Existing Theories Regarding Neanderthals: Extinction, Social Structures, Intelligence, Social Rituals, Neanderthal and AMH Interface, Behaviors, and Personalities

Bernadine Gangemi
SUNY New Paltz

Theories of Neanderthal Extinction

Theories of Neanderthal extinction generally fall into two schools. One set of theories maintains that Neanderthal civilization collapsed when Neanderthals failed to adjust to changing environmental conditions. These theories rest on paleontological and archaeological data. The paleontological data focuses on how Neanderthal decline correlates with the changing climate. The archaeological data focus on the lack of innovation in Neanderthal civilization, suggesting that Neanderthals adjusted poorly to changing environments.

A case study of Neanderthal and AMH populations in Southern Iberia related human industries (measured by archaeological record) with climate (estimated by Western Mediterranean Sea paleontological data). The study focused on 250kya to 25kya, noting that Neanderthals disappeared around 25kya. Even though weather patterns varied over this time period, the most dramatic change toward colder climate occurred around 25kya. Times of cold or variable climate showed relative flourishing of AMH industry and relative stagnation of Neanderthal industry. The authors argue that Neanderthals became extinct because they lacked the innovation to adapt to particularly harsh weather (Jiménez-Espejo et al., 2007).

Other researchers go so far as to cite that the Neanderthals' lack of innovation in clothing undermined them when weather changed rapidly. Wind-chill patterns fluctuated quickly, so the humans who survived would have needed to have had a foundation for sartorial innovation already; the weather changes were simply too quick for a group to build these foundations when the weather became harsh. AMH had a natural biological vulnerability to cold, so they needed to adjust to even mild changes in temperature. Neanderthals, however, had a body habitus that made them resilient to moderate changes in cold weather. When weather became very cold, however, the Neanderthals lacked the ability to adjust in time (Gilligan, 2007).

Of note, the pattern of Neanderthal extinction suggests that inland communities became extinct before coastal ones did. Coastal climates are more temperate than inland climates because of their proximity to the ocean. The relationship between better Neanderthal survival and milder climates in these settings supports other theorists who cite fluctuating climate as a major precipitator of Neanderthal extinction. Coastal communities, however, also have more ecological resources and permit better connectivity between communities. These factors may also explain why Neanderthals survived longer in coastal regions (Finlayson, 2008).

A major criticism to these theories is that Neanderthals successfully navigated their environment (and its changes) for more than 200,000 years (Mellars, 2004). That one episode of climate change would lead rapidly to the decline of Neanderthals everywhere seems unlikely. A better explanation may rely on the failure of Neanderthals to compete for resources against AMH. The second set of theories of Neanderthal extinction rests on the arrival of modern humans. Modern humans lacked the physical prowess of Neanderthals, but they were innovative and over time, created complex trade systems among groups. In a sense, the individual modern human compensated for his or her defects by forming more adaptive relationships with other modern humans. These theories rest on the assumption that modern humans and Neanderthals consumed the same resources, and therefore competed with each other to occupy a single niche (Coolidge & Wynn, 2005; Horan, Bulte, & Shogren, 2005).

Modern humans and Neanderthals diverged in telling ways in the upper Paleolithic (Aurignacian) era. Archaeological records show that about 35,000 to 40,000 years ago, modern humans began creating complex bone and ivory tools, conveying seashells large distances (indicating trade), and creating sophisticated art. During the same period, Neanderthal culture remained unchanged. The increase in cultural complexity indicates that modern humans also

became more sophisticated cognitively, particularly in symbolic reasoning and language (Mellars, 2004) Indeed, what can be gleaned about Neanderthal intelligence from the archaeological record is unimpressive. Neanderthals had few notable rituals and virtually no art (Gamble, 2011).

AMH also differed from Neanderthals in their superior ability to form relationships among communities. Compared to Neanderthals, AMH had vibrant trade among groups. This trade helped AMH outperform Neanderthals, who tended to live in isolated clusters. As such, even though AMH entered an occupied niche, they conquered it. Theorists suggest that the AMH's predilection for forming communities may be secondary to an underlying biological difference with Neanderthals (Horan et al., 2005). One theory holds that Neanderthals became extinct due to larger eye size. The larger eyes enabled them to see better in the gloom of the northern hemisphere. While this helped them see better, it may have meant that they did not have the brainpower to spare for forming complex social lives, and during the ice age having improved social interactions would have helped them survive. There are no Neanderthal brains to examine, but primates with larger eyes tend to have larger visual systems in their brains suggesting that Neanderthals did as well, leaving them with less grey matter in their frontal lobes—a brain area that is vital for social interaction.

A minority of theorists have speculated nonclimate and noncompetition causes of Neanderthal extinction. Underdown, for example, suggested that New Guineans and Neanderthals both had cannibalistic rituals. The New Guineans were ravaged by the kuru disease, a spongiform encephalopathy that spread from eating the brains of other humans or coming in contact with contaminated tools. Mathematical modeling showed that even with minimal connection between groups of Neanderthals, a similarly deadly disease could have

spread throughout the entire population very quickly (Underdown, 2008)

Some critics suggest that the archaeological record is too uncertain to say definitively that AMH and Neanderthals ever had much overlap. Radioisotope dating has inherent uncertainties that make the exact dating of Neanderthal or AMH demography impossible. These critics suggest that, given the large statistical uncertainty, we are "blind in a cloud of data." Theories that suggest that AMH competition drove Neanderthals extinct predicate themselves on Neanderthals and AMH co-occurring. Any uncertainty in their co-occurrence leads to uncertainty in the competition theories (Ettitt & Ike, 2001).

The South Caucasus is an interesting case study in AMH-Neanderthal relations. Theorists originally speculated that AMH failed to move into this region earlier because of Neanderthal habitation. AMH went to surrounding areas, but not this region. This was notable because it indicated that, in this region, Neanderthals posed a significant barrier to AMH migration. As such, the region may offer insight into what circumstances played to the strengths of Neanderthals. Pinhasi (2012) argued that whatever the reason AMH had for not settling the south Caucasus region sooner, the reason was not Neanderthal habitation; Neanderthals were likely absent from this region for some time before AMH arrived. Pinhasi goes further, stating that archaeological evidence casts into doubt any work that suggests AMH-Neanderthal inter-stratifications. With no interaction between AMH and Neanderthals, there would not have been any competition between the two species and therefore, one could not cause the extinction of the other (Pinhasi et al., 2012).

Theories of Social Structures of Neanderthals

It is hard to determine or discuss the social structures and society of a particular population after they have been extinct for many millennia. Using many experiments, archaeological evidence, and other research, anthropologists and other specialists have attempted to show what it would have been like to live in a Neanderthal society.

Currently, the closest living creatures who exhibit traits similar to Neanderthals and even modern day humans, is primates (Aldenderfer, 2001). Primates include chimpanzees, gorillas, and other monkeys. The traits of family life in primates is very similar, but not exact. Unlike humans, primates do not prefer pair-bonding. Pair-bonding refers to forming couples (i.e., husband and wife). Neanderthals and anatomically modern humans (AMH) exhibited food sharing behaviors among families and interpersonal violence. This was society-wide and it is a combination that is seen in primates today. Aldenderfer states that archaeological evidence from the Neanderthal society allows researchers to piece together the origins of families (2001). It is believed that there were family structures in Neanderthal societies. There was a mother, father, and children (if the couple had any). There was pair-bonding with one male and one female bonding together (Aldenderfer, 2001).

Neanderthals are thought to have lived in small groups. Archeological evidence suggests that based on the size of their living areas, Neanderthals lived in small local groups consisting of 12 to 50 individuals that were organized in nuclear family groups. There were also some hunting or task groups, and occasional individual families foraging on their own. Due to caves and rock shelters offering excellent archaeological preservation conditions, many sites have been found in rock cliffs and caves, but open-air sites have been found as well (Aldenderfer, 2001).

Gamble (1999), suggests that there were two scales of social network in Neanderthal society, the intimate network of close kin and the effective network of more distant relatives and nonkin friends. In the effective network, which was made up of friends and relatives, the network involved emotional investment and bodily interaction, as well as some material resources such as food and lithic raw material. He claimed that an extended network was rare, as can be seen from lithic artifact studies where the sources of raw materials was measured in reference to individual sites and then used as proxy data for the scale of Neanderthal movements. At many sites, sites seemed to gain sources that were within 5–10 km. This is much less that the Upper Paleolithic, where the average was >300 km.

Gamble (1999) also theorized that males and females lived in separate matrilocal (couple resides near wife's parents) and partilocal groups (couple resides near husbands parents). Evidence for patrilocal mating was found at the El Sidrón site (Asturias, Spain). The remains of 12 Neanderthal individuals were found and evidence indicates that they died around the same time as a result of the collapse of an underground karst and were later buried together. When positions of mtDNA (HVR 1 and 2) were studied, the mtDNA of the individuals revealed three different maternal lines. The fossils were also sexed (using Y chromosomes) and it was discovered that the males shared an mtDNA haplogroup while the adult females did not. This led the researchers to conclude that the group of Neanderthals was patrilocal (Bastir, Markus, et al., 2011).

As stated before, pair-bonding was common among Neanderthals (Aldenderfer, 2001). Neanderthal couples formed strong bonds with each other because of the need to raise children and to find food for themselves and their families (Mellars, 1996). Children were extremely dependent on their mothers for longer periods of time due to a retarded rate of growth and

maturation caused by an extremely rapid increase of brain size during gestation. Males protected their females and children from predators and other groups that might cause them harm (Mellars, 1996). With violence so prominent in their communities, that protection was extremely important.

