Out of Africa’s view, because there would not be any skeletal evidence to speak of, as sterile individuals cannot produce offspring. Sterile hybrids, however, could potentially be found in the archaeological record; sterility
does not prevent them from existing, it just prevents them from reproducing. There would be visible skeletal evidence for the mixing of Neandertal and modern human genes within an individual. The traits would be distinctive, much as a mule is very distinctive: not quite a horse, but definitely not a donkey.

Ten thousand years, the absolute minimum amount of time that lapses between the appearance of early modern humans in Europe and the complete disappearance of Neandertals, was originally thought to be too short a time to see an evolutionary transition. The Multiregional model, which suggests that Neandertals were directly involved in the evolution of modern humans, fully recognizes this fact. Neandertals were still present in Europe less than 25,000 years ago and modern humans had a strong presence by at least 35,000 years ago, if not before. If the Multiregional evolutionary model were to remain credible in comparison to the Out of Africa model, a “substantial elevation in gene flow”—e.g., interbreeding—would have to be considered in order to account for at least the morphological changes, if not the cultural and behavioral changes, from Neandertals to modern Homo sapiens (Trinkaus 1986: 198).

As I mentioned in the previous section addressing the Multiregional model, it has been proved by biological anthropologists that, in order to see the gene flow required to produce evolutionary, morphological, and genetic continuity in the transitional subspecies populations, the “substantial elevation in gene flow” suggested by Trinkaus is actually an increase of about 1 individual per generation migrating to a new continent (Relethford 1998). One person per generation, if we are defining a generation to be about twenty years, over a
minimum of ten thousand years adds up to a minimum of five hundred individuals migrating between large geographic areas and distributing traits. In the scope of over ten thousand years, five hundred individuals is nothing. Five hundred curious individuals are all that are needed to make Multiregional evolution a possibility.

In recent years, both the Out of Africa and Multiregional evolutionary hypotheses have considered the possibility of interbreeding between the coexisting populations of Neandertals and modern humans. For the Out of Africa model, it seems like an almost begrudging consideration while Multiregionalists avidly support the idea. The more vocal Out of Africa theorists (Stringer and Schwartz, for example) claim that while there is no direct physical evidence of interbreeding between the two populations, the geographic proximity of the two hominid groups in addition to lithic archaeological evidence suggests multiple interactions of unknown limits (Bower 1999: 155). Along with the rest of the archaeological evidence we see for non-sexual interactions between these two hominid groups (for example, “mixed” tool industries and seemingly out of place symbolic items), there should be no reason why we must dismiss the possibility of interbreeding between them. This argument is made appealing by the presence of physical characteristics (which are described in much greater detail later but include protruding brow ridges and large nasal apertures) in modern populations that are also attributed to Neandertals.

Not only is there debate as to the significance of morphological characteristics in both modern and archaic populations, but there is also debate as
to the significance of “modern” cultural characteristics and how they reflect upon physical morphology. Central to the debate is the argument as to whether or not there is any continuity between physiology and culture, based on instances of physical modernity associated with archaic culture and vice versa. This depends on what physical anthropologists can determine concerning the relationship of cognition to morphology. Whether there is continuity or not will determine how important of a role cognition plays in the analysis of evidence and, therefore, will affect any hypothesis concerning the instances of both cultural and sexual interactions between modern humans and their archaic counterparts.

Discounting the possibility of interbreeding would be an irresponsible oversight, because archaeologists do not have the ability to go back in time in order to observe how Neandertals and modern humans interacted. We do have the ability, however, to analyze artifacts and fossil remains pertaining to both Neandertals and modern *H. sapiens*. Through these analyses, we can speculate as to the layers of interactions between these two groups. We can then draw closer to an answer for the question of the existence of interbreeding between them.

**Cultural Characteristics**

The term “culture” (much like the term “species”) has numerous definitions that are used on a regular basis. Marshall Sahlins defines culture as the “superorganic means available to the human species for utilizing the earth’s resources in the service of survival…culture, continuing the life process, appropriates free energy and builds it into an organization for survival, and like life, culture moves to maximize the amount of energy exploitation” which evolves
based upon the energy requirements and availability (Sahlins et al. 1960: 8-9).
Alfred Kroeber defines culture as “all the activities and nonphysiological products of human personalities that are not automatically reflex or instinctive…culture consists of conditioned or learned activities” and is something that is “acquired by learning” (Kroeber in Cohen 1968: 14). Clifford Geertz introduces a more abstract definition of culture, suggesting that culture itself defines the people within it: “Each culture is dominated by ‘control mechanisms’—a unique set of regulating ideas—that shapes the individual into a unique kind of human. Every culture…is made up of a set of symbolic devices for the control of behavior, for giving the individual a set of life goals, and for giving him a set of definitions of himself and of others” (Geertz in Cohen 1968: 17).

These three definitions of culture are reiterated throughout the theoretical literature of anthropology. All of them emphasize different aspects of the lives humans lead: Sahlins focuses on culture based on its function, Kroeber on the fact that culture is learned and not instinctual, and Geertz on the abstract symbolism of culture that is used to control the behavior of man. All of these definitions of culture are fairly broad, however, and agree upon many things, probably the most important for this paper being that culture is learned by an individual from the environment (including the people) around him and from his predecessors. This, then, implies that behavior, which culture influences but also accommodates, is instinctual and is more of a natural part of every individual. Sahlins, Kroeber, and Geertz also all agree that culture manifests itself in different ways; the most important pertaining to archaeologists and, therefore, to my thesis
is the material culture, which can be physically preserved in the archaeological record. From the material culture, we can infer the abstract culture and, from the abstract culture, we can then infer the behavior.

From these definitions of culture, I intend to create my own definition, one that I think is the broadest and that encompasses all of the various important aspects described above: Culture is the acquired set of extra-somatic adaptations developed in response to an individual’s or group’s environment for the purpose of negating the need for physical evolution to accommodate environmental stresses. This definition emphasizes the main function of culture, which, in my opinion, is to provide “immediate gratification” in the sense that it allows for adaptive adjustments to develop almost instantaneously in the face of abrupt (or gradual) environmental changes. This negates the need for populations to wait the requisite multiple generations for a physically adaptive trait to be permanently integrated into a genome (Brace 1995: 714-715). Culture is the ultimate survival technique. Without it, hominids would not have developed to the stage we are at today; without it there is a very good chance that we would still be nesting in trees for protection from predators, and scavenging on other predators’ leavings for our sustenance.

In the case of Late Pleistocene cultures, specifically those of Neandertals and early Hss, I examine each major culture as it is seen in the archaeological record, then use the analyses of these archaeological finds to initiate a discussion of their behavioral implications. From the discussion of the cultures and behaviors of these two groups, I look at any mutually occurring characteristics
and analyze these overlaps in an attempt to determine to what degree—if at all—there was interaction between modern *H. sapiens* and Neandertals in terms of cultural exchanges.

**Lithic Cultures**

While Neandertals are most often defined by their physical characteristics (the easiest and most direct way to identify them), it was thought that they could also be identified by their “culture,” especially in terms of their stone tools and production techniques (lithics). Tool cultures dated to the time period in which we see Neandertals are referred to as Middle Paleolithic tool assemblages. This term releases the assemblages from being solely associated with Neandertals and is an effective way to separate the cultural characteristics of the populations from the morphological characteristics. Sometimes these tool assemblages are associated with fossils to strengthen the identification of the nature of the tools but oftentimes there are no hominid bones present, so the association of the lithics with a hominid form is assumed based upon those sites that do reveal fossils in the same stratigraphic level as their associated types of stone tools: “In [a cave located in the Betche-aux-Roches promontory in France], at one of the lowest levels, they found two almost perfect skeletons of Neandertals. The bones were found with Mousterian artifacts—an association that was to become so common that Mousterian tools were taken as prima facie evidence of Neandertal presence” (Trinkaus and Shipman 1993: 126-127).

The Middle Paleolithic technologies are primarily described as flake technologies, as opposed to the blade technologies characteristic of Upper

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6 See Table 4 Appendix A, also Images from Appendix C
Paleolithic tool cultures. The various Middle Paleolithic assemblages maintain for the most part overarching morphological and functional similarities: large numbers of larger flake tools (points, scrapers, etc) with relatively few blades and bone or antler tools (Riel-Salvatore and Clark 2001: 452). Assemblages were crafted using prepared core flaking techniques known as Levallois techniques—methods that are considered a strong indicator of Middle Paleolithic assemblages rather than Upper or Lower Paleolithic tools—whereby flint or obsidian nodules are initially shaped in order to ensure that a functional flake can be struck from it in one blow (Klein 2000: 24). This technique allowed for the creation of a variety of “edge types” on the flakes, presumably for specialization: “There were steep-edged ‘scraping’ tools, flakes with coarse serrations (denticulates), points…bifacially trimmed ‘leaf’ points…Neandertals continued to make handaxes, but they were less common; presumably many of their functions had been taken on by flaked tools with more specialized edges” (Coolidge and Wynn 2009: 185-186).

The variety of flake tools found at Mousterian sites suggests job specificity for the tools based upon a comparison of their “predecessors” *H. heidelbergensis* (according to Coolidge and Wynn), where we do not see nearly as much tool variation. The variety of edge types and flake sizes in Middle Paleolithic assemblages indicates the ability of Neandertals to see functional needs and to be able to accommodate them in their tool manufacture and designs. According to Coolidge and Wynn, points could not be used as scrapers because animal hide would be torn by its sharp pointed edge, while scrapers and hand-axes
would not be ideal for hunting because of their unwieldy size and weight (Coolidge and Wynn 2009: 186). Additional analyses of Levallois flakes, as well as re-enacting their various functions, show that this is not necessarily true and that Levallois points can fulfill multiple functions, from being hafted onto a spear to functioning as an awl or a scraper (Rollefson, personal communication 2011). This does not, however, take away from the idea of job specificity within Neandertal toolkits; in fact, it reveals that Neandertals could manufacture tools that served multiple functions in order to conserve time and resources.

The Levallois technology itself suggests a conservative Neandertal mentality with regards to time and resources. Small bits of the cores were struck off in order to prepare a core that would produce multiple flake tools with few or no mistakes. With this economic technique, the Neandertals could control the shape they wanted their flakes to be based upon the job each tool had to do. The Levallois shaping techniques would have saved a fair amount of time for the lithic craftsman, who would have had to gather the flint and proceed to produce a variety of tools from the collected resources. It minimized the margin of error in the knapping and helped to ensure the creation of whole and fully functional flakes with little to no mistakes.

Based upon trace element analyses of flint tools excavated from Middle Paleolithic sites inhabited by Neandertals, it would seem that the flint resources were gathered from areas within a short radius around the archaeological site (Coolidge and Wynn 2009: 187). This discovery feeds into the theories concerning Neandertal cognition, which is discussed later in this section. The
large amount of local flint discovered at most Neandertal sites does not, however, mean that flint resources aren’t found from much farther away than expected. A Mousterian site in southwestern France revealed a flint nodule that has been traced to a flint source at Bergerac from over 100 Km away from the site (Gamble 1999: 241). It is rare to have trace element flint analyses reveal resources that originate over 15Km from the site. A distance of one hundred kilometers is far outside of a reasonable traveling radius from a Neandertal site, contributing to the theory that Neandertals settled more permanently and did not venture too far away from their homes. What are the possible explanations for this occurrence? That the Neandertals who inhabited the site picked it up in the process of their migration and brought it back to the site; that the site inhabitants traveled 100Km to harvest this specific piece of flint, which places a greater value of some flint over others; or that the flint appears as a product of trade, also implying the value of flint. None of these explanations can be proved, but each of them is a legitimate theory.

Perhaps the most well known Middle Paleolithic culture is the Mousterian⁷, found in Western Europe and has been associated since its discovery almost primarily with Neandertals (Brose and Wolpoff 1971: 1161). Mousterian stone tool assemblages are usually characterized by scrapers, knives, denticulates (tooth-edged stone tools), arrowheads, and spearheads (larger points) that are all made of stone. In the Middle Paleolithic cultures, there is also evidence of point hafting, where stone points were strapped to wooden shafts with plant fibers or strips of leathered animal skin: “Micropolishes formed when stone flakes rubbed

⁷ See Images 1 and 2 Appendix C
against handles or encircling thongs, directly documenting hafting” (Klein 2000: 26). These new composite tools were most likely created in order to increase the effectiveness and ease of wielding them as well as possibly expanding upon the tools’ original functions. There is little evidence of bone implementation, even in the sites where bone and antler would have been nicely preserved (Coolidge and Wynn 2009: 186) and very little to no evidence of personal adornment, which is considered an indication of “modern” behavior (Nowell 2010: 441; see section titled “Behavior”).

Overall, the Middle Paleolithic stone tool cultures were fairly homogenous among themselves, with a few regionally specific styles, such as heart-shaped handaxes in the European and Western Asian Mousterian assemblages (Klein 2000: 26). This homogeneity suggests similar cultural behaviors throughout the Middle Paleolithic period in the Old World with variations based upon the lithic resources and the ecology of each region, which contributes to the argument of continuity between physical and cultural evolution. There are, as always, a few exceptions to this homogeneity (The Chatelperronian, the Szletian, and the Levantine-Mousterian cultures), which are discussed in the “Interactions” section of this paper as being examples of potential interactions between modern humans and Neandertals.

The modern human lithic technology, known as the Upper Paleolithic culture in Europe and Western Asia, contains a high percentage of blades and bone or antler tools in comparison with the Middle Paleolithic assemblages, which have a higher frequency of larger bifaced tools: “In virtually all regions of
Europe and Western Asia, there is evidence for a significant expansion in the scale of blade-producing technology, coinciding closely with the conventional transition from the Middle to the Upper Paleolithic” (Mellars 1989: 340). There are distinctive cultures within the Upper Paleolithic, two of the most prominent being the contemporary Aurignacian and the Perigordian cultures. The Aurignacian culture consists of the traditional Upper Paleolithic types of tools, while the Perigordian—which is split into two parts, the Chatelperronian and the Gravettian—is made up of additional culture characteristics, among them being the creation of Venus figurines in the late Perigordian, indicating the appearance of religious symbolism (Encyclopedia Britannica 2011).

In the Upper Paleolithic, we see an increase in the frequency of hafted tools, which we also have evidence of in Mousterian assemblages, as well as an increase in frequency of precision work tools, such as burins used for punching holes and engraving, which Coolidge and Wynn believe to be related to a “jump” in cognition (Trinkaus 1986: 202; Coolidge and Wynn 2009: 146). Upper Paleolithic stone tool cultures sport many smaller stone tools used for fine detailing that could imply a change in dexterity, mental or physical, in the people who wielded them (Mellars 1989: 340). Again, just as we saw in the Middle Paleolithic, there was a widespread homogeneity in the Upper Paleolithic stone tool assemblages with regional variations based upon the technologies of the populations and what resources were available to them. In comparing both the Neandertal and modern human technologies, physical and behavioral differences pertaining to and implied by the lithic culture of each group can be brought into

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8 See Table 4 Appendix A
play, such as differences in hunting techniques and arm morphology (Trinkaus 1986: 199). Most of the blades are retouched; they were most likely used on a daily basis and were in constant need of re-sharpening. Upper Paleolithic technologies also implemented a conservative and standardized process in the formation of their blade toolkits, preparing the core in such a way that blades of various sizes could be knocked off and then, depending on the size and the need, could be used for a variety of purposes (Stringer 1997: 109-110).

This standardization of blades and of Upper Paleolithic tool morphologies in general could suggest an even greater specialization than what we see in the Middle Paleolithic. It has been suggested and demonstrated by Harold Dibble, through the re-manufacturing of flint tools, that many of the larger Middle Paleolithic tools, such as bifacial handaxes and scrapers, were easily morphed into the smaller points and blades that accompany them simply through continuous retouch to re-sharpen edges dulled by frequent use (Dibble 1987: 109). It would seem that the variety we see in Middle Paleolithic tools was not intentional and, therefore, not dependent on the specific differences of function. There was certainly much more conservatism in the use of flint resources than was originally thought. The presence of many of the points and blades are simply a result of retouching a dull scraper and finding a new use for the re-shaped tool and the flakes made as byproducts of Levallois preparation. In contrast, the presence of prismatic cores for the production of multiple, standardized Upper Paleolithic blades suggests that the individuals who employed Upper Paleolithic technologies
purposefully created a variety of stone tools to fit a variety of different functions (Mellars 1989: 345).

