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Neanderthal Fiber Technology Innovations and the Reduction of the Biological Cost of Having Offspring

Dana Song[1] and James Woodall[#]

[1]Horace Mann School
[#]Advisor

ABSTRACT

Many laypeople often consider Neanderthals (400 kya to 40 kya) to be our cognitively inferior forebears. Recent interdisciplinary research, however, has contended that Neanderthals were much smarter than our prejudices allow. Archaeological findings of technologies – like digging sticks and woven cordage – indicate that Neanderthals had the capacity to make tools to aid their life processes. As such, Neanderthals innovated technologies related to weaning in order to reduce its energetic demands. By using research from archaeology, anthropology, and dental morphology concerning Neanderthal weaning, this paper contends that Neanderthals had much greater cognitive abilities than many have previously thought.

Introduction

Neanderthals are often thought of as being our intellectually inferior forebears. Recent research – ranging from archaeology to anthropology – however, has undermined many of these prejudices. Archaeological and anthropological researchers have uncovered numerous artifacts, proposed various evolutionary models for birth intervals, and researched a multitude of anthropological accounts and case studies of various hunter-gatherer cultures and societies in the contemporary world to contend that Neanderthals actually had relatively advanced tools, technologies, and behaviors. These advanced technologies are exhibited especially in regard to Neanderthal weaning. Researchers define weaning as the "end of lactational dependence," or the "complete cessation of breastfeeding [that] recognizes that nonmilk foods will be added to the diet of the infant" (Dettwyler, 1995; Nava et al., 2020). By studying Neanderthals' use of weaning technologies, we may learn more about why Neanderthals went extinct while also discovering behaviors and intellectual capacities that may not be the sole domain of homo sapiens. This literature review will, thus, seek to piece together disparate research on Neanderthals to argue that they were more advanced than previously thought by understanding the importance of weaning for members of the homo genus, the Neanderthal use of various tools like diggings sticks and weaved cordage, modern anthropological comparisons, and dental morphology.

Discussion

Isotopic Evidence

Many scholars have used isotopic evidence to suggest that Neanderthals had similarly short weaning times like modern-day homo sapiens. As such, anthropologists have used dental growth rates to conclude that Neanderthal weaning began at "5 to 6 months… akin to modern humans, implying similar energy demands during early

infancy," which follows a similar timeline when compared trajectories to modern humans (Dettwyler, 1995; Nava et al., 2020).

Dental Evidence

Austin et al. (2013), as well as Nava et al. (2020), found that early-life dietary shifts can be tracked in the composition of matter in dental tissue. They determined this by using modern humans and macaques as a control. They monitored barium distributions in their teeth while the juvenile primates were weaning. Through findings obtained from the experiments with contemporary juvenile primates, Austin et al. found from Neanderthal teeth that Neanderthal mothers nursed infants for seven months, supplemented breast milk with other foods for seven months, and abruptly stopped breastfeeding at about 1.2 years (Austin et al., 2013; Nava et al., 2020). Likewise, Bocherens (2009) also found that teeth collagen reflects the first few years of an individual's life, but contended that it is very difficult to reconstruct the Neanderthal diet since the teeth mark such a short amount of time. Therefore, Bocherens could not conclude what the infant Neanderthal diet or weaning period was but ultimately inferred that the isotopic data from Neanderthals suggest that the barium levels in their bones were consistent with other carnivorous mammals like wolves, hyenas, and lions. For Bocherens, this "rigidity" in the Neanderthal diet perhaps led to their extinction (Bocherens., 2009). Although it is often difficult to reconstruct the diets of Neanderthals from teeth and bones as one easily can do for living mammals because of poor collagen preservation, there have been some studies that have found Neanderthal weaning times similar to modern humans, which is about 1.2 years as compared to other nonhuman primates who breastfeed between 2.5 and 7 years (Dettwyler, 1995).