It is suggested that there was a need for alliances among local bands in order to deal with periodic local food shortages and to ensure mating opportunities. Transport of stone tools beyond 30–50 km from sources hints that there was periodic visiting with other bands or the aggregation of several allied bands (Hayden, Brian, 2102). Simple hearths were found. The nature of these hearths indicates that Neanderthals engaged in social interaction marked by cooperation in routine acts within intimate and effective networks. The distance between the hearths and the back wall in the inner zone suggest that the space was uses as a sleeping and resting area. A group of 8–10 individuals could occupy the area (Vallverdú et al., 2010).

The groups were very mobile within a small range and would set up temporary camps. Once the resources were exhausted, they would move on. This is evident by underdeveloped site organization and the absence of well-built permanent structures. Both males and females are thought to have hunted. Men did the dangerous part of the hunting using spears and thrusting them close by into the animal. Woman and children probably did not put themselves in a position of high risk in order to preserve the reproductive core of the population. They may have served as beaters or game drivers. Marked skeletal and muscular robusticity of Neanderthals is evidence of high activity among both males and females, and the robusticity is likely a result of high activity during child development (Kuhn, S. L. & M. C. Stiner, 2006).

While it is theorized that women and children took part in the hunting, there are also theories that emphasize that females and children were less mobile in the hunting activities.

Among Neanderthals there was a general delay in rates of growth and maturation, and there was a rapid increase in the size and therefore the nutritional demands of early growth, of the human brain. The rapid increase in human brain size would have retarded the overal rate of growth and maturation of young children, which means they would have been dependent on their mothers for longer periods. There also would have been heavy demands on the nutritional levels of females during pregency to sustain the heavy metabolic costs involved in rapid brain growth. Some argue that Neanderthal females would therefore have been less mobile to engage in frequent and far searches for food and that they would also have been dependent on abundant and nutritious food daily to support the high energy expense of raising children. Males may have also been involved even more so in these child-rearing groups in order to protect the women and children from either predators or members of other groups. This increased parental investment may have lead to strong permanent bonds between specific pairs of males and females. Ecological groups arguments support that there was probably a pattern of mutual cooperation and food sharing within Neanderthal communities, which would have led to a very close integration of males and females in local groups (Mellars, 1996).

Neanderthals are thought to have been big-game hunters who followed large herds of animals. Remains at sites suggest they consumed reindeer, red deer, fallow deer, bison, wild oxen, wild sheep, goats, gazelles, and horses. Bones from elephants and rhinoceroses have also been found, but in much less quantity (Aldenderfer, 2001). Neanderthals ate mostly meat. No fishing technology has been revealed, so they probably hunted large terrestrial prey. Neanderthals could only tolerate the cold climate if they could consume a large amount of energy such as protein and fat. Kuhn and Stiner (2006), show that few plants could survive the

cold climate in which Neanderthal lived and also lacked substantial nutrients. Carbon and nitrogen isotopes of bone collagen also supports that plant percentage in diet was low.

There is some archaeological evidence that indicates some individuals in certain Neanderthal communities actually had elevated social statuses. They were considered to be more important. Archaeologists and research shows that this is visible in the burial treatments, skull deformation, skull removal, special clothing, painted body designs, and personal adornments found at different archaeological sites (Hayden, 2012). The different statuses could have been based on rituals, war, kinships, and economically productive areas (2012). Status markers were probably used as well. Neanderthals could have used anything from predator pelts, bird wings, bird claws, colorants, to any other specialty items of the time (Hayden, 2012).

P. B. Pettitt, suggests that Neanderthals lifecycles were short (approximately 40 years), and full of stress. He claims that individual value was gained through the physical and intellectual value of an indivual to group fertility, foraging, and therefore to group-inclusive fitness. If an individual managed to maintian his or her value until death, mortuary ritual may have been performed. Material culture and langauge did not have a place in Neanderthal society. It was their bodies, its development and its interaction with others, that formed the social aspects of the individual's life. Having a body that developed strongly, and that avoided harsh traumas was valuable to a Neanderthal (Pettitt, P. B. 2000).

Theories of Neanderthal Intelligence

Most researchers seem to agree that Neanderthals were somewhat intelligent, but were no where near as intelligent as modern day humans. At the level of biological capacities there seems to be subtle differences. While Neanderthals had slightly bigger cranial capacity than modern

humans, research suggests that this does not mean they had higher mental abilities. In addition, when measured in terms of gross volume, much of the variability in size is related to the body size of the two different groups (Mellars, 1996). Research looking at a brain of a Neanderthal who died in infancy suggests that modern human infant brains are similar in size and posses similar structures (Gunz, 2010; Ponce de León, 2001). Both Neanderthal and modern humans are born with elongated brain cases, probably to facilitate passage through the birth canal. After the first year, however, modern human skulls become rounder, permitting more cerebellum space. According to Gunz, however, after a year the modern human begins to connect together different regions of the brain. The connection between these brain regions are important for higher-order social, emotional, and communicative functions. Neanderthal brains, however, did not undergo these changes and therefore it is unlikely they had the same level of intelligence as modern humans.

Due to a smaller neocortex and smaller association cortices, the Neanderthals almost definitely had a lower long-term memory capacity than modern humans and had smaller working memory capacities. Due to their lacking enhanced working memory, this probably decreased their complexity of plans of action. Neanderthals also were lacking in phonological storage. This would account for Neanderthals being intelligent enough to thrive in their environment, but not intelligent enough to have signs of culture (Mithen, 2008).

Coolidge & Wynn (2005), argue that much of modern thinking is based on abilities that evolved long ago and that the neural change leading to modernity was modest. He claims that the mutation that occurs to form enhanced working memory in modern human was either specific to phonological storage and the capacity to maintain speech sounds and form complex language or

was an enhancement of executive functioning, such as being able to maintain attention despite competing but nonrelevant stimuli.

Coolidge & Wynn (2005), also explain that while Neanderthals lacked enhanced working memory, they were skilled and had expert knowledge. This can be seen especially in tool making which involved the use of long-term working memory. The levallois (a technique in which a core is prepared for the ultimate removal of one or several flake blanks which may then be father modified) and its variants were used by Neanderthals for thousands of years and is an example of sequentially organized action in Neanderthal society. The procedure involves several preparatory, intermediate, and final products, which demonstrates a complex sequence of actions. There are several steps and much of the knowledge must have been held in the form of visual, tactile, and aural images concerning raw material. It had been argued that the early stone-tool technology developed by AMH was more efficient than those used by Neanderthals, but a study found this was not true (Miten, 2008). The researchers recreated stone tools called flakes, which were wider tools used by Neanderthals, and then made blades that were a narrow stone tool later used by homo sapiens. Blades were first produced by homo sapiens during their colonization of Europe from Africa about 40k years ago. The research team found that there was no statistical difference between the efficiency of the two technologies. In fact they found that flakes that were favored by Neanderthals may have been in some ways more efficient.

Another sign that Neanderthals possessed skilled and expert knowledge can be seen in the evidence of specialized hunting and tools at several Neanderthal sites. One example is at Saltzgitter-Lebenstedt in Northern Germany. At this site, Neanderthals appear to have used a small but steep valley when hunting reindeer. They used a natural topographical feature to lead the animals into a killing zone and then reused the site on occasion. This indicates tactical

hunting, however, and Coolidge & Wynn (2005) argue that this does not involve the use of enhanced working memory.

While skilled and expert knowledge and long-term working memory was apparent amongst Neanderthals, Coolidge & Wynn (2005), point out that although long-term working memory can rapidly assess and respond to a range of familiar situations and problems, it is not inherently innovative. Having the capacity for long-term memory does not enable one to create truly novel responses since it is simply a retrieval structure tied to cues. This technology was not innovative and it seems that Neanderthals did not experiment with new forms and techniques. They seemed to have lacked creativity. Even though the Neanderthals' technology did vary and change, it did so on a scale and a rate that rules out conscious experimentation and creativity (components of enhanced working memory). In addition, there is limited evidence of Neanderthal ritual, religion, or even art, primairly because their brains did not develop the frontal lobe which is responsible for creativity. It is possible that perhaps Neanderthals preferred organic media when creating any form of artwork, but that preserved poorly and evidence has not survived. With the lack of evidence to support a greatly developed frontal lobe like that of AMH, researchers are led to believe that Neanderthals had severly underdeveloped brains (Mithen, 2001).

Due to Neanderthals possibly having restricted working memory capacities, they would have had trouble solving new tasks because of prior habits of thought. They may have experienced proactive interference, which means they would have had difficulty learning new information because of already existing information. This may be the underlying reason why Neanderthals had trouble changing their ways of manufacturing tools. After 200,000 years of making tools the same way, they probably had competition between new task goals and old

habitual responses (Coolidge & Wynn, 2005). Long-term memory provided them the ability to solve their immediate problems, but their day-to-day life consisted of recipe-like activities.

In addition Mithen (2008), argues that Neanderthals had a lack of cognitive fluidity. He hypothesized that Neanderthals lacked a higher level of consciousness involving a person being able to reflect on one's own mental states. He suspects that Neanderthals had a "rolling" consciousness that involved swift memory loss and no introspection. He adds that ancient Neanderthal thinking involved visuospatial reasoning. Furthering this point, a team of physical anthropologists from the UK suggests that Neanderthal brains were organized differently than those of modern humans. An analysis was conducted by Eliuned Pearce and Robin Dunbar at the University of Oxford. They compared the skulls of 32 anatomically modern humans and 13 Neanderthals and took note of the much larger eye sockets of Neanderthals. They then calculated the standard size of fossil brains for body mass and visual processing requirements and compared how much of the brain was left over for other cognitive functions. They found that the brains of Neanderthals were structured to support vision and the Neanderthals large body mass, which left a smaller portion of brain tissue available for other cognitive functions. They concluded that Neanderthals possessed limited capacity for advanced cognitive function and social interaction (UPI newstrack, 2013).