In the following sections and subsections, I relate these cultural characteristics with behavior, cognition, and morphological characteristics of both Neandertals and modern humans. Everything is interrelated and, in order to achieve a deeper understanding of exactly what occurred during the period of Neandertal/modern human coexistence all those thousands of years ago, everything must be taken into consideration, especially since any conclusions I—or any anthropologist—draw are ultimately the result of educated speculation. The cultural differences described above and the behavioral, cognitive, physical, and genetic differences introduced below provide us with detailed descriptions of each group. It is the comparison among all of these and the discovery of overlapping traits that will ultimately provide the deeper understanding I seek.

Behavior

There is a perceptible shift in technology as we look at the transition from the Middle Paleolithic to the Upper Paleolithic. There is currently a heated debate being addressed in paleoanthropological circles concerning the continuity (or lack thereof) in the shifts in culture with the changes in physical morphology from Neandertal to early modern *H. sapiens*. There are archaeologists who originally saw a rough connection between the physical and cultural transitions between the Middle and Upper Paleolithic, including Francis Harrold and Paul Mellars. They equated the seeming continuity in transitions with a change in behavioral capacity
based upon physical differences from the Neandertal form to the early modern human form:

Because this change in cultural remains roughly parallels the human fossil transition in Western Europe from Neandertals (*Homo sapiens neandertalensis*) to anatomically-modern humans (*Homo sapiens sapiens*), it is possible that the archaeological record is monitoring not only changes in cultural systems, but also changes in human cultural capacities (Harrold 1989: 677).

C. Loring Brace, on the other hand, has the opposite idea and addresses the appearance of “modern behavior”—which will be defined momentarily—without physical modernity during the Middle Paleolithic:

It seems reasonable to suggest that when the relative brain size expansion ceased and cumulative technological elaboration began, the rudiments of language were in place; thus our hominid predecessors merit the designation sapiens. However, at that point 200,000 years ago, nothing else about these ancestral hominids would strike us as “modern” in appearance (Brace 1995: 712).

Brace suggests that while there is significant evidence for the spread of culture from one population to the other, it must have been connected with gene flow, which in the long run is attributed to the connection between cultural and physical transitions (Brace 1995: 714). He does, however, claim that “individual advantageous cultural innovations can be expected to have spread much more rapidly than the genetic characteristics of the groups within which they first arose” (Brace 1995: 718). According to Brace, the best example for this “probable mutation effect” is the appearance of hearths and the remnants of burned animal and vegetable remains to imply the practice of cooking food in the western Eurasian archaeological record, which is then followed by a chronologically proportional reduction in dental size, specifically at Tabun cave
in Israel and Pech de l’Aze in France, indicating that not as much strength is required to masticate (Brace 1995: 715). Because in the archaeological record we find remnants of what we take to be indicative of “modern behavior” in non-physically modern individuals—for example, the Neandertal symbolic burials in Shanidar Iraq and the appearance of red ochre and items of personal adornment in the Chatelperronian industry—the theory Brace introduces is that Neandertals and other Middle Paleolithic populations did indeed have the capacity for modern behavior, just like modern *H. sapiens*, but perhaps they had no need of the cultural changes.

The reasons why a group adopts new cultural characteristics can rarely be seen in the archaeological record. Aside from paleoclimatic, pollen, and faunal analyses of regional Middle Paleolithic sites, it is difficult to determine causes for cultural evolution (if that is what we can call it) because of its abstract nature. The data and artifacts gathered by archaeologists are the physical manifestations of the influence of culture, but culture itself cannot be physically gathered and processed; it is not a concrete thing that can be preserved in the soil over time. Instead, just as a body is buried in the ground where its flesh and soft tissues decompose to leave only the skeleton when it is uncovered thousands of years later, the culture of a population disappears with the extinction of the group, leaving the skeleton for archaeologists to uncover and study in an attempt to re-create the missing “flesh” or abstract aspects of culture.

That does not, however, prevent archaeologists and anthropologists from speculating as to the reasons for cultural shifts and acquisitions. The material
culture left behind for archaeologists to discover “exists here in the present; how do we get it to tell us about the past?” (Johnson 2010: 50). Archaeologists have battled since the birth of archaeology with the issue of interpreting the material culture that passes their way: “We can debate whether ‘human nature’ or ‘basic human needs’ are constant for other periods, but at these early times we are dealing with hominid species that are not our own. Archaeologists cannot therefore assume that practices we might suppose common to all human groups were even present at that time” (Johnson 2010: 57). There is, however, no way in which archaeologists can avoid making assumptions. If they want to determine the meaning behind their artifact analyses, they must speculate and form hypotheses.

Archaeologists have developed various ways of inferring the abstract reasons behind material culture, one of the easiest and most popular being ethnoarchaeology, the study of modern cultures that show similar inferred cultural behaviors—stone tool manufacture and hunting and gathering techniques—in the present and relate them back to what we have discovered in the archaeological record. Johnson, a British archaeological theorist, describes this method as finding a Rosetta Stone for translating the observed archaeological record in the context of the past (Johnson 2010: 53). Using ethnoarchaeology and primatology—the study of the behaviors of chimpanzees, gorillas, and bonobos (modern humans’ closest primate relatives that exist today) and applying them to what is found in the archaeological record that is indicative of behavior—
archaeologists can make inferences about the culture and the behavior of our ancient ancestors.

In the archaeological record, behavior is just as abstract as culture. Behavior and culture go hand in hand. Behavior influences culture and culture influences behavior. The main distinction that is made between behavior and culture in the above section, where I presented theoretical definitions of culture, is that culture is learned by an individual from the people surrounding him or her, while behavior is natural and inherent in all individuals. This presents an issue to archaeologists, primarily due to the fact that every individual is innately different, so their behaviors are many and varied throughout a species, subspecies, or population. Behavior is a deep facet of human nature that has been given more attention as the field of archaeology has matured: “Behavioural archaeology began in the 1970s as the study of site formation processes—how artifacts move from their ‘systemic context’, that is, their use in actual human behaviour, to their ‘archaeological context’ in which they are excavated…behavioural archaeology looks for regularities in the relations between people and objects in all times and places” (Johnson 2010: 65). Because the only thing archaeologists see in the archaeological record are tangible artifacts, behavioral archaeology was developed in order to determine their abstract links to the people who produced them and placed them in the record.

Like culture, behavior controls the artifacts that archaeologists are able to see within a site. It is impossible for an archaeologist to directly observe the behavior of either early modern humans or Neandertals. Everything we can see as
being “behavioral” evidence is ultimately the material result of the actual behavior of a group that was acted out during the time the archaeological site was in use, making it difficult to place behavior in an evolutionary context. Only recently have paleoanthropologists actually taken behavior into consideration when analyzing the relationship and interactions between Neandertals and early modern Homo sapiens. Just as with culture, speculation should not be withheld from inferring behavior from the archaeological record. Archaeology is a field that relies on imagination based upon physical data and artifacts and is, therefore, unique in that imagination is encouraged.

The first task in the analysis of behavior is to come up with a definition for “modern behavior.” Modern behavior is a fairly arbitrary term. It is considered “the greatest hindrance to resolving the debate surrounding the origins of human behavior” because of its abstract nature and the lack of substantial theory behind it (Nowell 2010: 439). It is related to “modern culture” and they are often used as interchangeable terms, but they are different: because behavior is innate within the individual, we can assume that modern behavior originated before modern culture and, therefore, modern behavior created modern culture. Modern culture leaves artifacts behind in the archaeological record; modern behavior creates these artifacts.

Superficially, we can attribute modern behavior to modern humans, which suggests a connection between anatomical modernity and behavioral modernity. This is a heavily debated topic, for just as there is evidence for the manifestation of modern behavior in people today, there is also an apparent lag in the
emergence of modern behavior after the appearance of anatomical modernity (Chase 2003: 637). An example of this appears in the Levant with the Skhul and Qafzeh Hss specimens that used the Neandertal associated Levantine Mousterian lithic culture which, according to how long it was in use before the appearance of modern humans, might not be considered “modern” (Clark and Lindley 1989: 977). The opposite appears in France and the northern parts of Spain with the Neandertal associated Chatelperronian lithic culture, which not only contains more traditional Upper Paleolithic type tools than we normally see in the Mousterian culture, but also contains evidence of bone implements and personal decoration (Harrold 2000).

C. Loring Brace brings the problem of defining modernity into perspective. “The term modern properly refers to present times, but has come to be associated with the idea of progress to such an extent that the present state of affairs has been suffused with implications of superiority over what was current in the past” (Brace 1995: 711). Attempting to define what is modern behavior has in many cases (including myself when I first began this research) unintentionally, or perhaps intentionally in some instances, instigated a feeling of what I will call “species-centrism”: We, as modern *H. sapiens* studying our ancient relatives, have become inclined to view Neandertals and other Archaic *H. sapiens* in a prejudiced way, making them appear to be lesser beings than ourselves.9 Granted, Neandertals did become extinct while Hss succeeded, so, according to natural selection, modern humans were more equipped to survive, implying that their

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9 See Images 1 and 2 Appendix E
behavior and, therefore, their culture was more able to handle the environmental stresses at the Middle to Late Pleistocene transition.\(^\text{10}\)

If we (as the modern humans of today) are to place Neandertals on a lower evolutionary level than the one we occupy, especially when trying to gauge the extent to which they interacted with their own contemporary populations of modern humans, we should not discount similar feelings of different-ness and displacement directed towards our own modern ancestors by Neandertal populations. Interactions are not unidirectional in any context. Each party always takes something—tangible or intangible—away from the other after the instance of contact. The views of both groups concerning the other can affect how the two groups would have interacted with each other. The only reason we have the upper hand now and are not checked in our views is because we cannot know how Neandertals looked upon modern humans: were the new *H. sapiens* populations ugly or repulsive to them? That would have certainly affected any desires to interbreed. If there appeared to be no desirable traits in a potential mate then, according to Darwin and other evolutionary biologists, what was the point of mating? Here, I am building on the mating displays of tropical birds in order to attract a mate; I am not implying that attractiveness would have been the only desirable characteristic in a mate, but that based upon a comparison with the rest of the natural world, it is certainly one of the preliminary deciding factors. However, this claim can readily be refuted if we bring love and affection into the equation, something I am reluctant to do because while we do have instances of Neandertals participating in supporting family groups and showing empathy in

\(^{10}\) See Table 2 Appendix A
Shanidar, Iraq—evidenced by a skeleton of a disabled old man who would not have been able to move and/or eat by himself—it brings another layer of emotion that cannot definitively be determined in the archaeological record. Sympathy or empathy does not necessarily mean love and affection. Would prejudices on either account have also affected other interactions besides interbreeding, such as cultural exchanges?

With these questions in mind and the supposition of these biases, finding a relatively “objective” definition of modern behavior is difficult. Chase proposes defining modern behavior in a theoretical frame by ignoring physical characteristics and looking instead into what human beings consider to be important in life, which are the things that influence behavior: symbols in art and language, in religious contexts, social proximity and organization, etc. (Chase 2003: 637). Chase also noted that, according to Henshilwood and Marean, “Behavior is mediated by symbolism…symbols are representative of social conventions, tacit agreements, or explicit codes that link one thing to another and are mediated by some formal or merely agreed-upon link irrespective of any physical characteristic of either sign or object” (Chase 2003: 635). In relation to this form of behavior, culture would then be the manifestations of this behavior within a group of individuals in order to accommodate and exploit their environment. These manifestations are then passed on to subsequent generations.

The appearance of symbolism explodes at the onset of the Upper Paleolithic period and, with the knowledge that modern humans now live in a world basically run by symbolism, the development of symbolism would seem to
be a cornerstone for the identification of “modern.” Ultimately, modern behavior is now defined as “symbolic behavior including language and codified social relationships,” although this is, once again, arbitrary and is frequently extended to specifying behavior in relation to early modern *Homo sapiens* and the culture associated with them (Nowell 2010: 441). I use Nowell’s definition of modern behavior, but in order to fully investigate and interpret all interactions, it is necessary at some point to place it in the context of physical and cultural characteristics, as these are the only palpable representations of ancient behavior that archaeologists have access to.

**Cognition**

Now that modern behavior has been defined for the purposes of this paper, I want to determine what the material correlates are for modern behavior in a population. What do archaeologists and paleoanthropologists see in either modern humans or Neandertals that implies their capacities (or apparent lack of capacities) for modern behavior? The foundation for modern behavior is symbolism, so we must look at what can indicate the ability to produce and understand symbols in the multitude of ways that typified early modern humans. The most pronounced jump in symbolism between the Middle and Upper Paleolithic periods is the exponential increase in the appearance of art and personal decoration, both of which appear in large frequencies in the Upper Paleolithic with the emergence of Hss. The earliest time we see evidence of behavioral modernity in western Eurasia is during the occupation of Skhul and Qafzeh, both of which are considered to be the earliest Hss sites in Israel but
utilized the Levantine Mousterian lithic industry previously associated with Levantine Neandertals: “Unresolved evidence for bead use comes from the approximately 100-ka [100,000 years ago] Mousterian levels at Qafzeh cave in Israel, where four water-worn Glycymeris...shells with natural perforations are interpreted as beads, or alternatively, pigment containers” (Bouzouggar 2007: 9964). More direct evidences of symbolic art and personal ornamentation appear in later Upper Paleolithic sites, the penultimate of which are the cave paintings at Lascaux, France.

Personal ornamentation also appears unmistakably at the shift from the Middle to the Upper Paleolithic in the Chatelperronian industry—which is described in more detail at the beginning of the “Interactions” section—an industry that is associated with Neandertals, not with modern humans. Evidence of the use of red ochre has also been found in Middle Paleolithic burials, indicating some symbolic use of the pigment potentially before modern humans heightened its use: “Two [Middle Paleolithic] graves contained ochre, and when present this material was found only in pebble form. Striae showed that these pebbles had been rubbed repeatedly across relatively hard surfaces prior to their inclusion in the graves” (Riel-Salvatore and Clark 2001: 455). This definite evidence of personal ornamentation and potential evidence of symbolic art suggest that “Neandertals possessed highly symbolic cultural and cognitive capabilities (including language) closely similar, if not identical, to those of the ‘ensuing’ modern human populations” (Mellars 2010: 20147). The ability for an individual to produce symbols is based upon his or her cognitive capabilities,
which in turn depends on the development of the brain, a veritable developmental
chain argument and one which has caused much debate among anthropologists as
to whether or not Neandertals were just as cognitively developed as Hs.

Symbols are a form of abstraction. To somebody who does not know
what each symbol means and how multiple symbols can be pieced together to
produce meaning, the symbols mean nothing. Symbols do not appear only in
cave paintings, sculptures, or grave goods either. Language is completely
composed of symbols and sequences of symbols used to communicate. The
ability to produce and understand language is, potentially, the most abstract aspect
of symbolism, and therefore the most complex, of what we have defined as
modern behavior:

In spite of visible differences in things such as skin color, cheekbone
shape, and tooth size, all living human populations possess to an
equivalent extent the mental capacity necessary to learn a language. There
are no ‘primitive languages’...This is the single most profound distinction
between the human and nonhuman, and it is shared by all living human
groups. This quality alone substantiates the term sapiens and, whatever
their morphological differences, by this criterion, all living people are
equally sapient (Brace 1995: 712).

Of course, just like behavior and culture, language is not a solid artifact. It
must be inferred by looking at the evidence presented to archaeologists. Only
recently with genetic evidence by way of the discovery of the FOXP2 gene in
Neandertal DNA, which contributes to the capacity and production of language,
and the discovery of a Neandertal hyoid bone in Kebara, Israel, which physically
aids in the act of speaking, have anthropologists actually been able to argue that
Neandertals did, in fact, have the capacity and the morphology for language
(d'Errico et al. 1998: 3; see also Burr 1976; Wolpoff et al. 2004). Their language,
however (and the language of early modern humans for that matter), will never be heard and will, therefore, never be analyzed in comparison with the language of present day modern humans.

In the following section, I discuss the biological and physical characteristics of Neandertals and modern humans and address the implications of brain development to the cognitive capabilities of each population as well as the post-cranial morphologies that would pertain not only to the creation of language, but also to the shifts in technologies. Cognition relies completely upon the brain, so based upon the cranial differences and similarities between Neandertals and modern humans—assuming that the brain of Neandertals functioned in the same way as the brains of today’s modern humans do—it is possible to draw implications as to the effectiveness and types of interactions between them, such as verbal communication and trade of valuable objects.