Neanderthal Technologies: Digging Sticks to Weaved Cordage

Within the last thirty years, researchers have unearthed 300,000-year-old wooden Schöningen spears in Germany, and wooden Poggetti Vecchi digging sticks from a Middle Paleolithic site, for example, that suggest an advanced usage of technologies by Neanderthals (Hoffecker, 2018). Digging sticks are used in various ways such as to grind plant materials, hunt small game, and dig roots and tubers" (Hoffecker, 2018). Based on the locations of these sites and the use of electron spin resonance and U-series minimum dates, scholars have estimated their dates of creation to attribute them to Neanderthals. Hardy et al. (2020) believe that Neanderthals had advanced knowledge of trees since "they chose boxwood for its density and use for in the production of 'digging sticks'" and made Schöningen spears with "[decentered points] to increase strength." Additionally, at the sites of Konigsaue and Inden-Altdorf in Germany, researchers discovered that "Neanderthals were manufacturing birch bark tar" (Hardy et al., 2020). Since these artifacts required assembly and the creative application of multiple techniques, Neanderthals may have had a deeper understanding of the various methods and materials needed to make these tools than previously recognized. As Hoffecker (2018) notes, these findings have "implications for the cognitive faculties of their makers." Hoffecker suggests that when the "Chomsky Hierarchy" – a method of inferring basic knowledge needed for increasingly complex steps – is applied to the creation of the Schöningen spears and Poggetti Vecchi digging sticks, researchers can gain more insight into the cognitive development of Neanderthals. As Hoffecker (2018) suggests, "the artifacts, which include mechanical instruments and facilities, such as spear-throwers and even self-acting mechanical facilities or automata (e.g., snares/traps), require the computational complexity (and working memory capacity) of an unrestricted grammar or natural language." If Neanderthals may have indeed had the cognitive capabilities to create more complex technological innovations, then it is quite possible that they employed similarly advanced technology to aid with the weaning of children.

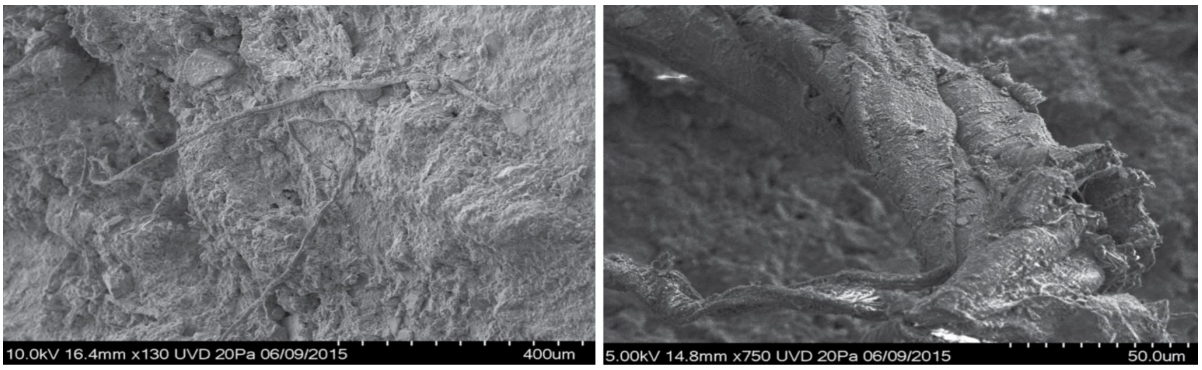

Figure 1. Scanning electron microscope images of fiber found at Abri du Maras, Southeastern France. The left is a photo of untwisted fiber, while the one on the right is a photo of multiple fibers with a "Z twist" (Hardy et al., 2020).

Neanderthal may have also used weaved cordage, which is made from wood fiber, to create weaning technologies, such as slings used to carry offspring. Unfortunately, fiber artifacts are rarely found due to both their perishability and the small number of archaeologists trained to recognize them. A cordage fragment, however, was found at Abri du Maras, a valley near the Ardeche River in Southeastern France. Researchers Hardy et al. (2020) believe that the examination of "a 3-ply cord fragment made from inner bark fibers on a stone tool recovered in situ" showed direct evidence of fiber technology that could have been used to make clothing, bags, and other useful tools. As depicted in Figure 1, photomicrographs reveal three bundles of fibers in a Z twist that form a 3-ply cord, which could thus be used to create simple technologies like a bag or trap. Researchers also have used more indirect methods to hypothesize about the use of weaved cordage by Neanderthals. By examining the fossilized prey bones at confirmed and dated sites like Les Canalettes, France, Cochard et al. (2012), for example, have found that there is evidence of mass game procurement by Neanderthals of leporids (rabbits) through using netting derived from weaved cordage. As fast-game, like rabbits, were difficult to catch, the fact that there are specific patterns of damage observed on rabbit bone elements dated to the Late Pleistocene (a time, in which Neanderthals thrived) suggests that the Neanderthals employed advanced methods of mass-game harvesting like netting, fencing, water, and/or fire. The preservation of twisted fibers presented here emphasizes the point that other activities such as the procurement of raw material for the manufacture of string should be taken into account when reconstructing past lifeways. Thus, the preserved cordage from the Abri du Maras and rabbit bone fragments from the Les Canalettes sites, in tandem with the Schöningen spears and Poggetti Vecchi wooden digging sticks, support the hypothesis that Neanderthals had the requisite cognitive capability needed for the innovation of weaning technologies.