Neanderthals also lacked phonological storage capacity, which is a crucial foundation in modern human cognition and memory. Phonological storage and having narratives and story telling would have been efficient and safe means of transferring information. It also would have lead to more information being added into long-term memory, facilitating a wider range of choices when they recalled information from long-term memory (Coolidge & Wynn, 2005).

Theories of Neanderthal Social Rituals

Stan Gooch, in his book *The Neanderthal Question*, hypothesizes about Neanderthal social ritual and religion. He makes claims such as that they worshipped the cave bear, the spider, and the serpent. animals that were found commonly in the caves in which many of them lived. He also theorizes that Neanderthals were the first to develop fully religious cults and that cave-bear worship was the most common one. Hayden (2003) argues there is evidence for bear-cult rituals at the Neanderthal site of Regourdou cave in southwestern France. Remains of a bear skull, bones, and other materials that look as though they were intentionally arranged and manipulated have been found there.

Burial sites are evidence of possible religion. Wallace (1966) describes these burials in detail. Neanderthals buried their dead in caves and deposited the body in the earth with great care. Their legs were usually contracted tightly against the body, the head was frequently pillowed on the arms. Grave goods were also placed with the deceased. A child's body was surrounded by ibex horns, a young man was buried with a hand ax. At a Neanderthal burial site found by Solecki (1971) in Shanidar in Iraq, pollen remains were found with the bones, so mourners may have covered the corpse in flowers as a part of mortuary ceremony (Swartz & Jordan, 1976). Neanderthals have also been buried surrounded by goat horns placed in a circle, with reindeer vertebrae, animal skins, stone tools, red ocher, and in one grave, seven different types of flowers (Solecki, 1971). In one cave (unearthed after 60,000 years had passed), a deep chamber was discovered which housed a single skull which was surrounded by a ring of stones (Mellars, 1996). While many of these instances seem to be done purposely, it is argued that at the burial with flowers, rats were possibly the reason pollen was found. Rodent bones were found at the site and suggest that rats horded flowers, as they often do, and that this created the

appearance that the Neanderthal was buried in a ritualistic way (Sommer, 2009). None of this evidence is conclusive regarding the presence of religion in Neanderthal society. However, taken in total, it suggests that there was some manner of behavior transcending utilitarian concerns, therefore hinting at the possibility that religion existed.

One major ritual in Neanderthal society seems to be cannibalism. Signs of Neanderthal cannibalism were found at Moula-Guercy in France. Archaeological evidence suggests that deer remains were treated similarly to hominid remains. Prior to this, some theorists suspected that evidence of cannibalism was really just evidence of a burial ritual. The co-occurrence of deer remains being treated similarly to hominid remains however, suggests that cannibalism was more likely (Defleur, 1999). Skulls unearthed from the Zhoukoudien site near Beijing also show signs of cannibalism. Many of the skulls were broken open from the bottom suggesting that extraction and consumption of the brain might have been the goal (Hayden, 2003). Another skull found in Bodo, Ethiopia, contains 25 stone-tool cut marks that presumably occurred when the skin was removed. Facial-skin removal seems to have lacked a practical purpose so it therefore hints at having a possible symbolic or ritual significance (White, 1986).

The diet of a species is an important social ritual as well. For years it has been hypothesized that Neanderthals ate mainly meat and were not hunter-gather groups. New evidence shows a more expansive diet similar to that of modern day humans. Neanderthals did not just focus their diets on large game and other “easy to get” food. Finding Neanderthal skulls has been very beneficial to researchers. Using starch grains and other microfossils that were trapped in the teeth of Neanderthals, researchers were able to determine that some Neanderthals did eat certain plant foods. Proving this helps researchers understand how anatomically modern

humans (AMH) developed their own eating habits. It is now believed that they developed theirs from interactions with Neanderthals (Henry, Brooks, & Piperno, 2010).

Social ritual involving red ochre is also stipulated. The use of manganese and iron oxides by late Neanderthals is well documented in Europe. The findings have been interpreted as pigments, such as ochre, although their exact function is unknown. Some speculate that pigments were used for body painting, since red ochre was shortly thereafter used by the Upper Paleolithic for cave paintings and ritual burials. More domestic uses of red ochre are, however, known, for instance, as medication, as a food preservative, in tanning of hides, and as insect repellent (Arps, Charles E. S., et al., 2012). However, two sites in Iberia contained perforated and pigment stained marine shells. These innovations may have been fulfilling a need, that is, aiding in the personal and social identification of people (Zilhão, 2009).

It is also theorized that Neanderthals must have worn clothing. Wales (2012) used estimates for the temperatures at proven Neanderthal sites proves that to survive the cold environment in which they lived, they did need clothing. There is not, however, archaeological evidence of Neanderthal clothing available. Research indicates that Neanderthals probably wore simple clothing. Using 245 hunter-gatherer groups as a basis, the researchers established a mathematical relationship between external conditions and the need for clothing (percent of body to be covered). The explanation for not finding clothing tools at Neanderthal sites could stem from the much simpler clothing the Neanderthals had, compared to modern humans. The reason behind simpler clothing might be in the focus on living in the colder environment, preventing the development of more sophisticated clothing.

Theories Regarding the Interface of Neanderthals and Homo Sapiens

There was a short time period in which Neanderthals and homo sapiens, or anatomically modern humans (AMH), coexisted on this earth (Mellars, 1989). There is much speculation about whether or not interbreeding and interface was common between them, but as yet there is no conclusive evidence to prove any theory. Some researchers also speculate that the behaviors of Neanderthals may have affected the behaviors of AMH because they did coexist for a brief while (Mellars, 1989). Genetic testing is particularly impaired with Neanderthal specimens because so little DNA has been recovered (Jolly, 2001). Physiological data is impaired because all research can only be retrieved through fossils. Because of these two facts, it is likely that researchers will never be able to characterize conclusively AMH and Neanderthal hybridization (Jolly, 2001).

There are three main theories regarding Neanderthal and AMH interface. The Recent African Origin model holds that AMH evolved in Africa and replaced Neanderthals when they migrated into Europe and Asian. This view rejects the notion that Neanderthals in Europe contributed anything to the modern human genotype. The Multiregional hypothesis is at the other extreme and suggests that modern humans evolved in all regions of the world during the same time. They do not feel that Neanderthals were replaced by AMH, but that there was gene flow among Africa, Europe and Asia populations, which led to the evolution of modern humans. In this model, Neanderthals contributed to the modern human genotype.

However, the Multiregional model has been found to be highly improbably. The chronology in the Middle East where Neanderthals and anatomically modern humans overlapped for a long period of time does not support the Multiregional model .

To support the Multiregional hypothesis, evidence of a potential 24,500-year-old Neanderthal/sapiens hybrid from the site of Lagar Velho, Portugal is often cited (Duarte 1999). This 4-year-old had a squat body like a Neanderthal, but possessed an anatomically modern skull. However, as Tattersall (1999) explains, there are a number of problems with interpreting this find as a Neanderthal/sapiens hybrid. First of all, as a hybrid it should have a mixture of traits throughout its body and not possess the body of a Neanderthal and skull of a modern human. Also, acceptance of this specimen as a hybrid would suggest that Neanderthal traits had been retained for approximately 6,000 to 10,000 years after Neanderthals became extinct, which is highly unlikely since Neanderthal traits would have been genetically swamped by the homo sapiens genes over such a protracted period of time.

Fred H. Smith (2005), originated the Assimilation model, a variation of the Recent African Origin model. He agreed that modern humans did come out of Africa, but felt that as they moved into the areas where Neanderthals lived (western Asia and Europe), instead of replacing Neanderthals, they bred with them. One piece of evidence is found in the presence of an occipital bun among Neanderthals, unlike among early modern humans in Africa. Occipital buns are, however, present among AMH, and Smith sees this is a major piece of anatomical evidence for believing that AMH bred with Neanderthals. According to this view, AMH and Neanderthals thus shared skeletal traits despite belonging to a separate species. Neanderthal skulls and jaws from Vindija Cave in Croatia, dating back to 38,000 years ago, for example, exhibit smaller facial features similar to those of the ancient European AMH.

Smith suspects that genetic changes to human DNA over the last 10,000 years has erased evidence of more than 2.5% of Neanderthal genetic heritage and is the result of mating across much larger populations than in the Stone Age. The fact that Neanderthals and anatomically

modern humans overlapped for a long period of time, however, strongly supports the Assimilation model. There is a lot of evidence at several sites of Châtelperronian in France, dating to roughly 40,000 years ago, of an archaeological industry that contains elements of Middle and Upper Paleolithic artifacts. Neanderthal skeletons are found there, which suggests that these Châtelperronian sites are examples of Neanderthals mimicking the culture of modern humans (Caron, 2011 & Hublin, 2012). These late Neanderthals only manufactured Châtelperronian body ornaments after AMH arrived in neighboring regions, which highly suggests that cultural diffusion may have taken place between modern humans and Neanderthals.

In areas like Croatia, Neanderthals already existed and were able to affect the area they lived in. When AMH arrived in the area, they interacted with Neanderthals and helped add to the development with the area. It is evidence like this that leads some researchers to believe that Neanderthals had a more significant impact on anatomically modern humans than we are led to believe through archaeological evidence (Trinkaus, 1986).

Nevertheless, the issue of interbreeding has long been debated. Neves and Serva completed a study (2011) in which they used mathematical models to measure the degree of exchange necessary between Neanderthals and AMHs to produce just 4% of DNA in modern day non-Africans. They believe this small portion of DNA can be found in non-Africans today and is of Neanderthal origin. This assumption is based on archaeological evidence from which the researchers concluded that very little exchange is needed for DNA to remain in the population, and suggest that interbreeding, contact, and interface between AMH and Neanderthals, even if rare, nevertheless occurred (Neves & Serva, 2011).