Neandertals and modern humans coexisted across many geographical and environmental spaces, most likely participating in multiple interactions. Could there have been a transfer of modern culture and, potentially, modern behavior through these interactions? Can modern behavior be learned or, more clearly, can modern culture be learned and transferred even if modern behavior (as I have defined behavior as innate and culture as learned) is not present? Something as abstract as behavior is impossible to trace in the archaeological record, but based upon the definitions I’ve presented, we can make inferences from artifacts and remains in order to map out potential common behavioral and cultural characteristics of both Neandertals and early modern humans to trace the
transitions from one to the other. By taking these analyses one step further into the picture of Neandertal and Hss coexistence, we can use these transitions to determine the extent of cultural interactions and, eventually, the extent of sexual and genetic interactions.

**Biological Characteristics**

“I bet when Neanderthal kids would make a snowman, someone would always end up saying, ‘Don’t forget the thick, heavy brows.’ Then they would get all embarrassed because they remembered they had the big husky brows too, and they’d get mad and eat the snowman.”

~Jack Handy

By far, the most important aspect of archaeology is the discovery of human/hominid skeletal remains. Not only do they tell us, to an extent, what the individuals occupying the site looked like and how healthy they were, they provide archaeologists with the means necessary to plot out the cultural development of our species in connection with our physical development. While hominid bone discoveries are few and far between, archaeologists would not be able to make any associations between material cultural artifacts with physical forms without them. Neandertal remains discovered at Le Moustier and La Ferrassie make a direct association of Neandertals with the Mousterian possible; similarly, with the discoveries of Hss remains in tandem with most Upper Paleolithic industries. Without physical remains, archaeologists would be at a loss as to what hominid group would have produced which cultures. But this is not to say that discoveries of physical remains in sites have not thrown archaeologists for a loop: the discovery of very early Hss remains at Skhul and Qafzeh, Israel—where the commonly Neandertal associated Levantine
Mousterian industry is found—has caused speculation among archaeologists as to the meaning of modernity and modern behavior and its association—or lack thereof—with physical modernity. Similar issues have been raised with the discovery of Neandertal skeletal remains at St. Cesaire’s Chatelperronian industry pertaining to the capacity of Neandertals for modern behavior.

By paying attention to the physical similarities and the physical differences between Neandertals and Hss, we can create a better understanding of their relationship to each other. Anthropologists know that both forms coexisted for a span of over 10,000 years and know that in modern human ancestry, Neandertals were physically, cognitively, developmentally, and behaviorally the closest form to modern humans. The distinctive differences between both forms—such as cranial shape—provide for some interesting implications both with regards to the archaeological record and to the ancestry of modern humans. Digging deeper into these similarities and differences will reveal a deeper understanding of just how modern humans and Neandertals are related to each other.

This knowledge, then, contributes to archaeological and genetic analyses regarding the types of encounters and interactions Hss and Neandertals had with each other. Similarities and differences must be regarded within the context of each other, unlike the Out of Africa and Multiregional evolutionary theories would have us believe. The physical differences we encounter are small in comparison with differences between modern humans and chimpanzees, but they can have large implications regarding behavioral and reproductive capabilities.
between modern humans and Neandertals. The similarities provide a context in which anthropologists can balance out the differences to see a more rounded picture of these interactions. And, by pairing these physical similarities and differences with the cultural, behavioral, and cognitive aspects of both Hs and Neandertals, the picture anthropologists and archaeologists paint of encounters between these two groups comes into focus more clearly, allowing us to see more details than we would with only a few of these aspects: all are important if we are to determine to the best of our abilities how modern humans relate to Neandertals.

In terms of physical characteristics, Neandertals and modern *H. sapiens* are very similar. Still, there are detailed differences between Neandertals and early modern humans that allow archaeologists to identify each hominid group separately. These slight but significant distinctions relate not only to the environments in which the groups initially evolved, but also to the behavior of each group pertaining to tool making, hunting, food preparation, and potentially to their capacity for modern behavior by way of abstract thinking and symbols.

**Physical Characteristics of Neandertals**

Neandertals were initially described by Marcellin Boule in the early 1900s, based upon his study of an almost complete Neandertal skeleton discovered at La Chapelle-aux-Saints in France, as in possession of “divergent big toes (hence grasping feet, on which, moreover, weight was borne, apelike, on the outer edges), a slouching posture, bent knees, short and thick necks, and inferior brains,” portraying them as closer to our chimpanzee relatives than to the fully
erect modern humans (Tattersall 1995: 45; Spencer 1984). However, this is not an accurate description of the Neandertal body. There are no differences as drastic as Boule describes. There are, nevertheless, differences in both cranial and post-cranial (head and body, respectively) morphologies that separate Neandertals from modern humans.

Beginning with the skull of the Neandertal, we can immediately see some striking differences when compared to a modern human skull. Neandertals sport a very large supra-orbital torus (the bony brow ridges over the eye sockets, giving Neandertals an almost “glowering” characteristic in our imagination), facial prognathism (a projection of the maxillary [upper jaw] and the mandible [lower jaw]), very large front teeth, an almost non-existent chin, and a lower cranial vault (the top of the skull does not arch as dramatically in Neandertals as it does in modern humans). In addition, we also see an almost excessively large nasal aperture compared to the average of modern humans—Neandertals had a mean aperture width of approximately 34.5mm while modern humans have a width of approximately 28.3mm (Franciscus 1999: 1807)—which indicates the presence of a very large nose. This characteristic is described as a cold weather adaptation, allowing the large surface area of the inside of the nose to warm the freezing air that was inhaled before it reached the trachea and the lungs (Franciscus 1999: 1808). When the skull is turned to profile, we can see that the low cranial vault follows the skull all the way from the supra-orbital torus back to a bony “knot” at the base of the skull, known scientifically as the supercraniac fossa and colloquially as the occipital bun or the “chignon.” The occipital bun is one of the

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11 See Image 1 Appendix E
most distinctive physical characteristics of a Neandertal and is only found in these archaic *H. sapiens* of Europe and the Levant, a result of genetic drift for these isolated populations. It is conspicuously absent in archaic populations of the rest of the Old World.

Traveling further down the Neandertal body below the skull, we can also see differences from modern human morphology, although many of these differences require measurement rather than just an eyeball assessment. The postcranial physical distinctions are based more upon ratios of the long-bones than upon the existence of immediately visible characteristics. Overall, Neandertals tend to be shorter than modern humans and are much stockier, they have long torsos and short limbs. Their tibia to femur ratio is much more drastic in comparison to modern humans, indicating that the tibia is significantly shorter than the femur, which in turn is an indication of cold weather adaptation (Trinkaus 1986: 209).

“[Christopher Ruff] discovered that adaptation to heat or cold is not related to a person’s height…much more important is the width of the body trunk…because the ratio of surface area to body mass is maintained regardless of height…In addition, the ratio of the tibia (lower leg) length to the femur (upper leg) length differs between people that live in hot climates and people that live in cold climates…cold-adapted populations have short tibias relative to their femurs…[Neandertals’] body trunks are wide, and their tibias are short. Simply, they were cold-adapted” (Larsen 2010: 288).

The same thing can be seen when comparing the radius and ulna lengths to the length of the humerus in the arms.

The long bones in a Neandertal are slightly bowed, which was what gave Boule the mistaken impression that Neandertals could not walk with straightened
legs and therefore hobbled like chimps. The Neandertal ribcage is very broad, indicating an increased lung capacity for enhanced oxygen intake, a characteristic that is seen in modern human populations—such as the indigenous Andean peoples and the Inuit—that live in perpetually cold climates or in very high altitudes. The long-bones themselves are very thick and include deep grooves where muscles and tendons attached to the bone, indicating a much heavier musculature than is seen in modern humans, but they also indicate a degree of inflexibility (Trinkaus 1986: 196). The hands of Neandertals are also very similar to modern humans, but with different morphologies such that Neandertal metacarpals were subjected to a larger amount of stress when being used. They were perhaps not as readily able to shift grips when working in order to relieve joint stress (Churchill 2001: 2953).

As I said above, many of these post-cranial somatic characteristics are direct evolutionary adaptations to a cold environment. Paleoclimatologists have determined that Classic (later) Neandertals emerged and multiplied during a climatic period known as a Würm, the early part of the last glacial period. The average temperature of the earth dropped about 10°-15°F, resulting in a drastic ecological shift and, consequently, making it a better environment for Neandertals to survive with their cold-weather adaptations (Shea 2001:41). The early Würm period ended around 40,000 years ago, when we begin to see the appearance of early modern humans, who were adapted for warmer climates (Shea 2001: 41). The robusticity of Neandertals is conducive to maintaining body heat by increasing surface area of the body and, therefore, increasing the warming blood
supply to all areas of the body. This in turn requires an increased capacity for oxygen in order to oxygenate the large amount of blood being pumped all over the body, which explains the plasticity (broad ribcage).

The heavy musculature of the Neandertals also indicates the limited flexibility that they had in their joints, which would have affected their ability to optimally use tools and perhaps have disadvantaged them when hunting animals for meat. Their physical build determined their range of behaviors, from the way they held their hammer tools when flint knapping to their methods of hunting. Based upon their hand morphology, it is apparent that Neandertals used a “power grip”\textsuperscript{12} when they were making stone tools, “as indicated by the greater leverage of their thumbs, enlarged crests for the muscles of finger flexion, broad finger tips, and lack of specializations in the midhand (carpometacarpal joints) to resist obliquely oriented reaction forces” (Churchill 2001: 2954). This, as a result, caused a large amount of force to be exerted on the bones of the midhand and of the wrist, which in Neandertals explains evidence of osteoarthritis that would lead to debilitation (Churchill 2001: 2954). While this could have certainly been a drawback of Neandertal physiology, Gary Rollefson claims that because we see so many countless examples of exquisitely fashioned Mousterian tools every bit as fine as those found in the Upper Paleolithic, Neandertal flint knapping techniques must not have been too debilitating (Rollefson, personal communication 2011), at least not until later in life.

In addition, based upon the morphology of the neck vertebrae and upon muscle attachment grooves on the scapulae of Neandertals, it was determined that

\textsuperscript{12} See Image 1 Appendix C
Neandertals did not have the joint flexibility in their shoulders to have a full circular range of motion, like modern humans of today do (Trinkaus 1986: 200-201). Neandertals would not have been as effective at throwing spears or slings for hunting as modern humans and might have instead resorted to jabbing their prey. Modern humans have the flexibility to fully rotate their shoulders, allowing for a more precise and powerful throwing motion and, therefore, more projectile force without more muscular force. The jabbing path of motion would have been very powerful, based upon the heavy amounts of muscles in Neandertals, but it would have required the hunters to approach their prey at a short distance to make killing possible. We do have evidence of hafted tools in many Neandertal sites, which would have helped decrease the danger and increase the effectiveness of this hunting strategy (Brace 1995: 716; see also Churchill 2001: 2954).

This is not to say that Neandertals could not throw spears or slings. Muscular hypertrophy can be compensated for as an individual matures (Rollefson, personal communication 2011). These assumptions of a limited range of flexibility and subsequently of low precision are based on our own modern human body types: unless a body builder with muscular shoulders stretches on a regular basis, he has a very limited range of rotational motion, whereas a javelin thrower tends to not have muscular hypertrophy in this region of his body where constant rotational motion is necessary. Archaeologists cannot say for sure that Neandertals did not throw spears at all during the hunt; in fact they most likely did, but their projectile precision and distance might have been compromised due to their heavy musculature.
Hunting and meat procurement was an extremely important aspect of Neandertal survival. Meat comprised of a large part of the Neandertal diet, unlike the more varied diet of early modern humans, because the tundra landscape of the early Würm did not allow for a variety of vegetation growth, leaving Neandertals to gather a majority of their sustenance from animals (Shea 2001: 52; see also Zollikofer et al. 2002: 6444). The morphology of Neandertal limbs explains a different aspect of their hunting strategy than just their spear throwing precision: their short length but their heavy musculature reflect strength and endurance, so Neandertals could travel for long distances to hunt, which evidence suggests they often did (Coolidge and Wynn 2009: 196). “The overall impression of Neandertal locomotor anatomy is one of great strength…suggests that they spent a sufficient portion of their waking hours moving across the landscape to require an exaggerated level of endurance…it implies that this strength was a necessary component of their adaptation” (Trinkaus 1986: 205-206).

Neandertals did keep their settlements in one area over a long period of time so they kept returning to the same spot while increasing their hunting radius. Their leg and foot morphology would have allowed these long distances to be traveled without much trouble, supporting and perhaps creating this certain behavior: “We have no reason to conclude that Neandertals used intercept strategies that required the plotting and following of novel routes…The best way to describe Neandertal movement in space is by using radiating or star-shaped paths and tracks…over millennia and lifetimes, Neandertals appear to have learned their territories and their opportunities intimately…This required spatial
memory, but not the ability to imagine novel paths” (Gamble in Coolidge and Wynn 2009: 195; see also Gamble 1999). Here, Gamble is speculating. While there is no evidence that points to the conclusion that Neandertals used intercept strategies while hunting, there is also no evidence to say that they did not, or could not, use such strategies. Absence of evidence is not the evidence of absence (Rollefson, personal communication 2011). There is no definitive way in which anthropologists and archaeologists can make conclusions concerning Neandertal cognition in comparison with Hss cognition because we cannot confirm that Neandertals and Hss brains have the same functional pattern.

All of these different speculations regarding Neandertal culture, behavior, and cognition based upon perceived physical limitations transition forward onto the next section regarding Neandertal cranial morphology. How does cranial morphology reflect upon Neandertal cognitive capabilities, which in turn reflect upon behavioral and cultural capacities? This question brings us back to the original question that is driving this thesis: How did Neandertals and Hss interact with each other and could they interbreed? The balance of physical differences and similarities signify deeper relationships between Neandertals and modern humans that cannot be seen on the surface, whether these things are part of behavior and abstract culture, material cultural remains that have not yet been found, or in genetic comparisons. By recognizing these superficial similarities and differences, anthropologists continue to fuel the discussion surrounding the relationship of Neandertals to modern humans.
Cranial Morphology of Neandertals

The cranial morphology of Neandertals might also help explain these hunting behaviors in respect to cognitive abilities. It is impossible for archaeologists and scientists to observe how a Neandertal’s brain functions because Neandertals are, in fact, extinct. Can we therefore assume that each part of the brain would have functioned as we know it does in modern humans of today? It might be an assumption that we have to make if we are to take cognition into account. So with the assumption that Neandertals’ brain functions were similar to those of today’s humans, we can look at their cranial structures and potentially determine what parts of their brains were developed in relation to modern humans and consequently what this indicates about their cognitive capabilities.

A low cranial vault paired with the same brain size as modern humans shows that Neandertals’ frontal lobes were not the same shape as those of modern humans, but they were the same size: “Indeed, specimens such as the Neandertal calvarium [skull] at La Ferrassie cannot be shown to have smaller frontal lobes than that of modern Homo sapiens” (Holloway et al. 2002: 16). Neandertals, while having frontal lobes of a different shape, had brains of roughly the same size as Hss in relation to their body size to brain size ratio. As a result, we must conclude that “Neandertals were at least as encephalized [having the same ratio of excess brain tissue expected for body weight] as modern humans” (Coolidge and Wynn 2009: 183; see also Holloway 2004: 17). Neandertals, therefore, were the first members of the genus Homo (before H. sapiens sapiens) that had the same weight
to brain ratio as modern humans have, indicating that there was a large jump
towards, if not into, a modern cognitive capacity between them and their
predecessors, *H. erectus*. This also suggests that, at least to an extent,
Neandertals’ mental capacity was on par with that of modern humans. The piece
of data that could be an indicator of whether or not Neandertals and modern
humans shared the same mental powers as each other is the shape of the brain,
reflected in the shape of the skull:

Neandertals had large brains: the mean cranial capacity was 1,427 cc
[cubic centimeter]…with a range of 1,250 cc-1,700 cc…as an absolute
measure, this exceeds the modern human average (about 1,350 cc), but
whether or not there was a significant difference in EQ [encephalization
quotient] is clouded by Neandertals’ obvious muscularity, and the
decrease in body mass that has occurred in modern populations over the
last 10,000 years (based on skeletal remains, not twenty-first-century
McDonald’s-fed teenagers…)…But size is not the only consideration;
Neandertal brains differed in shape from modern human brains (Coolidge
and Wynn 2009: 183).

The frontal lobes of a human brain give an individual the ability to
foresee consequences of any action or event taking place; determine what is right,
wrong, better, or best; regulate social acceptability; establish relationships
between events; and they allow for long term retention of emotional based
memories. “The frontal lobes serve as a kind of executive that makes decisions,
forms goals, devises strategies for attaining these goals, plans, organizes, and
changes and devises new strategies when initial plans fail” (Coolidge and Wynn
2009: 3). Therefore, a less developed frontal lobe could mean—and here
anthropologists purely speculate—that there is less ability, or no ability at all, to
perform these mental functions that pertain to such abstract things as emotional
memory, good or bad, and changing behavior patterns to increase the

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effectiveness of actions. This could explain why, in Neandertal hunting patterns, we see static star-shaped and radial hunting patterns rather than dynamic hunting paths: Because Neandertals did not (perhaps) have the brain function that would have allowed them to imagine new ways to approach a herd’s grazing areas. We have absolutely no definitive proof for any of this. These comparisons are made based on our own present day modern cognition because we do not have a functioning Neandertal brain to analyze.

The parietal lobe of the brain controls our senses (especially our sense of touch), our ability to process the “manipulation of objects in visual space,” and our ability to retain long-term tactile memories (Coolidge and Wynn 2001: 17). Neandertals in general all had what appear to be expanded parietals compared to those of modern humans, although in conjunction to the difference in shape of the frontal lobes, the parietal lobes were fully developed; not larger or smaller or a different shape compared to modern humans, but the same (Shea 2001: 44). This suggests that Neandertals could have been almost completely dependent upon their ability to retain visual and muscle memories in order to function and survive in their chosen environments because they did not have the frontal lobe morphology allowing for abstract thinking. This speculation is, again, based on the brain function of modern humans and cannot be proven, but neither can it be refuted due to issues regarding archaeological visibility: the specimens we are researching are extinct and the soft tissues of their brains decomposed long ago. This being said, I do make these speculations because they are logical, but in turn
give Neandertals the benefit of the doubt and assume they had a greater capacity for intelligence than what is suggested by these comparisons.

So how does cognition in relation to physical characteristics pertain to interactions between Neandertals and early modern *H. sapiens*? First of all, the physical markers we see in Neandertal skeletons—particularly the osteoarthritis and stress fractures in their wrist bones due to constant stress on the bones caused by flint knapping—can tell us that, perhaps due to limited cognition compared to modern humans, Neandertals had a set way of doing things based upon a muscle memory and did not have the ability to change: “On the basis of a multivariate analysis of three-dimensional landmark data from carpal and metacarpal joint surfaces of Neandertals and Near Eastern early modern humans, Niewoehner concludes that important manipulative differences existed between them—differences not in dexterity but in grip strength and the ability to resist forces incurred in certain grip positions” (Churchill 2001: 2953).

That their flint-knapping motions caused pain cannot be proven without seeing a Neandertal in action. Most likely, the pain would have been from repetitive motion and force, not necessarily based upon the power grip, much like carpal tunnel syndrome, which is soft tissue damage and cannot be seen on the bone. Osteoarthritis would have also been a result of sustained, repetitive motion: flint knapping is repetitive motion, but unless a large toolkit is being made at once, it doesn’t take more than a few minutes to produce a handaxe (Rollefson, personal communication 2011). Regardless, we do see more arthritis in Neandertal wrists than in Hss wrists, so we can assume that something was
different and perhaps had nothing to do with tool production; maybe it was related to repetitive loading when gathering vegetation and/or other materials (Churchill 2001: 2954). The inability to shift grip was amplified by the restriction in their hand morphology (Churchill 2001: 2954). Perhaps, then, the increased amount of osteoarthritis in Neandertal wrists that we see is not a result of cognitive capabilities, but of restrictive musculature and bone morphology.

That Neandertals remembered how their grip felt around the hammerstone and did not (could not) shift it, even if their motion would eventually cause pain, is complete conjecture. I seriously doubt any anthropologist who specializes in flint tool replication will be willing to test this theory and cause themselves pain, so we have no way to demonstrate this. They speculatively took the same hunting paths away from the camp because every landmark was memorized and the repetition ensured they would reach their destination: they did not, arguably, have the cognitive ability to create a new path to the same place. Neandertals could not imagine a new space without seeing it first, nor, supposedly, could they design completely new, more efficient tools, because they did not have the foresight to anticipate their effectiveness.

Again, these conclusions, especially those concerning hunting patterns, are conjecture based upon an assumption that the Neandertal brain functions in the same way that the modern human brain does, not upon concrete evidence. Because we cannot place a Neandertal under a CAT scanner to monitor his brain function, all of this data is based upon comparison between Neandertals and modern humans via their physical, cultural, and behavioral similarities. Why
should their cognitive capabilities not also reveal similarities to modern humans? Perhaps they do. Or, for all we know, Neandertal brains did not synapse in the same way that those of modern humans do, so all of our cognitive speculation is off and anthropologists are actually just floundering for explanations. The evidence presented here can be neither proven nor refuted due to the lack of a live Neandertal specimen to observe.

**Physical Characteristics of Early Modern Humans**

Enter modern humans. Based upon what I described above as Neandertal characteristics, it is easy to make a comparison between the two hominid groups. Neandertals fully emerged in Europe and the Levant upwards of 300,000 years ago with evidence of Mousterian lithics appearing around 250,000 years ago in the Levant (Shea 2001: 43; see also Howell 1998: 10-13). Early modern humans first appear in the Levant between 100,000 and 80,000 years ago at the sites of Skhul and Qafzeh in Israel (Holliday 2000: 102; see also Trinkaus 2007: 7367), although there is still debate concerning the extent to which we can designate the Skhul and Qafzeh individuals as being completely modern. Modern populations began emerging throughout Europe and the Levant around 40,000 years ago.

Physically, early modern *H. sapiens* are characterized (in comparison to Neandertals) by a decrease in overall robusticity. This gracilization can be seen both in cranial and post-cranial features: a substantial reduction in the prominence of the supraorbital torus and the occipital bun, the development of a distinctly vaulted cranium (indicating a change in shape of the frontal lobes and, therefore, a cognitive shift), a flattening of the maxilla (causing a marked decrease
in facial prognathism), the appearance of a definite chin on the mandible, a narrowing of the nasal aperture (indicating less of a need for a large nose for heating purposes), a decrease in the cortical thickness of the long bones and in the surface area of the scapula (indicating a decrease in muscularity), a decrease in circumference of the trunk, and a decrease in the ratio of tibia to femur length which, in addition to the smaller surface area of the torso and a relatively narrow nasal opening, indicate “evolutionarily recent tropical ancestry” and warm weather adaptations (marked differences compared to the prominent cold weather adaptations of the Neandertals) (Trinkaus 2007: 7368).

These morphological differences allowed for a greater range of physical flexibility in comparison with Neandertals and, therefore, could have provided a greater range of behaviors that would not be feasible if there were physical limitations. Their hands and wrists were built for an oblique power grip, like that which we use today to grip a hafted tool’s shaft and use the tool in a hammering motion. This, unlike the transverse power grip directly on the hammerstone that we see when Neandertals made stone tools, reduces the jarring force of connecting hammerstone with flint by forcing the shock waves to travel through the shaft, saving the carpals and metacarpals from stress (Churchill 2001: 2954; Trinkaus 1986: 201).

These morphological shifts would also allow for the greater variety of lithic tools that we find in the archaeological record because there is less of a physical restriction in grip and because there is also a cognitive shift that accompanies it. The frontal lobe of modern humans, based upon the analysis of
the cranial vault, is not larger than it is in Neandertals, but it presents itself as spatially fuller in the front and top compared to the Neandertal frontal lobes, indicating a difference in the development of the areas of the front lobe and, therefore, an assumed difference in frontal lobe function. Making the aforementioned assumption that Neandertal brains functioned in the same areas and the same ways that the brains of today’s modern humans do, it would be safe to take this shape change as a further development of the frontal lobe that produced the cognitive ability to comprehend, remember, and predict abstract concepts, such as good, bad, and emotion.

The shift in lower limb morphology between Neandertals and early modern H. sapiens not only indicated warm-weather adaptations, but it also affected the locomotive capabilities of early modern humans. The decrease in muscle strength and increase in limb length indicate a decrease in locomotive endurance, which would require a much smaller hunting radius around a permanent settlement or a shift from more permanent living to a seasonal nomadic living style. This could include a shift from subsistence predominantly by hunting to subsistence through a more even distribution of hunting and gathering (Trinkaus 1986: 206). This claim can also be supported by the physical decrease in robusticity: early modern humans did not need nearly as many calories to survive and function. These calories could be evenly gleaned from meat protein and edible flora, while the greater caloric need of Neandertals had to be met primarily by meat consumption (which in turn would have made the need for gathering the sparse Würm vegetation almost obsolete because it would only
provide supplemental calories and vitamins to those supplied by meat) (Zollikofer et al. 2002: 6444).

It can be seen that in both Neandertals and in modern humans, physical morphology influences behavior within the context of the environment and cognition. The behavioral differences between Neandertals and early modern *H. sapiens* are, as I have said in the previous chapter, not easily found in the archaeological record. Flint can be analyzed for trace elements in order to determine where it came from, which would then indicate the distance traveled from the site to obtain the flint. This analysis, in conjunction with the lithic culture itself, helps to assign behavior. Faunal remains at sites, especially when the remains are paired with tools, also indicate aspects of behavior: meat rich bones with cut marks on them that can be attributed to a specific type of tool found at the site point to hunting behavior. Pigment traces, shells that are not native to the area where a site is found, bone tools, and art (sculptures, wall paintings, etc.) are also signifiers of the behavior that archaeologists have designated as modern behavior.

These indicators, if they are presented with corresponding carbon 14 (C-14) and/or Electron Spin Resonance (ESR) dates, they can usually be assigned to either Neandertals or modern humans. However, in the minimum 10,000 years of coexistence of Neandertals and modern humans in Europe (Trinkaus 1986: 197) and the approximate 50,000 years of potential coexistence between Neandertals and modern humans in the Levant (Clark and Lindley 1989: 963), we have a significant span of time where archaeological sites—and the remains of behavior
In Middle and Upper Paleolithic sites, but, for a time, a pattern had been established. Middle Paleolithic tools and the behaviors associated with them were considered to be Neandertal, while Upper Paleolithic tools and their respective behaviors were those of early modern humans. This pattern has been interrupted by striking archaeological evidence on all sides, leading to the debate I address in this paper: What is the extent to which Neandertals and early modern *H. sapiens* interacted during their period of coexistence? In the next section, I look at the archaeological holes in this pattern of attributed behavior and use the evidence to formulate my own interaction scenarios—most especially pertaining to the existence of interbreeding.

**Interactions**

**Cultural Interactions**

One of the discoveries that has fueled the discussion of behavioral capacities of Neandertals appears in France with a stone tool industry that is neither purely Upper Paleolithic nor purely Mousterian, but what appears to be an amalgamation of both industries (in terms of tool types and technologies) used in the same archaeological stratum. It can be assumed, then, that this industry was developed and used by the site’s inhabitants during its occupation in the earliest Upper Paleolithic or during a transitional period between Mousterian and Upper Paleolithic: “The Early Upper Paleolithic industry known as the Chatelperronian has been the subject of considerable controversy since its recognition in the early
twentieth century. It has variously been considered to be associated with Neandertals or with modern humans, to be an intrusive or an indigenous development, and to be related or unrelated to subsequent industries in France and Spain” (Harrold 2000: 59). The so-called Chatelperronian industry\(^\text{13}\) appears in St. Césaire, Arcy-Sur-Cure, and La Ferrassie (all french Neandertal sites) verified by the discovery of Neandertal skeletal remains—as well as in Grotto des Fetes and other sites throughout France and Northern Spain that are not associated with physical remains.

Some scholars—Brace, Brose, Zilhao, and Wolpoff, for example—believe that Neandertals apparently developed this new industry themselves “in situ,” without any apparent disturbance and subsequent contamination of the archaeology after the site’s abandonment (Nowell 2010: 443; Harrold 2000; Zilhao et al. 2006). Some scholars, such as Mellars, oppose this and believe that the Chatelperronian industry is a result of acculturation between the coexistent Neandertal and Hss populations in France and Spain (Mellars et al. 2007). While this argument as to the origin of the Chatelperronian industry will most likely never be completely resolved, I follow Mellars in believing that the Chatelperronian is indeed the product of cultural interactions between Neandertals and their modern human neighbors. In a lithic industry timeline\(^\text{14}\), the Chatelperronian appears contemporary with the Aurignacian and is considered to be the first part of the “Perigordian” period, which followed the Mousterian in Western Europe and consists of first the Chatelperronian and then the Gravettian.

\(^{13}\) See Images 2 and 4 Appendix C
\(^{14}\) See Table 4 Appendix A
industries (Encyclopedia Britannica 2011). This smooth transition from the Mousterian into the Perigordian/Chatelperronian, paired with the appearance of the Aurignacian around the time of the transition implies that interactions did take place between the Mousterian—and eventually Chatelperronian—Neandertals with the Aurignacian Hss.

The Chatelperronian industry consists of a toolkit containing both Mousterian and Upper Paleolithic type lithic tools as well as worked bone and items of personal adornment normally associated with the modern humans with whom these Neandertals were in co-existence: “If only stone artifacts were involved, the Chatelperronian might be considered simply a kind of final Mousterian…At Arcy-sur-Cure, however, Chatelperronian people not only produced a mix of Mousterian and Upper Paleolithic artifact types, they also manufactured quintessential Upper Paleolithic bone tools and personal ornaments” (Edgar and Klein 2002: 207). Before the discovery of these sites, Neandertal tool assemblages in Western Europe paralleled elements of the Upper Paleolithic toolkit on a much lesser scale. Items of personal adornment were rarely if at all found associated with Neandertals and were more commonly associated with modern humans—although there are sites associated with Mousterian tool assemblages in the Levant with early modern human remains from Skhul and Qafzeh (Clark and Lindly 1989: 967). We do see some instances outside of Western Europe where Middle and Upper Paleolithic type tools are clustered together, specifically in the Levant with the Levantine Mousterian industry (which existed before the appearance of modern humans in Skhul and
Qafzeh but transferred to the early Hss populations from the native Neandertal population, an instance of potential physical modernity before behavioral modernity) and in Eastern Europe with the Szletian industry, which could also be considered a result of Hss and Neandertal cultural assimilation (Brose and Wolpoff 1971: 1163).

Archaeologically speaking, “[The Chatelperronian] industrial type always succeeds other Mousterian types/facies” but at least four sites are known in Europe where the Chatelperronian industry is inter-stratified (surrounded) with Aurignacian strata: “Such occurrences demonstrate the independence of these industries and, as well, the close penecontemporaneity of such social (and biological) entities responsible for their production” (Howell 1998: 22). The question of the development of the Chatelperronian industry is how and why Middle Paleolithic (Neandertal) type tools and Upper Paleolithic (modern human) type tools appear together in a seemingly undisturbed archaeological site. Did Neandertals actually develop this Upper Paleolithic culture themselves, or was it “a result of acculturation, trade with AMHs [anatomically modern humans], imitation of AMHs,” or a “mixing of layers” (Nowell 2010: 443)?

Acculturation, as seen in the archaeological record, is identified by changes in artifact inventories. It would be silly, however, to assume that physical items were the only exchanges made between Neandertals and early modern humans. Abstract cultural items and behaviors that do not show up in the archaeological record could just as well have been integral parts of any exchange. The minimal archaeological visibility, unfortunately, restricts archaeologists’
ability to observe the abstract, making it necessary to imply scenarios from the evidence. The Chatelperronian industry formed as a result of interactions between the newly arrived modern human populations and the native Neandertal populations.