An earlier study, however, holds that Neanderthals and AMH were distinct from each other in terms of morphology, ontogeny, mitochondrial, and nuclear genetic information. It

concludes that there is strong DNA evidence supporting this position there is very little genetic prove to show any kind of exchange in DNA between the two radically different species (Smith, Jankovic, & Karavanic, 2005). Researchers like Relethford (2001), however, believe this theory is false. They hold that Neanderthals could have made contributions to the DNA of anatomically modern humans (2001). If that were the case, the DNA they contributed would not have been regionally specific and, therefore, hard to find in current DNA. Reletheford states that we cannot conclusively say that no DNA was contributed by Neanderthals to the DNA of AMH.

Recent research further supports the idea of interbreeding. Green, Kraus et al. (2010) found that somewhere between 1 and 4 percent of AMH genes stem from Neanderthals. The researchers identified a catalog of genetic features unique to modern humans by comparing the Neanderthal, human, and chimpanzee genomes. The results showed that Neanderthal DNA is 99.7% identical to modern human DNA, versus 98.8% for modern humans and chimps. All modern ethic groups except for Africans carry traces of Neanderthal DNA in their genomes. The researchers speculate that Neanderthals probably interbred with early AMH right after they left Africa but before AMH spilt into different ethic groups and settled around the globe. The first opportunity for interbreeding probably occurred 60,000 years ago in Middle Eastern regions, where archaeological evidence has shown that the species overlapped for sometime, although they claim that low-level interbreeding probably occurred. Either several instances of interbreeding occurred as AMH moved into Neanderthal territory or the two groups were becoming separate species and thus were incompatible biologically so as to produce offspring who were sterile.

Behavior and Personality

Genetic research comparing the mtDNA of the Neanderthal genome to modern human DNA strongly suggests that autism existed among Neanderthals. In the genes modern humans have been found to share with Neanderthals, mutations in CADPS2 and AUTS2 have been implicated in autism (Green, 2010). In an effort to understand some of the behaviors Neanderthals would have expressed considering the "Neanderthal Autism Theory" may be helpful. This theory is, however, fairly new and controversial (Pickard, Pickard, & Bonsall, 2011). The theory is proposed by Leif Ekblad, the author of the well know Aspie Quiz and the Rdos operating system and suggests that traits associated with autism are the result of Neanderthal genes being expressed in remnants of the Neanderthalic genome in homo sapiens. Therefore the behaviors of autistic individuals are not deficits, but rather, that those with autism are actually fully functioning. While this theory does not appear in formal autism literature, Reser (2011) reviewed how some genes associated with the autism spectrum were naturally selected because they facilitated the solitary subsistence skills of hunter gathers such as the Neanderthals. He claims that certain present-day genetic autistic traits, such as keen observations, hyper focused interests, and the ability to live in solitude were not disabilities to prehistoric peoples, but were instead useful to survival. The genetic traits retained in today's society, where they are no longer needed, are a result of genetic mixing and the slow pace of evolutionary change.

Reser (2011), writes that Neanderthal children with autistic traits learned the value of foraging plants and how to hunt and gather from their parents as a means of survival. Autistic individuals systemize and find patterns in many things and would have excelled at skills such as systemizing their environments into categories such as edible and inedible resources. Autistic

individuals also tend to be keen observers of their environments, a skill that would have increased their ability to find edible and useful resources among the many forest goods. Autistic qualities such as routine, observation, and the ability to be alone and focused for long periods of time on a particular task would also have been useful in hunting and trapping animals.

In addition to genes related to autism found in both the Neanderthal and modern human genome, genes for schizophrenia, Down's syndrome, and bipolar disorder have also been found. It is speculated that Neanderthals did not experience schizophrenia because their cortex matured much more quickly that humans (Sheldon, 2007). Similarly, children with Down's syndrome probably did not survive infancy. Strong arguments have, however, been made that bipolar behaviors evolved among Neanderthals as adaptations to the Pleistocene in the northern temperate zone. Sherman (2012) considers the hypothesis of the evolutionary origin of bipolar disorder and claims that it can help clarify the behaviors of the Neanderthal. This hypothesis suggests that bipolar behavior evolved as seasonal adaptations. According to the theory, Neanderthal women in their reproductive years took part in gorging in preparation for the winter, and in the winter they expressed depressive behaviors, when desires for food, activity, social contact, and sex declined. Depressive behaviors in both women and men helped reduce activity levels, which helped conserve energy and reduce the caloric need. The lack of desire for sex and food also helped decrease conflict within the group's close winter quarters. Lack of interest and social withdrawal also have helped make it possible for the group to coexist under harsh and difficult circumstances. When winter was over, depression was replaced with hypomania: optimism, self-confidence, and a lot of energy. All of these helped the Neanderthals accomplish tasks, socialize, mate, and travel to other food locations. In addition, the switch process, a phenomenon in bipolar patients that enables them to switch from a prolonged state of depression

to mania naturally, helps explains how Neanderthals were able to respond to emergencies. Mania would have helped the Neanderthals respond to common emergencies that required physical strength and involved a lot of confidence, such as confrontations with wild animals, floods, storms, fires and earthquakes.

Another common theme noted in Neanderthal behavior is violence. Aside from the violence seen in their hunting strategy, there are many indications that interpersonal violence was common in Neanderthal society. This is clearly evident in many archaeological sites because of condition of the remains found (McCall & Shields, 2008). Using computer topographic imaging and computer-assisted skeletal and facial reconstruction, researchers have been able to determine that evidence at archaeological sites proves not just violence toward other groups, but interpersonal violence as well (Zollikofer, Ponce de León, Vandermeersch, & Leveque, 2002). Different remains have revealed different forms of violence. Although violence is a behavior, it was ingrained in the society as a whole, thus causing social structures and different statuses for different members of the community (McCall & Shileds, 2008).

Information about Neanderthal personality is limited, but examining behaviors common in Neanderthal society enables psychological traits to be inferred. Hunting dangerous species, which involved killing their quarry at close range, leads us to think they had bravery, low levels of harm avoidance, and perhaps greater difficulties making cost-benefit analyses. Stoicism—enduring pain and hardship without displaying one's feeling and without complaint—may have been the norm.

Neanderthals had a lower capacity for working memory and therefore had limited phonological storage. The language of Neanderthals may have been restricted to declarative, imperative, and exclamatory modes of speech. A discovery was made in Kebara of a well

preserved hyoid bone with anatomically correct structures that allow for speech (Arensburg & Tillier, 1991), but because to their brains allowed them, probably, to have only limited modes of speech, Neanderthals may have appeared more laconic. Neanderthals probably laughed less than modern humans in part because of the lack of cognitive fluidity. They would have been at a disadvantage when trying to appreciate appropriate incongruities, an important aspects of jokes. In addition, their lack of extended working memory and their restricted linguistic comprehension would have hindered their appreciation for language-based humor. There is no reason to suspect, however, that Neanderthals would not find some aspects of physical humor funny, for example, slap-stick humor (Wynn & Coolidge 2004).

Neanderthals were xenophobic (having abnormal hate or fear of things that are foreign) as shown by their high interpersonal violence. They were also neophobic (resistant and fear to change) and dogmatic (direct). They were unimaginative, which can be seen in their unchanging tool design (Wynn, T., & Coolidge, F. L., 2004). They were also pragmatic and were able to make rational decisions such as nursing those who were not seriously injured back to health, but leaving behind ones with serious lower-body injuries who would probably die. They were sympathetic and empathetic as seen by their caring of the injured or disabled in their communities and through the careful burial of dead (Gamble, 2011).

Studies have been done on patients with frontal lobe dysfunction (frontal lobes of Neanderthals were not as developed as modern humans) as well as interruptions of working memory. Using studies like this may not be accurate since it would be incorrect assume the behavioral consequences of brain damage are the same as the behavioral consequences of a lack of enhanced working memory. Nevertheless, Neanderthals may have shared characteristics seen in patients with frontal lobe dysfunction. These include: lack of creativity and spontaneity,

neglect of personal hygiene, narrow interests and not seeking out new hobbies, high tolerance for boredom, preference for to sticking to old ways, easily angered and irritated, not overly anxious, showing little grief or guilt, immodest and crude behavior, and employing methods blunt and overt force for getting what they want (Wynn & Coolidge 2004).

Annotated Bibliography

Theories of Neanderthal Extinction

Banks, W. E., d'Errico, F, Peterson, A.T., Kageyama, M, Sima, A, & Sánchez-Goñi, M. F. (2008). Neanderthal Extinction by Competitive Exclusion. *PLoS ONE* 3(12): e3972. doi:10.1371/journal.pone.0003972

In this journal article based on the their experiments and research, the authors argue that competition with AMH is a more compelling theory of the extinction of Neanderthals than extinction following extreme climate change. It is their belief that Neanderthals and AMH both cohabitated areas and lived apart, but both competed for resources. This article provides significant evidence to debunking the theory that Neanderthals became extinct after severe climate change. They claim that the principle factor was a result of the expansion of modern humans, which caused Neanderthals to be unable to cope with the changing systems.

Ettitt, P. B. P., & Ike, A. W. G. P. (2001). Blind in a cloud of data : problems with the chronology of Neanderthal extinction and anatomically modern human expansion, *75*, 415–420.

These researchers give a technical discussion (refutation) of the quality of the data that suggest that AMH and Neanderthals cohabitated. They claim there is uncertainty in radiocarbon dating and other dating techniques and this makes exact reconstruction of the timeline of Neanderthal movement impossible. Given the uncertainties in our dating techniques, we are "blind in a cloud of data."