The hypothesis posed by Zilhao and his colleagues that Neandertals developed the Chatelperronian industry completely independently suggests that Neandertals had the same cognitive capabilities as the emerging modern human populations that displayed these Upper Paleolithic characteristics. The opposing hypothesis presented by Paul Mellars implies that the Chatelperronian industry is a result of interactions, both direct and indirect, of incoming modern human populations with the Neandertals in a region: “…the most persuasive Upper Paleolithic elements appear only near [the Chatelperronian’s] very end. This suggests to us and others that the Chatelperronians borrowed the underlying concepts from early Aurignacian Cro-Magnon [early modern humans who inhabited Europe] neighbors” (Klein and Edgar 2002: 208). Mellars’, Klein’s, and Edgar’s theory involves speculation, however, as to whether Neandertals assimilating early modern human culture into their own culture proves, as Zilhao et al. believe, that the European AHS population had a “capacity for human behavior” (Nowell 2010: 443) or if the Upper Paleolithic artifacts found in Neandertal sites were purely a result of imitation without understanding (White 1992: 548), which does not seem to be a logical conclusion. Why would anyone imitate something without understanding to some extent?
If the former is true, then we see a problem in what the archaeological record is telling us: the Neandertals had a capacity for modern behavior and created the Chatelperronian industry using this capacity, but they ended up disappearing. Why then did they not become completely integrated with modern humans to ensure the survival of their kind? If they had assimilated into modern human cultures, then “we would expect their anatomical traits and their genes to be more obvious in later populations”, which—depending upon the traits considered—they are, but not to the extent that Klein and Edgar would like to see (Klein and Edgar 2002: 208). In my opinion, however, the latter scenario depicting the Neandertals parroting their early modern H. sapiens neighbors is much more difficult to believe, especially because we cannot make any definitive conclusions about Neandertal cognition. I share Wolpoff et al.’s reluctance to assume the Chatelperronian industry is a result of imitation without understanding: “Even if…the Chatelperronian Neandertals were ‘only’ copying other Upper Paleolithic industries, the fact is that one does not copy what one cannot understand” (Wolpoff et al. 2004: 538).

But, of course, these are not the only two scenarios that could have taken place between modern humans and Neandertals in relation to the Chatelperronian. Indisputably, there absolutely had to be a period of coexistence “unless,” as Mellars et al. so eloquently put it, “we suggest that the native Neandertal populations effectively self-destructed the moment the first modern populations set foot in their territories” (Mellars et al. 2007: 3662). Zilhao et al. suggest that the Chatelperronian industry was an in situ occurrence. They support their claim
using the theory that Neandertals actually did have the capacity for what we now call modern behavior, claiming that it was “in place...before the split of the Neandertal lineage” (Zilhao et al. 2006: 12643).

I do not dispute the claim that Neandertals had a greater capacity for “modern behavior” than what was originally thought by Stringer and Tattersall. That the Chatelperronian industry was developed by these Neandertals without any outside influence, however, is implausible. There are numerous evidences that the Neandertals of the Mousterian, and later of the Chatelperronian, lived at the same time and in the same geographic area as the early modern humans who developed the Aurignacian industry. The Chatelperronian industry only emerges after we see the first instances of early modern humans and the Aurignacian industry in Europe. This, coupled with the fact that I do not know of any mammal, especially not one with a greater cognitive capability like Neandertals or modern humans, that is not eventually curious about any new creature it encounters, makes it naïve to assume any shift in cultural characteristic as being developed solely by the Neandertals or by Hss. Living in close proximity with each other, Neandertal and early modern human populations most likely would not have been able to resist interacting with each other on some level.

Any number of scenarios could have occurred at any point during this time span, including inter-species mating, lithic cultural transfer (the Chatelperronian industry), and even episodes of violence between populations. For all we know, the items of personal adornment we see in Chatelperronian stratigraphic layers could be a result of early modern humans and Neandertals exchanging gifts or of
Neandertals sneaking into modern human camps and stealing things. In saying this, I do not mean to imply that this acculturation was one sided from early modern humans to Neandertals; I only say this because the only “mixed” lithic cultures that I have found evidence for have been associated with Neandertal populations. That is not to say that there are no lithic cultures out there exposing Aurignacian tools mixed with a small amount of Mousterian tools.

The Chatelperronian industry is not the only lithic industry in which we see what could potentially be crossover in tool kits. Howell describes a similar industry in the Levant, known as the Levantine Mousterian, at the transition between the late Middle Paleolithic and the early Upper Paleolithic, a time period associated with the physical transition from archaic *H. sapiens* occupation to early modern human occupation:

…There is some evidence, particularly in the Negev and in the northern Levant, for progressive technological shifts in core-reduction processes and in the production of blade blanks, as well as in the introduction and elaboration of newer tool types and variants, all from a dominantly Mousterian/Levallois facies base. There is, unfortunately, only a scant, poorly preserved human fossil record associated with this important industrial succession (Howell 1998: 15).

In Eastern Europe, Brose and Wolpoff claim that we see similar tool assemblages to the Mousterian called Szletian and the “Levalloisian Mousterian of the Acheulian tradition containing bifacially retouched points, ‘Clactonian flakes,’ and a large number of bone and antler tools including ‘barbed’ or split-base points” (Brose and Wolpoff 1971: 1164).

While the claim might be that in a chronological context these are Middle Paleolithic assemblages, Levantine Mousterian assemblages lean more towards an
Upper Paleolithic collection of tool types and techniques, typical of later Hss manufacture (Rollefson personal communication 2011). Brose and Wolpoff describe Levantine Mousterian assemblages that show a multitude of similarities to “the facies of France but which have relatively high frequencies of blades, knives, gravers, and burins...characterized by a few denticulated tools” (Brose and Wolpoff 1971: 1165). Similar to Brose and Wolpoff, Howell describes the Levantine Mousterian, the Szletian, and the Chatelperronian industries as having been “obscurely and misleadingly” called “transitional industries, a premature perceptual commitment that tends in fact to preempt understanding and explanation” (Howell 1998: 20-21). He then explains, “it has been proposed by some (not all!) workers that these particular industrial manifestations,” which he describes as a few distinct Upper Paleolithic components—such as burins, end scrapers, and retouched blades—amid a fundamentally Middle Paleolithic industry, “correspond, most probably, to an ‘acculturation’ phenomenon” between populations that utilized Mousterian tool types and “intrusive” populations that use “early Upper Paleolithic (specifically Aurignacian)” technologies (Howell 1998: 21).

These lithic cultures can tell us two things. Firstly, that there absolutely had to be some interaction between modern humans and the native Neandertals, whose environment early modern H. sapiens were migrating into. Secondly, that there is a significant chance that Neandertals were more cognitively capable than many anthropologists (Mellars, Stringer, and Tattersall) would have originally thought. This would then suggest that the cognitive jump was not related to
biological change at all, but potentially related to environmental shifts and external stresses. Wolpoff, Zilhao et al., and Clark and Lindly all make the claim that culture, and therefore lithic technologies, have “no correlation whatsoever” to hominid phases based upon “Technologies, like blades, bone tools, and ornaments, found in Mousterian contexts and the association of Neandertal remains with Upper Paleolithic industries” (Clark and Lindly 1989: 967; Wolpoff et al. 2004: 538).

Another view of the Chatelperronian and other lithic cultures that can be described as “mixed” is that they developed parallel to the Aurignacian from the Middle Paleolithic industries, but not from scratch. An increase in “Upper Paleolithic” type tools does not necessarily mean the complete conception and development of them: burins and endscrapers are seen in smaller numbers in Middle and even Lower Paleolithic assemblages, most especially in the Levant. The presence of these plus a drastic climate and environmental change, which necessitated the use of these kinds of tools, would have instigated a parallel cultural development in the Aurignacian and the Chatelperronian between modern humans and Neandertals (Rollefson, personal communication 2011). This theory supports the idea that Neandertal cognition was much more advanced than was originally believed and does not discount interactions, but greatly downplays them in the development of the Chatelperronian in favor of cultural evolution as a result of environmental stress.

Additional evidence to support the independence of physical and cultural modernity from each other is seen at the sites of Skhul and Qafzeh in Israel, both
of which are, at this point in time, the earliest modern human remains discovered in either the Levant or Europe. All skeletal remains in both sites are associated with the local Levantine Mousterian lithic industry, which is also seen with Tabun and Kebara Neandertal remains. The hominids of Skhul and Qafzeh did not bring their own industry into the Levant; they used a culture that was already there. In the Levant, modern humans took up the Neandertal culture, counter to what paleoanthropologists would expect to see if they are assuming a “superior” mentality of modern humans. The lag of cultural modernity in relation to physical modernity here is another piece of evidence to support the disjunction between them. Why is there a discrepancy here in the Levant when we do not see one in Europe? Perhaps the lack of continuity between these two aspects of modernity highlight a deeper lack of continuity between physical modernity and modern cognition, which allows for the capacity for modern behavior which, in turn, develops modern culture. Physical modernity, therefore, might not be responsible in any way for the development of behavioral and cultural modernity.

The Levant is the most interesting region where we observe Neandertal and early modern human coexistence and eventual replacement. It is here in the Middle East where we see the earliest emergence of anatomically modern humans and an abrupt disappearance of these same early modern humans in favor of Neandertals: “Multiple lines of evidence indicate that the Qafzeh-Skhul sample represents a temporary northward expansion of these earliest modern humans into that region, after which they were replaced by Neandertal populations dispersing southward” (Trinkaus 2007: 7367). Early modern humans then re-emerge around
40,000 years ago, thriving in both the Levant and in Europe and coexisting with the declining Neandertal populations: “Perhaps Neandertal occupation of the Levant was indeed episodic, and it would be valuable to identify the environmental factors that might have controlled this…by affecting the geographical range of early modern humans, who would perhaps have competed for the available resources in this region” (Stringer 1998: 34). In the Levant, the Skhul and Qafzeh early modern humans—as well as their Tabun, Kebara, and Shanidar Neandertal neighbors—utilized a Middle Paleolithic industry that was being used by the Neandertals prior to the appearance of the Hss (Mellars 1989: 354). This lithic culture is similar to the Chatelperronian in that it contains similar tools (burins, handaxes, endscrapers, points, blades, knives, Levallois flakes), but it is different in that it did not change with the introduction of modern humans and was in place thousands of years before the transition into the Upper Paleolithic. It is, therefore, another instance of interaction in itself: complete cultural integration with respect to lithic technologies and ignoring morphological aspects of modernity.

The conclusions I draw from all of these different viewpoints are these: that the Chatelperronian, Szletian, and, to an extent, the Levantine Mousterian industries emerged or were maintained as a result of interactions between the native European Neandertals and the newly migrated early modern human populations; and that Neandertals had cognitive abilities similar to those of modern humans because they either assimilated Aurignacian tools into their own lithic culture and were able to use them or they developed the Chatelperronian at
the same time the Aurignacian developed, which does not preclude interactions between the two groups. As I see it, there is no other plausible explanation than that the Chatelperronian industry developed with the Aurignacian and at least part of its development included transfers of cultural ideas between modern humans and Neandertals (and vice versa). We cannot know for certain the cognitive abilities of Neandertals, but based upon the archaeological evidence we see in the Chatelperronian, Levantine Mousterian, and Szletian industries, it seems apparent to me that they included the ability to implement, if not develop, new tool types, implying a higher cognitive understanding of both the uses of the tools and of how they buffer environmental changes.

The co-existence of early modern humans and Neandertals in western France and northern Spain, where we see the Chatelperronian industry, between 43,000 and 36,000 years ago would have provided numerous “opportunities for various forms of contact, demographic interaction and potential exchanges of technology or other aspects of culture between two populations” (Mellars et al. 2005: 51). Neandertals and early modern humans coexisted everywhere in Europe and the Levant. It is not out of the question that there might be other lithic cultural examples consisting of different frequencies of traditional Middle and Upper Paleolithic tool types that have not been uncovered yet. In addition, the instance of physical modernity without cultural modernity at the Skhul and Qafzeh sites in Israel introduce more questions specifically concerning the relationship between these early modern humans and their Neandertal neighbors.
Interbreeding and Hybridization

Throughout the history of modern humans, there are multiple instances in which populations new to a region end up mingling with established indigenous populations, interbreeding, and eventually producing a population of, for lack of a better word, hybrids. These hybrid populations represent a distinct genetic mixture of allele frequencies that differ from the expected shift in frequencies that would be seen as a result of a population shift due to natural selection. For example, a relative comparison of a hybrid population would be the *mestizos* of Central and Latin America: Spanish conquistadors conquered the indigenous populations of Central America, mating with them and producing an ethnically mixed population of *mestizos* that has grown to be the ethnic majority today. *Mestizos* are, however, *ethnic* hybrids from the same species as their parents, not species hybrids who had parents of different species or subspecies. How can we determine that populations of Neandertals and modern humans interbred, especially when it is unclear as to whether they are members of the same species or not?

I discussed in the first section (History and Problem) the raging debate that has come to a head in the past couple of decades thanks to the discoveries of evidence that could point directly to Neandertal and Hss interbreeding: the definition of a species. Were Neandertals and modern humans contemporary species of the same genus? Or were they contemporary subspecies of *Homo sapiens*? Based upon the basic definition I mentioned earlier—that two individuals of a different species could not mate to produce viable offspring, but
two individuals of different subspecies could—the following evidence I present regarding Neandertal and Hss interbreeding will determine whether or not Neandertals and modern humans are members of different species or different subspecies. This is the culmination of the entire paper. I have up until now demonstrated that Neandertals and modern humans certainly coexisted and more than likely participated in multiple exchanges of a cultural nature. Now, I take it a step further and analyze skeletal and genetic data in order to prove that they mated with each other in addition to non-physical interactions.

*Skhul and Qafzeh, Israel*

The first issue archaeologists came upon concerning the possibility of the existence of Neandertal/modern human hybrids were the human remains at Skhul and Qafzeh. I made references to these remains in previous sections, referring to them as early modern human remains—the earliest so far in the Levant—because now, after some debate, it has been determined by archaeologists that they are indeed the remains of early modern humans who retain some archaic characteristics (Holliday 2000). Originally, when Dorothy Garrod began excavations in the Mt. Carmel area of Israel in the 1920s (Tabun Cave, Skhul, and Qafzeh), hominid remains were discovered in several layers of Tabun Cave and have since been officially identified as Neandertal remains. In addition, layers of remains were uncovered at the Skhul rockshelter close by and at the site of Qafzeh further north. Garrod, McGowan, and Keith all described these fossil remains as “a single sample. The morphological differences among the Tabun
and Skhul fossils were seen as extremes within a population undergoing transition from more Neandertal-like to more modern-like configurations” (McGowan and Keith 1939 in Shea 2001: 45). The fact that these strata were all approximately contemporaneous strengthened their argument.

Echoing McGowan and Keith, Clark and Lindly propose that the modern humans of Skhul and Qafzeh evolved from the Neandertals that had occupied the area from the time of their emergence between 150 and 200,000 years ago, which would explain the identical lithic cultures through the Multiregional evolutionary model (Clark and Lindly 1989: 977). Now, however, after extensive testing and measurements, it has been determined that the Levantine Neandertals and modern humans from Tabun, Skhul, and Qafzeh are of two different populations that originated from different areas. Physical analysis of Levantine Neandertal remains and the remains from Skhul and Qafzeh point towards the Out of Africa hypothesis (two populations from two different areas inhabiting the Levant) and away from the Multiregional hypothesis (the early modern remains from Skhul and Qafzeh are products of a transition between Levantine Neandertals and early modern humans). Measurements and comparisons of distal limb segments indicate that “Qafzeh-Skhul hominids have African-like, or tropically adapted, proportions, while those of Amud, Kebara, Tabun, and Shanidar have more European-like, or cold adapted, proportions” suggesting that “the Qafzeh-Skhul hominids were most likely African in origin—a result consistent with the [physical] ‘Replacement’ model of modern human origins” (Holliday 2000: 54). These measurements also prove that the hominids from Skhul and Qafzeh are, in
fact, physically modern while those from Amud, Kebara, Tabun, and Shanidar are Neandertal.

Another view within the idea that multiple populations ended up contributing to the demography of Middle to Upper Paleolithic Levant is proposed by Brace who—based upon the morphology of the nasal aperture, scapula, and the degree of dental reduction—claims that the Qafzeh specimens were of African origins, while slight differences between these and the Skhul specimens implies that Skhul was more closely related to the Levantine Neandertals who originated in Europe (Brace 1995: 716-717). While Brace’s analysis is five years older than Holliday’s, it could make sense: the Skhul (modern human) and Tabun (Neandertal) cave sites are in very close proximity to each other, while Qafzeh is further northeast (see map in appendix). Given the period of co-existence between these hominids, a claim could be made that the reason we see a lack of “elevation and elongation of the nose that is so prominent in groups such as Skhul…and other long term residents of the north where warming and moistening of inspired air is essential for survival” (Brace 1995: 716) in the Qafzeh skulls is because Skhul individuals—being in such close proximity to the Neandertals of Tabun—were a product of interbreeding between an earlier population of modern humans out of Africa and the Neandertals of Tabun.

Qafzeh, however, is only about 20 miles away from both Tabun and Skhul caves, a short distance to travel. If we are assuming interbreeding, then based upon this distance, Qafzeh must also factor into the equation, making the physical
variation we see in Brace’s cold v. warm climate analysis not indicative of anything but a greater variability within the Mt. Carmel early modern populations. As it is, there is a fairly significant amount of variability within the human remains at the Skhul rockshelter. Of the ten remains found at Skhul—and the fifteen at Qafzeh—we see different ranges of modern and archaic features among the adult specimens:

“…it should be mentioned that at every pre-Upper Paleolithic site where remains of more than one individual are found there are undeniable indications that the range of variation was at least as great as that observable in modern primate populations…in fact, in the two instances where remains of 10 or more individuals have been found—Krapina [Croatia] and Mt. Carmel [Skhul and Qafzeh caves]—the range of variations is…great” (Brace 1962: 730).

In particular, while the Skhul crania all have a smaller bone thickness and a higher vault in general, there is a range of breadth of supraorbital ridges (an archaic feature) and a range in the extent—although not the existence—of mandibular prognathism (all had a chin, which is a modern feature) (Brace 1962: 731). Brace introduces the views of Thoma, who wrote in the 1950s, believed that the diversity found in the individuals could only be a result of hybridization between Neandertals and another “Sapiens” form (Thoma in Brace 1962: 732). Thoma’s claims are based on assumptions using evidence gleaned from analysis in the mid 1950s, so if they are to be given credence today, these analyses must be repeated using our more modern methods. That being said, the evidence put forth by Holliday concerning the different origins of Skhul and Qafzeh hominids could potentially fit nicely into Thoma’s theory, if it were not for the insignificant
distance between the sites and the implementation of the hypothesis of interbreeding.

Population variability, even variability over time, does not necessarily prove that interbreeding and subsequent hybridization occurred between two fairly different populations. Modern human populations of today are incredibly diverse, both on the exterior and in their skeletal structures based upon their region of origin. Inuits and individuals of the Andes show plasticity and larger tibia to femur ratios (shorter tibia) and high plasticity (broadening of the chest to increase lung surface area and capacity due to cold climate and high elevation) compared with Kung San bushmen, who show a narrower torso and smaller tibia to femur ratios (longer tibia) due to lower elevation and warm climate. Yet they are still considered to be members of the same species. Even in the modern human genome, we can see the potential for a large amount of variation for our species, which we can also see within the early modern populations of Skhul and Qafzeh. Variation insures the success of a species; it is ultimately a result of adaptation to the environments the population ended up settling in.

Even given this range of variability in the Skhul and Qafzeh remains, especially in comparison with the differences in the modern human populations of today—not to mention variability in other animal species—it would seem that variability is not enough to prove the existence of interbreeding and hybridization between early modern and Neandertal populations. If physical anthropologists and geneticists did, however, find that Neandertal characteristics—or at least a portion of them—fit into the variable range of early modern humans (as we
potentially see in Skhul and Qafzeh, with few archaic traits mixed in with modern
traits), would it be possible that Neandertals could be considered a part of the
species Homo sapiens? Most certainly. If so, hybridity would be a moot point:
you cannot have hybrids within the same species because interbreeding and the
production of offspring would be taken for granted as happening all the time. The
idea that variation within early modern populations could be so vast as to
incorporate Neandertal traits presents the potential to theoretically circle back to
McGowan and Keith’s initial analysis of the Skhul remains in relation to the
Neandertal remains of Tabun: they could represent spectrum extremes within a
population of the same hominid forms. This has not happened yet in the
academic world.

Lagar Velho, Portugal

“This is not just one Neandertal and one modern human making whoopee
in the bushes”
~Erik Trinkaus quoted in Time Magazine

Skhul and Qafzeh are not the only sites where the possibility of
interbreeding and hybridity has been offered as explanation for the mix of
Neandertal and modern human physical (as well as cultural) characteristics. In
fact, the most debated site and remains are found in Lagar Velho, Portugal. In
1998, archaeologists uncovered the bones of a “[An approximately] 4-year-old
child buried with a pierced shell and red ochre” in what appeared to be an
intentional burial at the foot of a cliff (Duarte et al. 1999: 7604). While the
fossilized skeletons of children this young are rare finds, this one is especially
important: what it presents to the archaeological and evolutionary world is highly
controversial and will continue to be debated by experts for years to come. The skeleton dates to 24,500 years BP and its “cranium, mandible, dentition, and postcrania present a mosaic of early modern human and Neandertal features…[indicating] admixtures between regional Neandertals and early modern humans dispersing into southern Iberia” (Duarte et al. 1999: 7604). These features “establish the complexities of the Late Pleistocene emergence of modern humans and refutes strict replacement models of modern human origins” because the obvious conclusion any individual would jump to, regardless of any lack of knowledge of evolutionary models, is that the child is in fact a hybrid (Duarte et al. 1999: 7604).

The burial itself is thought to reflect that of early modern humans in Iberia, considering the traces of red ochre found in the soil within the burial, the intentionally buried animal bones, the presence of a pierced shell that is reminiscent of Europe’s other early modern human sites (in England, the Czech Republic, and Italy), and the dates assigned to it by radiocarbon dating (Duarte et al. 1999: 7605). While these are all considered to have indicators of modern behavior, there is evidence elsewhere of Neandertals performing intentional burials with symbolic items (for example, the flower burial of the Shanidar Neandertals in Iraq) and using items of personal adornment, such as the perforated shell (with the Chatelperronian industry). However, no other explicit evidence of Neandertals occurs anywhere in Europe around 25,000 years BP and very little if any is seen around 28,000 years BP on the Iberian Peninsula (Duarte
et al. 1999: 7604). So then, where does this mosaic of traits come from in the Lagar Velho skeleton?

While the archaeological evidence points consistently towards assigning the Lagar Velho child to the group of modern humans, specific physical characteristics attributed to Neandertals prevents any definitive placement. Luckily, although the skull was smashed by a bulldozer, “the post-cranial skeleton was virtually complete as well as the child’s permanent and deciduous dentition [in its mandible]” (Zilhao 2001: 35). Duarte et al. took physical measurements of what bones they recovered from the site and then compared these measurements with the respective average measurements of European Neandertal juvenile remains, as well as those of the Skhul and Qafzeh juvenile early modern humans, Upper Paleolithic modern humans, and recent Europeans. In these comparisons, Duarte et al. discovered that the measurements for the processes of the temporal bone fit snugly between the ranges of both Neandertals and early modern humans (Duarte et al. 1999: 7606). The Lagar Velho child had a definite chin, which is considered to be a defining characteristic of modern human physiology, as well as a dentition that leans more towards that of modern humans. Nevertheless, the jaw was also extremely large and strong, a “snowplow” jaw, reflecting back on the strength of Neandertal mandibles (Bower 1999: 295). Trinkaus claims the existence of a “supercranial porosity”—not quite a supercranial fossa—on the cranium, although the original report by Duarte et al. does not reveal the existence of any such feature (Trinkaus 2007: 7369).
In the realm of postcranial morphology, the site preserved at least one of every long bone, allowing for growth projections to be calculated from their measurements, reflecting a “normal skeletal morphology”—normal here meaning modern (Duarte et al. 1999: 7606). The length of the pelvis is “relatively high for modern humans” but within the range for Neandertal pelvic length (Duarte et al. 1999: 7606). The most Neandertal-like characteristics, however, lie in the breadth of the trunk and in the ratio of femur to tibia. The ratio is higher in the Lagar Velho skeleton than is to be expected if it were a modern human, meaning that there is a greater difference in length between the femur and the tibia, indicating cold weather adaptation (Duarte et al. 1999: 7607). This is also indicated by a measurement and comparison of the thickness of the femoral head:

In comparison of femoral midshaft circumference to length, Lagar Velho 1 and the three Neandertal specimens [used in the comparison]…fall significantly above the recent human distribution…in the tibial comparison…La Ferrassie 6 [Neandertal] is well above the recent human distribution (reflecting the combination of hypertrophy and hyperarctic body proportions.) Lagar Velho 1 is beyond the Neandertal specimen, clearly separate from the recent humans. Therefore, either Lagar Velho 1 had exceptionally robust femora and tibiae, or more likely, it shared the hyperarctic trunk and lower limb proportions of the Neandertals (Duarte et al. 1999: 7607).

On the humerus of the arm, there are indications of heavy pectoral muscle attachments seen in Neandertals, but not usually in early modern humans, while the curvature (or lack thereof) of the radius is rarely seen in Neandertals, but almost always seen in modern humans (Duarte et al. 1999: 7607). Therefore, we see a veritable mosaic of Neandertal and modern human characteristics in the skeleton of the Lagar Velho child.
There are two immediate answers to this amalgamation of traits, posed by followers of opposing theories. Erik Trinkaus and Milford Wolpoff, two of the most vigorous proponents of the Multiregional Evolutionary Hypothesis, agree with Duarte et al. in that the skeleton is that of a Neandertal/modern human hybrid (Bower 1999: 295; also see Tattersall and Schwartz 1999: 7117): “This mosaic indicates admixture between Late Archaic [Neandertal] and early modern humans in Iberia, refuting hypotheses of complete replacement of Neandertals by early modern humans” (Duarte et al. 1999: 7609). The most prominent traits on the Lagar Velho skeleton that support this theory of hybridity are the modern chin, muscle attachments to indicate a Neandertal-like jaw strength, modern dentition, and the projected post-cranial measurements that indicate a body adapted for cold weather—like Neandertals.

The traits that imply cold weather adaptations are some of the most decisive factors in Duarte et al.’s analysis of the findings. In Neandertal children, based upon evidence gathered from another Neandertal infant discovered in Syria, the short length of the tibia compared to the femur becomes a distinctive characteristic early on in development (Zilhao 2001: 35), so this appearance cannot be attributed to infantile or juvenile development patterns in the Lagar Velho child. Oxygen isotope analysis—which helps determine the paleoclimate—for the stratigraphic level where they uncovered the remains indicates that the Iberian climate was significantly more moderate compared to that of interior Europe. Based on this finding, it is clear to them that the robusticity and cold weather adaptations of the child can “only indicate affinities
to the Neandertals” and were not reflections of adaptation to its immediate environment (Duarte et al. 1999: 7608). In addition to this, they compared the mosaic patterning of characteristics to those of known hybrids and find that they coincide in relative dominance of certain parental traits over others, re-enforcing their claim and their support from Trinkaus and Wolpoff (Duarte et al. 1999: 7608). It would appear that, according to Duarte et al. and Zilhao, Iberian Neandertals provided a genetic contribution to the Upper Paleolithic modern human Iberian populations before their disappearance around 28,000 years BP and, based on the discovery at Lagar Velho, the breeding within this population produced various admixtures of both modern human and Neandertal derived traits (Zilhao 2001; also see Duarte et al. 1999).

Opposing Trinkaus, Wolpoff, and the team that excavated the Lagar Velho child (which includes Duarte and Zilhao), is the Out of Africa model of evolution and its respective followers: Ian Tattersall, Jeffrey Schwartz, and Chris Stringer. All these claim to one extent or another that the physical morphology of the child could be attributed to being “unusually stocky” or even to having a “growth abnormality that created a bulky lower body,” but not to the existence of extensive interbreeding (Bower 1999: 295):

In summary, the analysis by Duarte et al. of the Lagar Velho child’s skeleton is a brave and imaginative interpretation, of which it is unlikely that a majority of paleoanthropologists will consider proven…the probability must thus remain that this is simply a chunky Gravettian child, a descendant of the modern invaders who had evicted the Neanderthals from Iberia several millennia earlier (Tattersall and Schwartz 1999: 7119).

The claim of Tattersall and Schwartz is based on a critique of long-term hybridization, which is the direct implication of Trinkaus, Zilhao, and Duarte et
al.’s published findings. Neandertals and modern humans co-inhabited the Iberian Peninsula for 1-2,000 years longer than they did in Europe. However, according to Tattersall and Schwartz, there have not been any archaeological discoveries to suggest that there was any cultural transference from modern humans to Neandertals or vice versa in Iberia such as we see in the Chatelperronian industry in France and in the Levantine Mousterian industry: “It is relevant [in Iberia] that while in certain other regions, Neandertals of the 36-33 kyr [thousand year] period appear to have acquired some of the Cro-Magnons’ behavioral attributes by acculturation, there is no evidence for this…abrupt cultural replacement appears to have been the rule” (Tattersall and Schwartz 1999: 7118).

This is an interesting phenomenon that would seem to support not only Tattersall and Schwartz’s reluctance to acknowledge Lagar Velho 1 as a potential hybrid, but it also supports their Out of Africa theory, which is a model of physical population replacement. It also suggests that during the period of coexistence between the two hominid groups in Iberia, they mutually avoided each other, which to me does not seem to be the most likely possible explanation for this dearth of acculturation in the archaeological record. It could just as easily be explained that evidence has not been uncovered yet. Regardless, the fact that there is currently no archaeology to suggest acculturation and, therefore, no hard morphological evidence of any interactions between the two groups—besides the Lagar Velho skeleton, whose meaning is currently under debate—produces more interpretive hurdles for archaeologists. Tattersall, Schwartz, and Stringer—who
labeled the child as a “chunky Gravettian child” (Bower 1999: 295; Tattersall and Schwartz 1999: 7119)—obviously use this lack of evidence to suggest that there were minimal interactions between the co-inhabitants of the Iberian peninsula and new populations of modern humans and that minimal interactions do not encompass interbreeding and the production of hybrids. Only recently has a German genetics laboratory, headed by Svante Paabo, analyzed genetic data to suggest otherwise.

In Bower’s short article in *Science News*, he quotes Chris Stringer as saying that even if further, more complete analysis confirms the hybrid status of Lagar Velho 1, he suspects that prehistoric interbreeding rarely occurred: “Numerous fossils of early modern humans show no signs of Neandertal contacts” (Bower 1999: 295). Zilhao defends his view, stating that “the transmission of cultural traits is a completely distinct process from the transmission of biological traits,” a claim that has been made in the past pertaining to discussions of the Chatelperronian industry and the process of acculturation (Zilhao 2001: 336; also see Clark and Lindy 1989):

In a scenario of short lived contemporaneity on a local scale, with extensive admixture resulting in the quick absorption of one group by another group, it would not be unexpected to see the culture of the side that predominated become the culture of the new biologically mixed populations…in such a scenario one could almost predict that the admixture would be more visible in the realm of biology than in the realm of culture (Zilhao 2001: 337).

While Tattersall and Schwartz are trying to negate the validity of the Lagar Velho findings based upon the lack of archaeological evidence for the admixture of cultural traits, Zilhao makes a valid point in the defense of his claims. Biological
and cultural mixture will be completely variable based upon multiple factors, including environment, time span of coexistence and population distribution of both new and old populations, to name a few. Limited archaeological visibility prevents any absolute statement concerning the definitive status of Lagar Velho 1, but it is risky to assume that lack of archaeological evidence signifies a non-existence of cultural and physical interaction. Absence of evidence does not indicate the evidence of absence, especially pertaining to archaeology. Educated speculation must therefore play a large part in archaeological analysis.

**Iberia: Sima de las Palomas**

More recent evidence published in 2008 brings to light extensive morphological variations in a group of Iberian Neandertals that could also suggest population contact with early modern humans who were beginning to travel into northern Iberia around 34,000 years BP. Neandertal specimens from the Sima de las Palomas site in Spain “exhibit a complex mix of Neandertal and more ‘modern’ features” in a rate of variation, which, in comparison with other Neandertal fossil samples from one area, is very unusual (Walker et al. 2008: 20635). This mix of traits cannot be explained by genetic drift due to isolation in Iberia because there are some distinctive modern human traits in the dentition, making it unlikely that they would have been able to drift to fixation within the Neandertal population without first being exposed to the traits. It could, potentially, be attributed to evolutionary adaptations to environmental stresses, but, again, these modern traits are part of the main characteristic set used to identify early modern humans and, according to Walker et al., most of the traits
are selectively neutral and would probably have not contributed to the evolutionary survival of the Neandertal population (Walker et al. 2008: 20635).

The most viable explanation for this mix of traits is that the modern human traits were introduced to the Neandertal population at Sima de las Palomas at some point and then were assimilated and fixed into the population, whether there was continued interbreeding with the modern humans or if there was isolation of the Neandertal population after a couple of instances of contact, resulting in fixation due to genetic drift (Walker et al. 2008: 20635). The Palomas remains consist of possibly six individuals and could be the “missing link” providing evidence to whether or not the Lagar Velho child is a Neandertal/modern human hybrid and, consequently, to the potentially large number of instances where coexisting modern human and Neandertal populations interbred on a one-time or fairly regular basis.