Finlayson, C. (2008). On the importance of coastal areas in the survival of Neanderthal populations during the late Pleistocene. *Quaternary Science Reviews*, 27(23–24), 2246–2252. doi: 10.1016/j.quascirev.2008.08.033

Finlayson surveys Neanderthal population records across the Middle East and Europe looking for changes in populations over time and how this fits local climate and environment changes. He ascertains that Neanderthal extinction began inland and spread to the coasts, where they migrated to escape harsh climates. Oceans have climate-tempering effects which concords with other theorists who believe that rapid weather fluctuations caused the eventual extinction of Neanderthals. This article provides significant explanations of the migration and population change witnessed in the last years of Neanderthal existence.

Gilligan, I. (2007). Neanderthal extinction and modern human behavior: The role of climate change and clothing. *World Archaeology*, 39(4), 499–514. Retrieved from http://www.jstor.org/stable/pdfplus/40026145.pdf

Gilligan's paper was prompted by a review of Neanderthal survival skills and the findings of a Stage 3 Project related to Neanderthal extinction. He argues that Neanderthals had less incentive to adapt to the colder weather because they were naturally endowed with body resilience. Modern humans had to adapt and create clothing because they were more vulnerable to the climate conditions. However, when the extremely cold climate arrived in the Upper Pleistocene, Neanderthals could not adapt fast enough to adjust to the new weather. This article is quite significant because it suggests that without being able to pre-adapt to future conditions, Neanderthals sabotaged

their own ability to survive in harsh climates. Unlike their AMH counterparts, Neanderthals could not compete and survive.

Horan, R. D., Bulte, E., & Shogren, J. F. (2005). How trade saved humanity from biological exclusion: An economic theory of Neanderthal extinction. *Journal of Economic Behavior and Organization*, 58, 1–29. doi: 10.1016/j.jebo.2004.03.009

Horan, Bulte, and Shogren present a compelling argument for the theory that Neanderthal extinction was caused by the ability of AMHs to adapt to the needs of survival. They state that economics was the reason for their success and the downfall of the Neanderthals. AMH were able to counter their physical deficits (relative to that of the Neanderthals) by dividing their labor among their people and trading among the different groups. The researchers used economic models to showcase this in their article. This article is significant because it clearly shows how one group was able to adapt their group dynamics even though they were not able to physically adapt to the environment.

Jennings, R., Finlayson, C., Fa, D., & Finlayson, G. (2011). Southern Iberia as a refuge for the last Neanderthal populations. *Journal of Biogeography*, 38(10), 1873–1885. doi: 10.1111/.1365-2699.2011.02356.x

This article attempts to determine if Southern Iberia became a refuge for Neanderthals as the climate in Europe began to change. Southern Iberia is believed to be one of the last places Neanderthals lived before their extinction during a particularly harsh glacialization in Southern Iberia. The authors used a novel climate-modeling approach to show relationships between current weather variables in this region to a model climate of the climate there during the last known period of Neanderthal occupation. The region had four diverse weather patterns: warm/wet, cool/dry, warm/dry, and cool/wet. The authors

believe rainfall was a major input for helping Neanderthals survive in the area. They outline several favorable locations for Neanderthals in this region and suggest using fossil record to verify these theories and encourage future studies to help confirm or deny their predictions and findings.

Jiménez-Espejo, F., Martínez-Ruiz, F., Finlayson, C., Paytan, A., Sakamoto, T., Ortega-Huertas, M., Finlayson, G., Iijima, K., et al. (2007). Climate forcing and Neanderthal extinction in southern Iberia: Insights from a multiproxy marine record. *Quaternary Science Reviews*, 26, 836–852. doi: 10.1016/j.quascirev.2006.12.013

In this journal article based on their research, the authors attempt to ascertain whether a drastic change in climate caused the extinction of Neanderthals in the Southern Iberia region. Using evidence of paleoenvironmental changes at the time of Neanderthal extinction, the authors determine that it is in fact possible that extremely cold conditions could have affected the Neanderthal population. Though they have proven that this theory of climate change is possible and a high percentage of evidence shows that there were significant climate changes, the authors understand that more research in those areas needs to be done and more evidence collected. This source is very helpful in getting an overview of one possible theory of Neanderthal extinction.

Neanderthal demise down to eye size? UPI News Track. (2013, March 13). Retrieved from http://www.upi.com/Science_News/2013/03/13/Neanderthal-demise-down-to-eye-size/UPI-20111363222217/

This article touches on the theory that Neanderthals went extinct due to their larger eye size which enabled them to see better in the gloom of the Northern Hemisphere. Although their eyes helped them to see better, Neanderthals had less brainpower to form

complex social lives. Having improved social interactions would have helped them to survive during the Ice Age. There are no Neanderthal brains to examine, but primates with larger eyes tend to have a larger visual system in their brains suggesting that Neanderthals did as well. This leaves them with less gray matter in their frontal lobes, a vital area of the brain for social interaction. This theory is of great importance and significance because it provides a physiological explanation for what may have caused the extinction of Neanderthals.

Pinhasi, R., Nioradze, M., Tushabramishvilli, N., Lordkipanidze, D., Pleurdeau, D., Moncel, M. H., Adler, D. S., & Stringer, C. (2012). New chronology for the middle Paleolithic of the southern Caucasus suggests early demise of Neanderthals in this region. *Journal of Human Evolution*, 63(6), 770–780. doi: 10.1016/j.jhevol.2012.08.004

In this article, the authors' experimental results help them determine that it is highly probably that AMH and Neanderthals did not interact because Neanderthals were extinct for a few millennia before AMH in the Caucasus region. This implies that the modern humans did not contribute to the death of Neanderthals and thus negating that common theory. In prior literature, some argued that Neanderthal colonization of this region prevented AMH from settling right away, so they went to other areas and avoided Neanderthals. If so, the region may provide insights into what circumstances may favor Neanderthals over the competing AMH.

Rae, T. C., Koppe, T., & Stringer, C. B. (2011). The Neanderthal face is not cold adapted. *Journal of Human Evolution*, 60(2), 234–239. doi: 10.1016/j.jhevol.2010.10.003

The authors suggest that based on certain craniofacial qualities, Neanderthal may not actually have been as adapted to cold climates as previously thought. The general

consensus of many researchers is that all Neanderthals had facial features that were optimal for various cold temperatures. Specifically, the authors argue that Neanderthals would have smaller paranasal sinuses than they were originally thought to have. Given computed tomography and other reconstruction analyses, the assumption that Neanderthals' sinuses are "hyperpneumatized" is inaccurate. This paper is significant because it suggests that the literature supporting Neanderthals having a naturally superior resilience to cold climates is not completely accurate. Thus, it helps to advocate the climate theories of extinction.

Underdown, S. (2008). A potential role for transmissible spongiform encephalopathies in Neanderthal extinction. *Medical Hypotheses,* 71(1), 4–7. doi: 10.1016/j.mehy.2007.12.014

Underdown argues that a transmissible disease may have caused the decline and eventual extinction of the Neanderthal populations. Transmissible spongiform encephalopathy (TSE) is a disease similar to that of mad cow disease in modern times. TSE spread through contaminated tools and cannibalistic rituals within the Neanderthal population. Once TSE is established and starts to grow, it can spread widely in a given population and do great damage. This article is significant because there are counter arguments that state the Neanderthals did not share practices and rarely cross-communicated. Thus, it would be possible for subgroups of Neanderthals to go extinct because of TSE, but not the entire world population.

Theories of Social Structures among Neanderthals

Aldenderfer, M. (2001). Introduction: The origins of the human family. In A. Andrea & C. Neel (Eds.), An Introduction to World History: *World History Encyclopedia* (1 ed., Vol. 2, pp.

165–166). Santa Barbara, CA: ABC-CLIO. Retrieved from http://books.google.com/books?hl=en&lr=&id=LEqaIGsT8SsC&oi=fnd&pg=PA165&dq=pair-bonding in neanderthals&ots=8cQ6AX-Gyp&sig=wfsXv3hs-VRAm4gvzPlNeTpKho4

Aldenderfer writes a brief introduction to learning about how human families got their origins. He explains that the closest living creature currently exhibiting similar but not identical traits of family life is primates (chimpanzees, etc.). He explains that although they are similar, they are not like. Humans prefer pair-bonding and primates have very little of that. Aldenderfer explains that Neanderthals and AMH exhibited both food sharing behavior among families and interpersonal violence. Through the combination of what can be observed among primates and what can be ascertained from archaeological evidence from Neanderthals, researchers can piece together the origin of families.

Andrea, A. J. (2001). Introduction: The origins of the human family. In A. Andrea & C. Neel (Eds.), An Introduction to World History: *World History Encyclopedia* (1 ed., Vol. 2). Santa Barbara, CA: ABC-CLIO. Retrieved from http://books.google.com/books?hl=en&lr=&id=LEqaIGsT8SsC&oi=fnd&pg=PA165&dq=pair-bonding in neanderthals&ots=8cQ6AX-Gyp&sig=wfsXv3hs-VRAm4gvzPlNeTpKho4

This brief excerpt concerns itself with Les Eyzies, France and the pair-bonding of Neanderthals. It notes that more than 200 Middle-Paleolithic sites have been found in France. Most of these sites are in caves or rock shelters. Shelter was found in rock cliffs, but open air sites were used by Neanderthals as well. Neanderthals are thought to have been big game hunters that followed large herds of animals.

Hayden, B. (2012), Neandertal Social Structure. *Oxford Journal of Archaeology*, 31: 1–26. doi: 10.1111/j.1468-0092.2011.00376.x

Hayden's article discusses the various structures of Neanderthal life and society. He suggests that the evidence shows that some Neanderthal groups needed to create allieances while others had enemy relationships. He disucesses the use of rituals, the rarity of cemeteries, and the various sexual divisions of labor. It is possible that some individuals in Neanderthal communities were of eleveated status as indicated by preferential burial treatments, skull deformation, skull removal, special clothing or painted body designs, and personal adornments. Status was linked to economically productive areas as well as ritual, war, and kinship. This article provides insights and explanations of the structure of a Neanderthal society and suggests that their social structure had a degree of complexity.

Gamble, C. (1999). *The Paleolithic societies of Europe*. (2 ed., Vol. 1). Cambridge, UK: Cambridge University Press.

Gamble attempts to deconstruct the lives of Neanderthals during the Paleolithic era. Using available research, he pieces together their lives with what little archaeological record is available. He uses skeletons, stone tools, archaeological sites, and other evidence to show how it all fits together to form the ancient society.

Kuhn, S. L., & Stiner, M. C. (2006). What's a mother to do? The division of labor among Neanderthals and modern humans in Eurasia. *Current Anthropology*, 46(7), 953–980. Retrieved from http://www.u.arizona.edu/~mstiner/pdf/Kuhn_Stiner2006.pdf

The authors discuss the differences between Neanderthals and homo sapiens. They state that homo sapiens had clear roles for males and females and that they worked well

together. The archeological evidence shows that many Neanderthal women hunted alongside the men, but refrained from doing the more dangerous tasks because they bore the children and carried on the lineage. The article allows readers to see the differences between the two species and explains how eating patterns as well as the division of labor was different between Neanderthals and AMH. The differences are what many believe allowed homo sapiens to survive and Neanderthals to become extinct.

McCall, G. S., & Shields, N. (2008). Examining the evidence from small-scale societies and early prehistory and implications for modern theories of aggression and violence. *Aggression and Violent Behavior*, 13(1), 1–9. Retrieved from http://www.sciencedirect.com/science/article/pii/S1359178907000377

The authors attempt to evaluate the theoretical positions of what causes violence within human societies. They use archeological evidence from Neanderthals and other early hominids, as well as data from small-scale non-Western societies. The researchers also examine evidence from early hominid archeological sites to determine if there is an evolutionary basis for violence and aggression and suggest areas of future studies. One such study is designed to refine the methods of recognizing interpersonal violence using skeletal remains and another compares modern societies to show violence patterns.

Mellars, P. (1996). *The Neanderthal legacy: An archaeological perspective from Western Europe*. (pp. 356–365). Princeton, NJ: Princeton University Press. Retrieved from http://www1.anthro.utah.edu/PDFs/mellars1996b.pdf

The author discusses the importance of the Neanderthal society and what it left behind for us. This particular chapter is about social structure and the society of Neanderthals. In particular it describes the roles of males, females, and children as well as the importance

of food and food requirements for the species. There is popular belief that Neanderthal couples had close bonds that were formed because of the raising of children and the need to find food. By writing this, the author allows readers to see what kind of society the Neanderthals created for themselves and allows us to see what it was like to live during that time period.

Vallverdu, J., Vaquero, M., Caceres, I., Allue, E., Rosell, J., Saladie, P., Chacon, G., & Olle, A. (2010). Sleeping activity area within the site structure of archaic human groups. *Current Anthropology*, 51(1), 137–145. doi: 10.1086/649499

The authors identify different prehistoric activity areas and Neanderthal behaviors. They write about different sleeping arrangements of archaic human groups.

Zollikofer, C. P. E., Ponce de León, M. S., Vandermeersch, B., & Leveque, F. (2002). Evidence for interpersonal violence in the St. Ce´ Saire Neanderthal. Proceedings of the National Academy of Sciences of the United States of America PNAS, Proceedings of the National Academy of Sciences, 99(9), 6444–6448. doi: 10.1073/pnas.082111899

Using computer-topographic imaging and computer-assisted skeletal and facial reconstructions, the authors provide evidence that Neanderthals experienced interpersonal violence against one another. The study helps develop an understanding of the evolution of social behavior and provides a look into the social behaviors of Neanderthals. Based on their research, the authors discovered that the fossilized individual they found had experienced a traumatic event in which he was hit in the head with a tool during an interpersonal attack. The authors believe this type of violence is not specific to any one species and that this behavioral pattern travels from species to species. Although there is

no evidence to prove that Neanderthals and AMHs are linked at the species level, it is clear that their behavior patterns were probably very similar.

Theories of Neanderthal Intelligence

Coolidge, F. L., & Wynn, T. (2005). Working memory, its executive functions, and the emergence of modern thinking. *Cambridge Archaeological Journal*, 15(1), 5–26.doi:10.1017/S0959774305000016

The authors review the current literature on the theories of the Neanderthal mind and cognitive abilities (cognitive psychology, neurocognitive, and linguistic). They argue that expansion in working memory was critical to the emergence of modern thought and explores possible ways in which a genetic mutation may have made a profound difference on cognitive ability. They state that symbolic thought and more enhanced working memory separate modern human cognition from primitive cognition. Phonological storage capacity (e.g., digit span) is a crucial foundation in modern human cognition and memory. The authors cite archaeological evidence to say that enhanced working memory has been present for at least 14,000 years, but acknowledge that older evidence may have deteriorated and that the archaeological data may not capture fully how smart ancient humans were. This article provides a look into the minds of Neanderthals and what they may have been like.

D'Errico, F., Zilhão, J., Julien, M., Baffier, D., & Pelegrin, J. (1998). Neanderthal acculturation in western Europe: A critical review of the evidence and its interpretation. *Current Anthropology*, 39(1), 1–44. doi: 10.1086/204689

The authors discuss the ability of Neanderthals to realize that they needed to acculturate with AMH because of the changing times, that is, to start creating bone tools, personal ornaments, and "modern" stone tools. Using archaeological sites and explaining findings the authors argue that while the Chãtelperronian may appear to be evidence of Neanderthals acculturating, that they lacked the cognitive ability to do so.

Gowlett, J., Gamble, C., & Dunbar, R. (2012). Human evolution and the archaeology of the social brain. *Current Anthropology*, 53(6), 693–722. Retrieved from http://www.jstor.org/discover/10.1086/667994?uid=3739832&uid=2129&uid=2134&uid=2&uid=70&uid=4&uid=3739256&sid=21102238460641

The authors discuss evolutionary psychology in the context of the social brain hypothesis. They explain that ideas of human evolution have changed over the years. New archaeological evidence gives a clearer view of the past. The authors argue that a 2-million year social record must be part of the mainstream interpretation in order to understand the past.

Gunz, P., Neubauer, S., Maureille, B., & Hublin, J. (2010). Brain development after birth differs between Neanderthals and modern humans. *Current Biology*, 921–922. doi:10.1016/j.cub.2010.10.018

This paper examines brain development to assess where in normal embryonic development AMH and Neanderthals differ. Despite similar brain volumes, Neanderthals and AMH likely evolved brain sizes via unique pathways. Existing evidence has shown that neonatal AMH and Neanderthals already had distinctive brains. The authors argue for a brain globariation phase in AMH that is lacking in Neanderthal development.Brain development and activity are to essential to understanding AMH and Neanderthal

intelligence because the species no longer exist. This article provides an excellent understanding and interpretation of how distinct brains affected AMH and Neanderthals.

Mithen, S. J. (2001). The Evolution of Imagination: An Archaeological Perspective. *SubStance*,30(1), 28–54. doi:10.1353/sub.2001.0012

The author argues that AMH and Neanderthal brains were similar in size, but Neanderthals showed very little variation in their brains, suggesting that they had a relatively limited capacity for imagination. Around 200,000–50,000 years ago, both AMH and Neanderthal lineages had massive brain-size increases. Researchers believe that in both cases brain size increased because of increased linguistic capacity/need, which in turn facilitated a greater capacity of theory of mind. The article explains in detail what implications brain size had on Neanderthals. It also explains various cognitive abilties they lacked and what it may have resulted from this deficit.

Ponce de León, M. S., Golovanova, L., Doronichev, V., Romanova, G., Akazawa, T., Kondo, O., Ishida, H., et al. (2008). Neanderthal brain size at birth provides insights into the evolution of human life history. Proceedings of the National Academy of Sciences of the United States of America, 105(37), 13764–8. doi:10.1073/pnas.0803917105

The authors argue that Neanderthals and AMHs had brains that were similar in size at birth but expanded in size about 3.3 times. This required mothers who are similarly more mature physically and helps prove the theory that mating in Neanderthal soceity and AMH society occurred later in the lives of the females. Both cultures are slower to mate than primates.

Ponce de León, M. S., & Zollikofer, C. P. (2001). Neanderthal cranial ontogeny and its implications for late hominid diversity. *Nature*, 412(6846), 534–8. doi:10.1038/35087573

The authors use computerized fossil reconstruction to argue that morphological differences between AMHs and Neanderthals likely arose prenatally. This strengthens the evidence that Neanderthals and AMH can be considered distinct species. The researchers used archaeological crania, AMH and Neanderthal mandibles for their research. They determined that specific regions of the skull and the brain grow at different rates in AMH and Neanderthals, which may have caused the differences in cognitive abilities. This article uses a number of models to show that intellegience can and is effected prenatally.

Wynn, T., & Coolidge, F. L. (2004). The expert Neandertal mind. *Journal of human evolution*, 46(4), 467–87. doi:10.1016/j.jhevol.2004.01.005

The authors use evidence from neuropsychology, anthropology, and archaeology to argue that long-term working memory and expertise were critical to Neanderthal cognition. Effective hunting, stone knapping, and other features of Neanderthal life indicate a need for long-term working memory. The relative lack of innovation suggests that Neanderthals had less working memory than AMH. The authors use models to make several predictions about Neanderthal behavior that can be judged against archaeological evidence. This article is clear and helpful, and provides a step-by-step understanding of what a Neanderthal's brain would have been like. It explains why certain cognitive areas were important and probably existed in the brains of Neanderthals.