Romania: Peștera Muierii

A case similar to the Lagar Velho child, and to the Sima de las Palomas skeletons, appears in a Romanian cave, Peștera Muierii (Woman’s Cave), which had been excavated in 1952. The excavation revealed hominid remains, but they were poorly recorded, dated, and were, therefore, largely ignored by the physical anthropological community. Only recently—In 2006 when Suficaru, Dobos, and Trinkaus re-analyzed the skeletal remains—has the significance of these Romanian early Upper Paleolithic hominid remains been realized (Suficaru et al. 2006). The remains are those of three individuals who display a “mosaic of modern human and archaic/Neandertal features, relative to their potential Middle
Paleolithic ancestral populations, [which] indicates considerable Neandertal/modern human admixture” (Suficaru et al. 2006: 17196).

The remains date to 30,000 years ago and are associated with a distinctly Upper Paleolithic industry—Including blades, bladelets, burins, and bone points—placing them securely in the Upper Paleolithic timeframe and associating them with modern human cultural elements. Physically, however, the individuals reveal a mixture of distinctive Neandertal and modern traits: no supraorbital tori, high cranial vault and parietal arc—both modern human traits—and a distinctive occipital bun, slightly shoveled incisors, and a narrow glenoid fossa (the socket part of the ball and socket shoulder joint of the scapula)—all of which are distinctive Neandertal traits (Suficaru et al. 2006: 17200-17201). Suficaru et al. fit these discovered characteristics quite nicely within the Multiregional transitional view of modern origins: “These data reinforce the mosaic nature of these early modern Europeans and the complex dynamics of human reproductive patterns when modern humans dispersed westwards across Europe. Strict population replacement of Neandertals is no longer tenable” (Suficaru et al. 2006: 17201).

The time discrepancy regarding the appearance of modern humans and the extinction of Neandertals (originally approximately 10,000 years, but this may be continually extended as dating techniques improve), does not render the hybridization hypothesis null. On the contrary, it makes it even more interesting as we uncover evidence of this potential hybridization dated to after the purported disappearance of the Neandertals as well as distinctive physical traits within our
own modern populations of today. That we can see these distinctive traits multiple generations after the disappearance of the Neandertals could be explained and understood first and foremost in our minds as the genetic and physical remnants of few and/or regular interactions that resulted in the production of hybrid individuals. Hybridity is a biological event that is not restricted just to mules and coyotes, but extended to include coexisting hominid populations. As scientists and anthropologists, we are always looking for new discoveries to tantalize our minds and challenge our perceptions. But, just as with any other attempt to prove a scientific theory, more evidence is required than just the morphological sort. Genetics must be taken into consideration.

**Genetics: Mapping and Comparing Genomes**

“*Though there might have been a bit of Pleistocene hanky-ponky, it evidently did not add up to a biologically significant exchange of genes*” ~Ian Tattersall

Similar to what modern medicine must do in order to perform a paternity test, so must anthropologists work with geneticists in order to determine in greater detail how much of an impact Neandertal and early modern human interbreeding had upon the modern human gene pool of today. The first thing that must be considered when addressing a topic like this is that there are as many holes in our genetic history as there are in the archaeological record. What we can analyze and map of our own genome and the DNA extracted from Neandertals in recent years will provide a greater insight into the extent of the Neandertal contribution into our modern gene pool.

Analysis began on the modern human genome in 1990 with the Human Genome Project, which ended in 2003 with a completely mapped human genome.
consisting of over 3 billion base pairs that coded our DNA. This technology instigated the analysis of ancient human remains for comparison. Initially, mitochondrial DNA (mtDNA)—found in an extra-nuclear organelle within cells, making it easier to recover—was considered to be the key to understanding the relationship between modern humans and Neandertals: an individual only inherits mtDNA maternally. Unless there is a fertilization fluke, only the nucleus head of the sperm cell can enter the ovum, leaving the propulsion tail and mitochondrial sheath outside of the egg. Therefore, the only DNA from mitochondria present in an individual is that of the mother, who received her mtDNA from her mother, and so on. Ideally, this is the case with Neandertal mtDNA as well: pure, maternally inherited mtDNA with very little to no recombination while allowing for natural mutations.

MtDNA was initially traced through modern populations in order to determine migration patterns of their ancient ancestors, but as technology and understanding of the nature of mtDNA increased, scientists became able to extract mtDNA from fossil remains and compare them to the mtDNA sequences of modern humans. As of 2006 (DeSalle and Tattersall 2008: 135), eight Neandertal individuals had been sequenced for mtDNA and by 2009 (Larsen 2010: 304) about twelve Neandertal individuals had been sequenced. DeSalle and Tattersall compared the results of these “Homo neandertalensis” mtDNA sequences with sequences of early modern humans and the modern humans of today, concluding that

The modern or living human mtDNA sequences show that all Homo sapiens make up one large group that excludes all eight Homo
neandertalensis…these data suggest that Homo sapiens more than likely did no interbreed with Neandertals…even very rare interbreeding events would leave a Neandertal footprint in the current genomic pools in modern Homo sapiens. Because we don’t find this Neandertal genomic footprint, we can assume that Neandertals did not interbreed with Homo sapiens as our species replaced them (DeSalle and Tattersall 2008: 135-136).

In other ways than this, mtDNA sequencing has produced support for the Out of Africa replacement theory, including a date for the last common ancestor between modern humans and Neandertals in Africa approximately 500,000 years ago, corresponding to evidence from Atapuerca, Spain, of a potential new last common ancestor named H. antecessor (Wolpoff et al. 2004: 542; see also de Castro et al. 1997).

While these results make sense and have been proven multiple times with multiple mtDNA sequences and present a strong argument, we must take into consideration that mtDNA is not the only DNA present in an individual and, therefore, no definitive claims can be made as to what the genetics tells us until efforts have been made to analyze all aspects of the genome. Comparisons of Neandertal and modern human mtDNA are being made to bridge over tens of thousands of years, which could account for the differences in the mtDNA sequences between the two groups (Larsen 2010: 304) based upon the natural rate of mtDNA decomposition and mutation. The DNA that presents a more complete picture of a species resides in the nucleus of a cell and is the product of genetic recombination from both parents at fertilization, unlike mtDNA which is solely maternal:

The only part of the [Neandertal] genome that has been examined from multiple Neandertals, the mitochondrial DNA (mtDNA) genome, consistently falls outside the variation found in present day humans and
thus provides no evidence for interbreeding. However, this observation does not preclude some amount of interbreeding or the possibility that Neandertals contributed other parts of their genomes to present day humans. In contrast, the nuclear genome is composed of tens of thousands of recombining, and hence independently evolving, DNA segments that provide an opportunity to obtain a clearer picture of the relationship between Neandertals and present-day humans (Green et al. 2010: 710).

It is from this nuclear DNA material that scientists in the past ten years have mapped the human (*Homo sapiens sapiens*) genome and in the past couple years, overseen by Svante Paabo of the Max Plank Institute of Genetics, have successfully mapped a significant portion of the Neandertal genome (Green et al. 2010).

Nuclear DNA is more difficult to retrieve than mtDNA is because it requires an intact cell nucleus. Even then, when it is found, the nuclear DNA is very fragmented due to numerous processes of natural decomposition as well as to microbial contamination (Green 2010: 710). Nuclear DNA was extracted from three Neandertal specimen bones, approximately 40,000 years old from Vindija Cave in Croatia, using a dentist’s drill in a clean-room facility to minimize contamination by modern human DNA from the scientists. About 400 mg of bone powder was ground and from that DNA was isolated from other materials. Because of the age of the bones, a majority of the DNA (95-99%) “was derived from non-primate organisms, which are presumably derived from microbes that colonized the bone after the death of the Neandertals” (Green et al. 2010: 711). Even so, enough Neandertal DNA was identified, isolated, and amplified using enzymes that would degrade bacterial DNA and enzymes that had the ability to reproduce the Neandertal DNA strands (Green et al. 2010: 711). The amount of
pure Neandertal DNA recovered was enough for Green et al. to sequence 60% of the Neandertal genome.

Green et al. discovered that, in a quick comparison of the Vindija Neandertal genome sequence to small DNA samples of three other Neandertal specimens from all over Europe during different time periods, all six of these Neandertals did not show much DNA variation among themselves, suggesting to the paleoanthropologists that “Neandertals from across a greater part of their range in western Eurasia are equally related to present-day humans” with regards to divergence dates, which had been pushed back to 825,000 years ago (Green et al. 2010: 713). This also suggests that while there was a natural amount of genetic variation within the Neandertal population of western Eurasia, there was also a significant amount of genetic continuity, which in turn implies that Neandertal populations were small and experienced genetic drift and an eventual reduction of genetic variation within the population (Larsen 2010: 306) while generating greater genetic diversity across these small populations, providing large scale variation within the species. This not only gives us insight into the demographic characteristics of ancient Neandertal populations, but such information also gives us clues as to the nature of our own ancient modern human populations, especially in comparison to Neandertal DNA sequences.

The comparison of five present day modern human genomes with Green et al.’s newly sequenced partial Neandertal genome produced unexpected results. Genomes were sequenced for modern individuals from West Africa, South Africa, Papua New Guinea, China, and France and subsequently analyzed in relation to
the Neandertal genome. In this analysis, based upon the lower genetic variation between the Vindija cave Neandertals and other Neandertals from earlier and elsewhere in Europe, the Croatian Neandertal genome was considered to represent all Neandertal populations. The results showed that “the Neandertal is closer to the Non-African [Papua New Guinean, Chinese, and French]…thus analysis of present-day humans consistently show that Neandertals share significantly more derived alleles with non-Africans than with Africans” (Green et al. 2010: 718).

The easiest and most practical explanation for this result is that there was gene flow between the native Neandertal populations and the newly emerged early modern human populations from Africa, but no gene flow between Neandertals and populations that remained in Africa. To an extent, this emphasizes one of the points of the Out of Africa theory: that species originated in Africa and did not return, but instead spread throughout the Old World.

This gene flow proves that Neandertals did, in fact, interbreed with their coexistent early modern human populations and that Neandertals did contribute to the gene pool of modern humans. Modern humans, however, did not contribute to the Neandertal gene pool (Green et al. 2010: 718), which is a conclusion based solely upon the fact that there have not been Neandertal specimens discovered within this context to analyze. Neandertals could and did, however, provide the early and present day modern human (non-African) genome with their own genes: “Assuming that gene flow occurred between 50,000 and 80,000 years ago, this method estimates \( f \) [the proportion of Neandertal ancestry of non-Africans] to be between 1 and 4%” (Green et al. 2010: 721). 1% to 4% is a very small portion of
our entire genome, but the implications of this result are significant nonetheless. Neandertals and modern humans did interact to the extent that they interbred with each other (and their hybrid offspring bred with any and all parties) with a frequency that ensured that we see a small percent of derived Neandertal genes in non-African genomes.

So how does this new genetic evidence reflect upon the previously accepted evolutionary models of modern human origins? It provides support for the Out of Africa model in that, compared with the mtDNA tests performed earlier, it almost certainly places the origin of modern humans in Africa. The claim based upon mtDNA maternal inheritance that all modern humans can trace their mtDNA ancestry back to a singular female individual “Eve” in Africa has since been changed to a more reasonable explanation. Due to the maternal nature of mtDNA inheritance, mtDNA lineages die out if a female does not bear any female children and that, ideally, a mother will give identical mtDNA sequences to all of her offspring, both male and female, it would make sense to say that there is no definitive way to prove that all modern humans are descendent from one woman. Instead, it might be said that all modern humans can hypothetically trace their lineage to one population within Africa at the time of genetic divergence between ourselves and our archaic counterparts (Seager 1990: 148). This theoretical claim has since been refuted by the nuclear DNA genetic evidence, which supports the idea of interbreeding between populations while still maintaining an African origin for modern humans.
How, then, can we see nuclear DNA evidence for interbreeding, which contradicts what we see in an mtDNA analysis? The simplest yet most concise explanation has to do with the nature of the two different types of DNA themselves. Mitochondrial DNA is the easiest ancient DNA to use in analysis because it is “present in several hundred copies per cell, in contrast to the single-copy nuclear genome” since it is found in every mitochondria organelle in a cell instead of only in the nucleus (Rourke et al. 2000: 217). This DNA, however, does not recombine: the paternal mtDNA on the sperm is lost upon fertilization, leaving only the maternal mtDNA within the zygote. This lack of recombination theoretically allows scientists to be able to track a maternal lineage as far back as possible. Because there is no recombination, mtDNA also makes it seem that there was no interbreeding between early modern humans and Neandertals in our ancient past. We cannot see a contribution of Neandertal mtDNA in our own mtDNA. This could be one of many reasons, the first and most obvious one being that there was no interbreeding between our early modern ancestors and Neandertals. Our nuclear DNA genome, however, tells us otherwise, so we must look to other explanations.

Scientists have a number of Neandertal physical remains from which to extract mtDNA, but these specimens are only a fraction of the actual total Neandertal population throughout their existence in Western Eurasia. They are even only a small part of the total population of the later Neandertals that coexisted with early modern humans. As a result of this small sample size, due in part to the archaeological visibility and in part to the condition of the remains in
relation to whether or not a large enough amount of mtDNA can be isolated, there is enough room in the mtDNA analysis for new fossil discoveries to contribute a genetic curveball. These specimens have yet to be uncovered, but based upon the comparison of estimated population sizes and the number of specimens that have currently contributed intact mtDNA to research, there is a significant chance that they exist.

Another possible explanation for the mtDNA analysis outcome concerns the maternal inheritance nature of the mtDNA. As mentioned before, the mtDNA of an individual is inherited from the mother, so it should ideally be identical to all other individuals who are a part of the same maternal lineage. In relation to interbreeding between early modern populations and Neandertal populations, this would mean that any hybrid infants born as a result of sexual interaction between an early modern female and a Neandertal male would have the same mtDNA markers as the early modern mother. In contrast, any hybrid offspring of a Neandertal female and an early modern male would bear Neandertal mtDNA markers. This tells us nothing about the interbreeding between the populations if scientists are analyzing only the mtDNA sequences. Hybrid offspring would ideally reflect their maternal parent and, based upon the dependent nature of the relationship of infants to their mothers, one might assume that infants will remain with and be raised by their mothers and her respective population. Therefore, if only mtDNA is considered without the context of physical appearance, cultural artifacts, and nuclear DNA, we would not see any evidence for interbreeding at all.
Of course, mtDNA behavior is not always ideal. It would be easier for scientists and anthropologists if it were: analysis would be consistent and assumptions would not cause conclusions to implode whenever new evidence is uncovered. All DNA has the potential to mutate and accidentally recombine for no specific reason. Mitochondrial DNA mutations occur fairly frequently: “Nucleic acids gradually degrade over time through processes such as hydrolysis and oxidation…Oxidation is the process by which water-derived hydroxyl or superoxide radicals modify bases or distort the helix. Because mitochondria are the center of [oxygen] metabolism, oxidation primarily affects the mitochondrial rather than the nuclear genome” (Rourke et al. 2000: 218). Therefore, the assumption of a flawless mtDNA lineage reconstruction becomes null and void. While these individual mutations would not necessarily be large or significant enough to completely throw off an entire genomic sequence, the combination of all mutations could skew any results, especially because mutations cannot always be predicted.

In contrast to mtDNA inheritance, the male’s sperm head enters the egg upon fertilization and deposits the nuclear DNA within it. This DNA then recombines with the female’s nuclear DNA inside the egg, creating a new and entirely unique genome due to the extremely large amount of genetic variability created by the recombination of the genomes of two unique parental individuals. While this nuclear DNA behavior makes it difficult for geneticists to trace lineages back past a few generations (unlike mtDNA), it determines just how much variation modern humans have within the species. It also allows for
geneticists and anthropologists to make comparisons among the derived genomes of Neandertals and modern humans within the ranges of genetic variation due to recombination and potential errors in recombination (which result in mutations). This presents a much more accurate, if not succinct, view of the enormously complex relationship between individuals within our present day species as well as between modern humans, our early modern ancestors, and our archaic ancestors the Neandertals: enough interbreeding occurred between early modern humans and Neandertals to leave a mark, however slight it may be, upon our modern genome.