Theories of Neanderthal Social Rituals

Arps, C. E. S., Sier, M. J., Kellberg-Nielsen, T., Roebroeks, W., DeLoecker, D., Pares, J. M., & Mucher, H. J. (2011). Use of red ochre by early Neanderthals. Proceedings of the National Academy of Sciences, 109(6), 1889–1894. doi: 10.1073/pnas.1112261109

The authors examine the use of red ochre by early Neanderthals and push back the currently accepted date when Neanderthals first arrived even further. The use of ochre suggests that Neanderthals may have had cave paintings and other rituals that have not been determined because of lack of evidence.

Defleur, A. (1999). Neanderthal cannibalism at Moula-Guercy, Ardèche, France. *Science*, 286(5437), 128–131. doi:10.1126/science.286.5437.128

The author examine an archaeolgical site in France where there was thought to be evidence of a ritual among Neanderthals when it was compared with other similar sites. Some theorists believe that Neanderthals were cannabals based on various other archaeological sites. Others believe these sites were ritualistic burial sites and show how Neanderthals buried their dead. Defleur shows that the deer remains found with the Neanderthal remains showed equal levels of damage. Based on this evidence, he states that Neanderthals were in fact cannibals. The article debunks an older theory and sheds more light on the cannibalistic rituals of Neanderthals. It also holds that Neanderthals probably did not have any burial rituals.

Henry, A. G., Brooks, A. S., & Piperno, D. R. (2010). Microfossils in calculus demonstrate consumption of plants and cooked foods in Neanderthal diets (Shanidar iii, Iraq; spy I and ii, Belgium). Proceedings of the National Academy of Sciences, 1–6. doi: 10.1073/pnas.1016868108

The authors discuss the food rituals among Neanderthals. It has been assumed for many years that Neanderthals primarily ate meat and were not hunter-gatherers. New research indicates that this is not the case. Based on current evidence, Neanderthal diets were similar to that of modern-day humans. This is extremely important because it shows that

anatomically modern humans (ancestors of modern day humans) may have developed their eating habits from Neanderthals and expanded upon it.

Solecki, R. (1971). *Shanidar: The first flower people*. New York: Knopf.

The author discusses the importance of exploring the Shanidar Cave in Iraq because of its significant archaeological finds regarding Neanderthals. It is through this cave that evidence of Neanderthals possessing "human" traits such as love and compassion were found through their use of flowers at a burial. The research describes the difficult and interesting conditions of their work, which was cut short because of the political situation, and shows an extreme respect for the lives of the Neanderthals.

Sommer, J. D. (1999). The Shanidar IV "flower burial": a re-evaluation of Neanderthal burial ritual. *Cambridge Archaeological Journal*, 9(01), 127–129. doi: 10.1017/S0959774300015249

The author examined a Neanderthal burial site in Iraq that suggests that Neanderthals were laid to rest on a bed of ornate flowers. As per previous archaeological evidence, it has been determined that Neanderthals lacked very many ritualistic qualities, they were not very creative, and did not have a great appreciation for beauty. It would be rare to have evidence of Neanderthal social rituals, but even more rare is the evidence of both a Neanderthal social ritual and a Neanderthal appreciation for abstract beauty. The burial site provides evidence of flowers from pollen residue found at the site. The author argues that the rodent bones found at this site suggest that the better explanation is that rats hoarded flowers as they do naturally, and that this created the appearance that this Neanderthal individual was buried in a ritual and remembered with art.

Swartz, M. J., & Jordan, D. K. (1976). *Anthropology: Perspectives on humanity*. New York: John Wiley and Sons, Inc.

The authors discuss the anthropological history and various perspectives of past populations, including various Neanderthal and other ancient peoples. The book mentions the Neanderthal flower burial site at the Shanidar Cave. Although this book was written in 1976, much of it still holds true today.

Wales, N. (2012). Modeling Neanderthal clothing using ethnographic analogues. *Journal of Human Evolution*, 63(6), 781–795. doi: 10.1016/j.jhevol.2012.08.006

Clothing rituals are an extremely important aspect of any civilization and group. Wales considers the clothing of Neanderthals, which is difficult to accomplish because there is no archaeological evidence of Neanderthal clothing available. The author used 275 recent hunter-gathers groups as the premise for his research. He author concluded that because of their lacking the ability to alter their clothing to suit the changing climates, Neanderthals could not have survived. Their clothing was just not warm enough for the harsh climates of the Ice Age. The article presents evidence to support clothing rituals and an understanding of why extinction was inevitable for Neanderthals.

Wallace, A. F. C. (1966). *Religion: An anthropological view*. New York, NY: Random House.

Wallace chronicles religion and shows its existence for millennia. He dedicates a portion of the book to describing Neanderthal religion which he claims is evident based on their careful burial of their dead. He explains in detail the positions the bodies were buried in, and hypothesizes what the religious purpose behind each position was. Although old, the book contains much useful and accessible information,

Zilhão, J., Angelucci, D. E., Badal-García, E., d'Errico, F., Daniel, F., Dayet, L., Douka, K., & Higham, T. F. G., et. al (2010). Symbolic use of marine shells and mineral pigments by Iberian Neanderthals. Proceedings of the National Academy of Sciences, 1–6. doi: 10.1073/pnas.0914088107

The authors researched the symbolic importance of marine shells found at an archaeological site attributed to Neanderthals. It is widely believed that Neanderthals did not have the cognitive ability to have very many social rituals and to be creative in any way. These marine shells, however appear to have had a symbolic importance and were used as ornamentations similar to those of Africans. The researchers determined that it is possible for the Neanderthals to have come across AMH and to have developed some acculturation skills.

Theories Regarding the Interface of Neanderthals and Homo Sapiens

Currat M., Excoffier L. (2004) Modern humans did not admix with Neanderthals during their range expansion into Europe. *PLoS Biol* 2(12): e421. doi:10.1371/journal.pbio.0020421

The authors theorize that it is possible that interbreeding rates were as high as 25% among the AMH and Neanderthals even though no DNA lineage has been found among contemporary Europeans. In this study, the researchers present a realistic model of the range of expansion of AMH, as well as their competition and possible breeding with Neanderthals. They estimated that the interbreeding rate was 0.1%, which fits with the theory that the two populations were distinct species and did not interbreed. Although some of the research has been contradicted by more recent discoveries, the work is useful for showing that if interbreeding occurred, it was on a small scale.

Duarte, C, J. Maurício, P.B. Pettitt, P. Souto, E. Trinkaus, H. van der Plicht, and J. Zilhão. 1999. The early Upper Paleolithic human skeleton from the Abrigo do Lagar Velho (Portugal) and modern human emergence in Iberia. Proceedings of the National Academy of Sciences, 96:7604–7609.

An early Upper Paleolithic human skeleton was found in Portugal. The skeleton seems to have been of a 4-year-old child. The cranium, mandible, dentition and postcrania present both modern human and Neanderthal features. This finding indicates possible admixture between Neanderthals and early modern humans dispersing into southern Iberia.

Hublin, J. et al. New Radiocarbon Dates from the Grotte du Renne and Saint Césaire support a Neanderthal Origin for the Châtelperronian. Proceedings of the National Academy of Sciences, October 29, 2012.

The authors used a series of accelerator mass-spectrometry radiocarbon dates on bone fragments found at Neanderthal sites to disprove the admixture hypothesis of Châtelperronian artifacts. They claim that Châtelperronian artifacts are indeed of Neanderthal origin. They find that the production of body ornaments postdates the arrival of modern humans in neighboring regions of Europe and conclude that artifacts are a result of cultural diffusion from AMH to Neanderthal groups.

Jolly, C. J. (2001). A proper study for mankind: analogies from the papionin monkeys and their implications for human evolution, 204, 177–204. doi:10.1002/ajpa.10021

This article looks at papionin primates, baboons, mangabeys, and mandrills, which are genetically similar to AMH and Neanderthals. Phyiscally they are different enough so that hybridization studies can give insights into how genes flow between related primate species. Researchers can assume that the hybrids will have the characteristic features of

their parents and give insight about their genes. Allotaxic apes share qualities of both primates and could become a distinct species if they are isolated from their parent populations and forced to reproduce only among themselves. They are noted to live at borders between populations of different ape species. Allotaxic organisms have very diverse genetic and physical qualities. Resarchers with access to living allotaxic species have a hard time characterizing them using only observable qualities and not genetic testing. The article provides insights into how researchers can attempt to determine the potential genetic connections between AMH and Neanderthals. They conclude that it may be impossible to do because of lack of DNA evidence from AMH and Neanderthals of that time period.

Karavanic, I., & Smith, F. H. (1998). The middle upper Paleolithic interface and the relationship of Neanderthals and early modern humans in the Hrvatsko Zagorje, Croatia. *Journal of Human Evolution*, 3(34), 223–248. Retrieved from http://www.ffzg.unizg.hr/arheo/prap/1. Karavanic, Smith.pdf

The authors present a detailed analysis of artifacts from Croatia. They claim that the mixture of artifacts was not due to geological mixing but represents cultural assemblage. They conclude that through imitation of or trade with early modern people, Neanderthals acquired and used Upper Paleolithic tools such as bone points.

Mellars, P. (1989). Major issues in the emergence of modern humans. *Current Anthropology*, 30(3), 349–385. Retrieved from http://www.jstor.org/discover/10.2307/2743534?uid=3739832&uid=2&uid=4&uid=3739256&sid=21102238717601

Mellars reviews the debate about how Neanderthals behaviors transitioned into modern-day behaviors. He states that it is important to note that Neanderthals and AMH coexisted and were not simply replaced by AMH. It is his belief that knowing the Neanderthals various behaviors is key to understanding how their interactions occurred.

Mellars, P. (2004). Neanderthals and the modern human colonization of Europe. *Nature*, 432, 461-465. doi: doi:10.1038/nature03103

This article reviews the DNA and archaeolgoical evidence of Neanderthal life, from their interactions with AMH to their extinction. DNA evidence suggests that Neanderthals and AMH had minimal interbreeding. It is, however, possible that over time all evidence of Neanderthal genes in the European genome have been eliminated. It is also possible that because AMH had superior cognitive skills and powers, it allowed them to create better technology than Neanderthals to help them survive in the world.

Neves, A., & Serva, M. (2011). Extremely rare interbreeding events can explain Neanderthal DNA in modern humans. arXiv preprint arXiv:1103.4621, 1–26. Retrieved from http://arxiv.org/abs/1103.4621

Neves and Serva use mathematical models to measure the degree of exchange necessary between Neandethals and AMH to produce just 1 to 4% of DNA in modern day non-Africans. It has been noted that this small portion of DNA can be found in non-Africans and has Neanderthal origin. The assumption is based on archaeological evidence. The authors conclude that a very small exchange can contribute to this amount of Neanderthal DNA remaining in the human population. Thus, it holds up the theory that there was at least some contact and interface between AMH and Neanderthals.

Relethford, J. (2001). Absence of regional affinities of Neandertal DNA with living humans does not reject multiregional evolution. *American Journal of Physical Anthropology*, 98, 95–98. Retrieved from http://onlinelibrary.wiley.com/doi/10.1002/ajpa.1060/abstract

Relethford uses computer models to explain that modern theories about AMH and Neanderthals may be faulty and even false. Many in the field believe that the current DNA evidence suggests that AMH came from Africa and had no genetic contribution from Neanderthals. If Neanderthals contributed DNA to AMH, intuitively their contribution would be more common among Europeans. No trend is observed, however, suggesting that no DNA contribution from Neanderthals was ever made. Relethford belives this theory may be false. He believes Neanderthals could have made contributions to AMH DNA that would not show a regional specificity for Europe. As such, we cannot say conclusively that no DNA contribution was made by Neanderthals toward AMH.

Smith, F. H., Janković, I., & Karavanić, I. (2005). The assimilation model, modern human origins in Europe, and the extinction of Neandertals. *Quaternary International*, 137(1), 7–19. doi:10.1016/j.quaint.2004.11.016

This article is an authoritative review of the different theories of how modern-day humans and Neanderthals are related based on archaeolgoical and genetic information. Evidence shows that Neanderthals and AMH were distinct from each other in terms of morphology, ontogeny, mitochondrial and nuclear genetic information. Archaeological evidence suggests that AMH entered regions where Neanderthals existed in later periods and there was only a brief overlap between the two species. Current consensus believes that AMH came from common ancestors in Africa and Neanderthals are their own

distinct species. There is strong DNA evidence for this theory and very little genetic exchange between the two different species.

Trinkaus, E. (1986). The Neanderthals and modern human origins. *Annual Review of Anthropology*, 15(1), 193–218.

Trinkaus discusses the origins of AMH and how they were affected by Neanderthals. The author believes that Neanderthals played not only a cultural, but a biological role in the origins of modern humans. He also examines the major shift in human biology and behavior during the Upper Pleistocene.

Caron F, d'Errico F, Del Moral P, Santos F, Zilhão J (2011) The Reality of Neandertal Symbolic Behavior at the Grotte du Renne, Arcy-sur-Cure, France. *PLoS ONE* 6(6): e21545. doi:10.1371/journal.pone.0021545

The authors explain how the Châtelperronian, which is an archeological culture of Neanderthals containing ornaments and decorated bone tools, was the result of nearby early modern humans. The authors claim that sites with these artifacts cannot be used to state that symbolically mediated behavior was shared with Neanderthals and that the association may reflect intrusion of symbolic artifacts from the nearby AMH sites.

Existing Ideas on the Personality and Behavioral Attributes of Neanderthals

Arensburg, B., & Tillier, A. M. (1991). Speech and the Neanderthals. *Endeavour*, 15(1), 26–28. Retrieved from http://www.sciencedirect.com/science/article/pii/016093279190084O

The authors discuss the ability to communicate using speech, a critical step in human evolution. The discovery at Kebara of a hyoid bone from a Neanderthal man shows that Neanderthals had developed the necessary anatomical structures to articulate words.

Finlayson, C. (2004). *Neanderthals and modern humans: An ecological and evolutionary perspective.* Cambridge, UK: Cambridge University Press.

Finlayson provides evidence to show that Neanderthals became extinct because they could not adapt quickly enough to the ecological and environmental conditions around them. Unlike the AMH, they were not able to change their personalities, behaviors, and overall being in the face of a changing climate.

Gamble, C. (2011). Neuroscience: Neanderthals in mind. *Nature*, 4–5. Retrieved from http://www.nature.com/nature/journal/v479/n7373/abs/479294a.html

Gamble provides a good introduction into the personality and behavioral traits of Neanderthals. It is clear that the current fossil records show unimpressive intelligence. There is little innovation in tools, few rituals, and no art present in the lives of Neanderthals based upon fossil records. The author highlights nine personality traits that suggest Neanderthals were xenophobic, Neanderthals were resistance to change, dogmatic, uninterested in exploring new territory, very pragmatic, stoic, risk-tolerant if hungry, and community oriented. They were also family focused and supported disabled members of the community. This article provides a good introduction to the topic of personality and behavioral attributes to Neanderthals.

R. E. Green, J. Krause, et al. (2010). A draft sequence of the Neandertal genome. *Science*, 328:710–722

A draft sequence of the Neanderthal genome was composed of more than 4 billion nucleotides taken from three Neanderthal skeletons. The genome was then compared to five present-day humans from different parts of the world. A number of genomic regions (such as those involved in metabolism and cognitive and skeletal development) seemed to

have been affected by positive selection in AMH. The research strongly suggests that modern humans and Neanderthals interbred and that all non-Africans today have Neanderthal gene fragments in their genetic codes. The study also found that disorders such as autism, Down syndrome and schizophrenia are linked to Neanderthal genes.

Holden, A. (2005, June 08). Inside the Neanderthal mind. Retrieved from http://www.thenakedscientists.com/HTML/articles/article/anneholdencolumn1.htm/

The author of this webpage article reviews the different beliefs and theories about Neanderthals. Her explanations allow readers to read and understand more clearly what researchers write. She discusses research regarding the cognitive differences between Neanderthals and AMH and regarding Neanderthal personality. She mentions Neanderthals having high levels of bravery, low harm avoidance and being opportunistic.

Pearce, E., Stringer, C., & Dunbar, R. I. M. (2013). New insights into differences in brain organization between Neanderthals and anatomically modern humans. Proceedings of the Royal Society Biological Sciences, 280(1758), doi: 10.1098/rspb.2013.0168

The authors show that Neanderthals and AMH did not have the same brain size and the same size of their visual systems. Neanderthals had a significantly larger visual system and a greater body mass, with a resulting smaller endocranial capacity. This has many implications on personality and behavior because of social cognition and brain organization. The authors argue that this altered the Neanderthal behavior and explains why they were not considered very social.

Pearson, O. M., Cordero, R. M., & Busby, A. M. (2006). How different were Neanderthals. In K. Harvati & T. Harrison (Eds.), *Neanderthals Revisited: New Approaches and Perspectives* (pp. 135–156). Dordrecht, The Netherlands: Springer.

The authors of this complied work discuss the ways of life of Neanderthals. They explain that there are hints to their behaviors and personalities in the archaeological evidence, which shows that anatomically modern humans (AMH) and Neanderthals had different personalities and behaviors.

Pettitt, P. B. (2000). Neanderthal lifecycles: Developmental and social phases in the lives of the last archaic. *World Archaeology*, 31(3), 351-366. Retrieved from http://www.jstor.org/stable/125106

Pettitt suggests that at a very early stage of development there would be no apparent differentiation along sexual or age based lines (due to a relatively short lifecycle). He also suggests that Neanderthals gained status through physical achievements and accumulated knowledge. Because the author doubts that language played a major role in structuring Neanderthal social systems, he suggests that it was the body, its development and interaction with others that served to some extent to structure the social aspects of the individual Neanderthal lifecycle.

Pickard, C., Pickard, B. & Bonsall, C. (2011). Autistic Spectrum Disorder in Prehistory. *Cambridge Archaeological Journal*, 21, pp 357–364 doi:10.1017/S0959774311000412

The authors discuss the possibility that Neanderthals possessed traits of autistic spectrum disorder because of the possible personalities and behaviors they exhibited. The authors state that it is possible, but there is no evidence to prove this just yet. There are complex genetic components to such disorders that are visible in modern-day humans. Without similar genetic components from Neanderthals, it is impossible to tell if the disorder manifested the same way among Neanderthals.

Reser, J. E. (2011). Autism spectrum in terms of natural selection and behavioral ecology: the solitary forager hypothesis. *Evolutionary Psychology*, 9(2): 207–238. Retrieved from http://www.epjournal.net/wp-content/uploads/EP092072382.pdf

Reser examines how autism personality traits may have played a role in evolution. The author claims that individuals on the autism spectrum would have had the mental tools to be self-sufficient foragers in environments marked by limited social contact. Their tendency for obsessive, repetitive activities would have been focused by hunger and thirst toward the learning and refinement of hunting and gathering skills. He claims that since contemporary autistic children are fed by their parents, hunger does not guide their interests and activities. They are able to obtain food free of effort and therefore their interests are redirected toward nonsocial activities, such as stacking blocks and flipping light switches.

Wynn, T., & Coolidge, F. L. (2004). The expert Neanderthal mind. *Journal of Human Evolution*, 46(2), 467–487. Retrieved from http://www.uccs.edu/~faculty/fcoolidg/Neanderthal JHE 2004.pdf

The authors discuss the cognitive neuropsychology, anthropology, and archaeology that are combined to show what true Neanderthal cognition was like. They argue that even though we may not have archaeological evidence to prove what Neanderthal behavior and personality was like, we are able to piece together what we do know about them to create a reasonable understanding of it.