Another evolutionary model has resurfaced in the light of these new mtDNA and nuclear DNA discoveries: the Assimilation model, proposed by Fred Smith in 1992 as a means of trying to find a middle ground between the two theoretical extremes of the Multiregional and Out of Africa hypotheses: “The Assimilation model arose through integration of the emerging evidence for an important African role in modern human origins with multiregional views. It was developed by Smith, who was originally a multiregionalist” (Stringer 2002: 564). The model proposes that modern humans did originate in Africa, but that instead of either specifically physically or evolutionarily replacing previous hominid populations throughout the old world upon an exodus from Africa, it emphasizes the significance of “gene flow, admixture, changing selection pressures, and resulting directional morphological change” (Stringer 2002: 564). Specifically, Smith proposed African origins of modern humans and interbreeding with local populations of their predecessors throughout the different regions of early modern
migrations, resulting in a genetic contribution of about 10% within living populations (Gibbons 2011: 393): much more reasonable based upon the 1% to 4% contribution determined by Green et al. when compared to the 0% contribution proposed by the Out of Africa model and the much higher percentage proposed by the Multiregional model. I predict that ultimately, counting on continued archaeological discoveries and successful genetic analyses, the Assimilation model will become the theoretical norm as a way to mediate between two legitimate theories that are individually proven by different pieces of evidence and will most likely never be completely refuted.

**Conclusion**

Neandertals and early modern humans interacted on multiple levels. The more superficial interactions are directly visible within the archaeological record, such as the complete cultural transfer of the Levantine Mousterian culture from Neandertals to the newly arrived early modern populations of Skhul and Qafzeh. Most of the interactions, however, are indirectly reflected in the archaeological record, such as the transfer of cultural ideas represented in shifts of material culture, and can be interpreted in many different ways, a prime example being the development of the Neandertal associated Chatelperronian culture around the same time as the appearance of the Aurignacian culture in Europe: Based on paleoclimate analysis, an assumption of advanced cognition, and the fact that we only see an increase in presence instead of a sudden appearance of traditional “Upper Paleolithic” type tools, a claim can be made that Neandertals and modern humans developed their respective lithic industries simultaneously in order to
adapt to the rapidly changing climate. On the other hand, if we are assuming the advanced cognition of Neandertals, why not interpret the sudden appearance of bone implements and items of personal adornment in the Chatelperronian industry as cultural transfer from the Aurignacian? This is where the abstract nature of behavior inhibits archaeological interpretation. We can never truly know what transpired between Neandertals and early modern humans, but we can certainly speculate based upon the material cultural evidence discovered.

Most importantly, this indirect nature of the archaeological record is reflected in the question of whether or not Neandertals interbred with their modern counterparts. Recently and most likely in the near future, geneticists and anthropologists found and will continue to find hard skeletal and genetic evidence to prove that, at least to a small extent, Neandertals and modern humans interacted on a sexual level, resulting in the production of offspring, leaving a Neandertal genetic mark in the genome of present day modern, non-African populations. This genetic proof, supported by the morphological mosaic features of specimens from Portugal, Spain, and Romania, provides almost irrefutable evidence of Neandertal/early modern human interbreeding. It is left up to future genetic and physical anthropological research to determine details such as the number of instances and whether or not the interbreeding was short term within one generation or long term, spanning multiple generations of both populations. And, now that scientists and archaeologists have the genetic, and potentially physical, proof that interbreeding did occur, they can apply the knowledge as a context to the interpretation of other archaeological evidence pertaining to other
interactions of Neandertals and modern humans, just as I used the evidence of cultural interactions to infer the existence of interbreeding. These analyses become circular in that the analysis of one contributes to the analysis of the other and vice versa.

Much has yet to be done by way of research to expand upon the conclusion that at some point during the course of Neandertal and early modern human coexistence, they had interactions to the point of interbreeding. For example, the biggest step would be to synthesize the remaining 40% of the Neandertal genome in order to make a full comparison with the modern human genome. Perhaps in doing so, geneticists will discover more similarities (or more differences) between the two. Ideally, archaeologists in the future would discover more remains that reflect a mixed morphology caused by interbreeding, preferably in a population of Neandertals, since most of the skeletal evidence anthropologists have now are of mosaic individuals found within an early modern human context. This would verify a non-unilineal genetic exchange, which would then also verify non-unilineal transfers of ideas and material culture between populations. A large step has been taken already as a result of the nuclear DNA discoveries in comparing the Neandertal and modern human genomes: the tentative affirmation of, until now, the previously fairly obscure Assimilation theory of evolution that had been discounted by both Multiregionalists and Out of Africa followers alike, but which proposes almost exactly what we are seeing in mtDNA and nuclear DNA analyses. Human origins are indisputably in Africa, but interbreeding did occur between Hss and Neandertals upon the African
exodus. There could not be a Multiregional model without an Out of Africa
model and, with the re-appearance of the Assimilation model as a middle ground,
both of them have, to an extent, been proven correct.

Trinkaus calls it “whoopee”. Tattersall calls it “hanky panky”. Both of
these terms make the mating act sound random and meaningless, relating it to
today’s culture surrounding the idea of sex in the Western world. The projection
of modern views and cultures of sex upon the idea of interbreeding between
ancient populations is dangerous; it makes the significance of interbreeding
between two populations of different cultures and physiognomies seem
insignificant, which it is anything but. With the discovery of the Lagar Velho
child paired with the nuclear genomic evidence for Neandertal genes in the
modern gene pool, archaeologists can now re-asses other findings that might
reveal more about modern humans’ relationship with Neandertals than originally
thought. Archaeologists’ eyes will now be opened wider for further physical and
cultural evidence that will aid in constructing a more detailed picture of this
relationship. Why? Because every person has a desire and the right to know
where they came from; to know who their ancestors were. We are on the right
track to answer these questions, but many more years of research and much more
evidence is required if we want to uncover the full picture. The Lagar Velho child
and the partially sequenced Neandertal genome are crucial steps, but they are only
the tip of the iceberg and, based upon problems related to archaeological
visibility, we might not be able to dig much further down. Our imaginations will
have to carry us.
## Appendix A: Tables

### Table 1: Theory Proponents

<table>
<thead>
<tr>
<th>Name</th>
<th>Discoveries/Theories</th>
<th>Evolutionary model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erik Trinkaus</td>
<td>Emphasis on biological implications of behavioral shifts due to Neandertal/MHS interactions.</td>
<td>Multiregional</td>
</tr>
<tr>
<td>Milford Wolpoff</td>
<td>Developed the theory of Multiregional evolution by opposing the idea of speciation and punctuated evolution.</td>
<td>Multiregional</td>
</tr>
<tr>
<td>C. Loring Brace</td>
<td>Work reflects a proposed need to integrate ideas of Darwinian evolution into Paleoanthropology, especially regarding the “Neandertal Problem”</td>
<td>Multiregional</td>
</tr>
<tr>
<td>Joao Zilhao</td>
<td>Most famous for analysis of potential in situ development of Chatelperronian industry and the discovery of the Lagar Velho “hybrid.”</td>
<td>Multiregional</td>
</tr>
<tr>
<td>Ian Tattersall</td>
<td>One of the most famous proponents of the Out of Africa theory through direct analysis of hominid fossil records, with an additional focus on hominid cognition.</td>
<td>Out of Africa</td>
</tr>
<tr>
<td>Chris Stringer</td>
<td>One of the leading Out of Africa proponents through research in fossil and genetic evidence.</td>
<td>Out of Africa</td>
</tr>
<tr>
<td>Paul Mellars</td>
<td>Focus on Neandertal and early modern human evolution through behavioral implications based on archaeological evidence.</td>
<td>Out of Africa</td>
</tr>
<tr>
<td>Richard G. Klein</td>
<td>Looks at behavioral modernity and its implications based upon archaeological and physical evidence. Claims that Neandertal cognition was very different than early modern <em>H. sapiens</em> cognition.</td>
<td>Out of Africa</td>
</tr>
<tr>
<td>Jeffrey Schwartz</td>
<td>Focuses on skeletal morphology and more recently on DNA analysis to determine relationships between humans and primate relatives.</td>
<td>Out of Africa</td>
</tr>
</tbody>
</table>
### Table 2: Major Paleolithic Event Dates

<table>
<thead>
<tr>
<th>Event:</th>
<th>Date range:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middle Paleolithic (Europe and the Levant)</td>
<td>Approximately 250,000 to 30,000 years BP (before present) (Bar-Yosef 2002: 364)</td>
</tr>
<tr>
<td>Upper Paleolithic (Europe and the Levant)</td>
<td>Approximately 40,000 to 10,000 years BP (Bar-Yosef 2002: 364)</td>
</tr>
<tr>
<td>Middle Pleistocene (glacial epoch)</td>
<td>Approx 781,000 to 126,000 years BP (Gibbard et al. 2005)</td>
</tr>
<tr>
<td>Upper/Late Pleistocene (glacial epoch)</td>
<td>Approx 126,000 to 10,000 years BP (Gibbard et al. 2005)</td>
</tr>
<tr>
<td>Eemian interglacial period</td>
<td>Approx 130,000 to 114,000 years BP (Gibbard et al. 2005)</td>
</tr>
<tr>
<td>Last Glacial Maximum (Wurm)</td>
<td>Approx 26,500 to 19,000 years BP (Gibbard et al. 2005)</td>
</tr>
</tbody>
</table>

### Table 3: Hominid dates

<table>
<thead>
<tr>
<th>Event</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Recent Common Ancestor: <em>H. antecessor</em> in Atapuerca, Spain</td>
<td>&gt;780,000 years BP (Falgueres et al. 1999)</td>
</tr>
<tr>
<td>Old Recent Common Ancestor: <em>H. heidelbergensis</em></td>
<td>Approx 600,000 years BP (Stringer 2002: 567)</td>
</tr>
<tr>
<td>Neandertals in Europe and the Levant</td>
<td>Approx 200,000 to 29,000 years BP (vague) (Stringer and Gamble in Tattersall and Schwartz 1999: 7117).</td>
</tr>
<tr>
<td>Early modern human emergence in Europe</td>
<td>Approx 36,000 to 38,000 years BP (Trinkaus 1986: 197)(Bar-Yosef 2002: 367)</td>
</tr>
<tr>
<td>Early modern human emergence in Levant</td>
<td>Between 81,000 and 101,000 years BP (see Skhul and Qafzeh dates) (Bar-Yosef 1998)</td>
</tr>
</tbody>
</table>

### Table 4: Lithic Industries

<table>
<thead>
<tr>
<th>Industry</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mousterian industry</td>
<td>Approx 200,000 to 30,000 years BP (Klein and Edgar 2002: 187)</td>
</tr>
<tr>
<td>Levantine Mousterian</td>
<td>250,000 to 40,000 years BP (Bisson et al. 2006: 75).</td>
</tr>
<tr>
<td>Szletian</td>
<td>Approx 38,000 to 28,000 years BP (Brose and Wolpoff 1971: 1163)</td>
</tr>
<tr>
<td>Perigordian industry</td>
<td>Approx 35,000 to 20,000 years BP (Mellars et al. 2005: 51)</td>
</tr>
<tr>
<td>Perigordian I: Chatelperronian industry</td>
<td>Between 35,000 and 29,000 years BP (Mellars et al. 2005: 51)</td>
</tr>
<tr>
<td>Perigordian II: Gravettian industry</td>
<td>Between 29,000 and 20,000 years BP (Mellars et al. 2005: 51)</td>
</tr>
<tr>
<td>Aurignacian industry</td>
<td>Approx 43,000 to 26,000 years BP (Mellars et al. 2005: 51)</td>
</tr>
<tr>
<td>Site</td>
<td>Hominid type</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>Skhul average dates (Israel)</td>
<td>Early modern Human</td>
</tr>
<tr>
<td>Lagar Velho child</td>
<td>Debated Hybrid</td>
</tr>
<tr>
<td>St. Cesaire 1 dates</td>
<td>Neandertal</td>
</tr>
<tr>
<td>Tabun 1 (Israel) female remains</td>
<td>Neandertal</td>
</tr>
<tr>
<td>Feldhofer 1 (Neander Valley Germany)</td>
<td>Neandertal Type fossil</td>
</tr>
<tr>
<td>Shanidar fossils (4 individuals) Iraq</td>
<td>Neandertal</td>
</tr>
<tr>
<td>La Ferrassie 1 (France)</td>
<td>Neandertal</td>
</tr>
</tbody>
</table>
Appendix B: Maps

1. This map shows some of the major Paleolithic sites in the Levant. The inset includes three of the sites described in my paper: Tabun cave, Skhul cave, and Qafzeh. (Courtesy of: http://www.athenapub.com/8shea1.htm)

2. This map shows many of the Middle and Upper Paleolithic transitional sites in Europe, especially La Chapelle, La Ferrassie, Le Moustier, Saint-Cesaire, and Arcy-sur-Cure in France; Atapuerca in Spain; and Lagar Velho in Portugal. (Courtesy of: http://www.athenapub.com/8zilhao1.htm)
Appendix C: Lithics

1. Power grip (L) versus precision grip (R), used primarily by Neandertals and modern humans respectively, although both forms could use both, one was more popular than the other. Courtesy of: http://www.britannica.com/bps/media-view/73005/1/0/0

2. “Stages of production of a ‘classic’ Levallois core, according to Bordes.” Middle Paleolithic lithic production technique. (Courtesy of: http://pech.museum.upenn.edu/what.php?sub=Middle+Paleolithic+Stone+Tool+Industries)
3. Traditional Mousterian lithic tool types: Convex side scraper, Levallois Point, Mousterian point, Canted Scraper, Transversal scraper, Convergent scraper, Double scraper, Levallois flake (Courtesy of: http://humanpast.net/tools/tools50k.htm).

4. This figure shows Aurignacian tools found interstratified within the Chatelperronian site Grotto des Fetes, representing (debatably) an “isolated intrusion into otherwise in situ Chatelperronian deposits” (Zilhao et al. 2006: 12643).
5. Traditional Aurignacian tools that define the Upper Paleolithic. Note that artifact 10 is made of bone, not of flint. (Courtesy of: http://arrowheadology.com/forums/primitive-technology-cultures/3038-tools-debitage.html)

6. Items of personal ornamentation found at Qincay, a Chatelperronian industry site. These beads and others like them instigated the debate about the Chatelperronian culture and, consequently, the debate about whether Neandertals had the capacity for modern behavior. (Courtesy of: http://www.donsmaps.com/nea)
Appendix D: Skeletal Remains

1. Feldhofer 1:
   Discovered in Germany’s Neander Valley in 1856. This is still considered the type fossil for Neandertals. Notice the low cranial vault and the prominent brow ridges. (Courtesy of: https://www.msu.edu/~heslipst/contents/ANP440/images/Neanderthal_1_langle.jpg).

2. Neandertal Skull from Tabun Cave, Israel
   (Courtesy of: http://www.nhm.ac.uk/research-curation/departments/palaeontology-new/research/anthropology/index.html).

3. Reconstruction of the Neandertalcranial fragments found at St. Cesaire, a Chatelperronian industry site in France. This discovery ultimately associated Neandertals with the Chatelperronian industry. (Courtesy of: https://www.msu.edu/~heslipst/contents/ANP440/neanderthalensis.htm).
4. Skhul 5 skull from Israel: an early modern human skull from Israel with distinctly modern features, such as a high cranial vault and a chin. (Courtesy of: http://s1.zetaboards.com/anthroscape/topic/2514553/1/).

5. Qafzeh 9 skull from Israel: another early modern human skull dated contemporaneously with remains from Skhul. Notice the high cranial vault, the chin, and the lack of brow ridges. Also notice the retention of slight facial prognathism, indicating that the skull is either not fully modern or that there is a significant amount of variability in early modern human populations of the levan…or both. (Courtesy of: https://www.msu.edu/~heslipst/contents/ANP440/images/Qafzeh_9.jpg).

7. This is a good comparison of Neandertal (Shanidar 1, La Ferrassie 1) and early modern *H. sapiens* (Qafzeh 9 and Predmosti 3) skulls, showing side by side the major morphological differences. (Courtesy of: http://mathildasanthropologyblog.wordpress.com/2008/08/14/neanderthal-skulls/).

4. The Lagar Velho 4 year old hominid skeleton from Portugal that shows distinctive features of both early modern humans and Neandertals. (Courtesy of: http://www.bristol.ac.uk/news/2010/6777.html).
Appendix E: Artistic Depictions


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Trinkaus, E.

Trinkaus, E.

Walker, P.L.,