Therefore, we have established that Neanderthals *may have* been capable of creating weaning technologies, such as slings to carry children. But what would drive the need for the creation of such weaning technologies?

The Energetic Demands of Raising Offspring

Firstly, the energetic demands of carrying offspring were significant enough, one can contend, to prompt the creation of technologies to aid such exertion. Hominin mothers were often responsible for gathering food when the men were unable to hunt successfully. While gathering food, hominin mothers often would have also had to hold their children, which created additional physical and metabolic demands (Shostak, 1981). In order to successfully raise a child, a Neanderthal mother would have to eat enough food to successfully lactate, while also maintaining enough energy to gather food. So, technological innovations such as slings made from weaved

cordage, similar to the material found at the Abri du Maras site, would have reduced this energetic cost, and helped ensure that Neanderthal mothers would have enough energy to gather sufficient food while also raising their offspring.

The energetic cost of carrying offspring is just one part of the biological cost of raising children. Kramer et. al (2015) note that in order for the patterns of raising children to evolve into modern-day trajectories, hominin mothers must have had help to reduce this biological cost in order to raise more offspring. The opportunity cost of raising one child is to devote enough energy that ensures their survival, but mothers are left with not enough energy to rear more offspring. Thus, with the creation and usage of fiber technologies, the opportunity costs of raising another child were thereby reduced because they lessened the physical demands of carrying children. The ability to raise more children creates an increased chance of genetic viability, which is favored by Darwin's theory of evolution.

Alloparenting

Kramer et al. (2015), however, propose that cooperative breeding, "a reproductive system in which nonparental members of the social group help to support offspring or other mothers," emerged as an evolutionarily adaptive trait beyond technological advancements that would also offset the biological cost of raising multiple offspring. In their discussion, they proposed thorough evolutionary models that incorporate various parameters such as "shorter birth intervals, increased offspring survivorship, juvenile dependence, and older ages at dispersal" (Kramer et al., 2015; Russell, 2004). Since the average birth interval was reduced over time, the researchers argue that cooperative breeding was one way that hominin mothers were able to reduce the biological cost of raising children and thereby increase their number of offspring. Others refer to the phenomenon of individuals in a community raising children that are not biologically theirs as "alloparenting." While alloparenting may have played a role in reducing the biological cost of raising children, the technologies that Neanderthals were capable of creating suggest that they plausibly could have also used technological innovations such as slings to lessen the physical burden of carrying offspring.

Weaning Technology

Weaning length in contemporary indigenous populations can provide insight into Neanderthal weaning technologies because it could potentially show how these indigenous groups have adapted to their environments using limited resources. In order to devote their milk and nutritional resources to another child, hominin mothers may have weaned the other children they had been raising at the time. In an anthropological account of the !Kung women, anthropologist Marjorie Shostak stated that among the Dobe !Kung, "the mother breastfeeds the baby until either the baby dies, the baby outgrows the need or desire for breast milk (4-6 years), or the mother becomes pregnant again" (Shostak, 1981). However, the biological cost of devoting energy to successfully raising one child is the energy that could have otherwise been used to raise more offspring, or as Shostak noted "the rate of growth is limited by the mother's ability to deliver energy to her offspring." Since mothers had to carry children while gathering food, there were significant physical demands on Neanderthal women. Therefore, if a sling or other weaning technology could be used to save some of the energy that would have otherwise been expended while gathering food while also carrying children, this would reduce the average birth interval or time between having more children (Shostak, 1981).

Conclusion

Archaeological artifacts, anthropological accounts, dental morphology, and proposed evolutionary models can all be used to shed light on the various weaning technologies Neanderthals may have used. These weaning technologies, in turn, can be studied in relation to the change in average birth intervals throughout evolution as a function of the physical demands and energetic cost of carrying children. Thus, Neanderthals were much more technologically and, more importantly, cognitively advanced than many might assume. Weaning technology is just one example of a larger network of tools from Neanderthal behavior and culture. Future research and contemporary advancements will only further corroborate current scholarship that undermines common assumptions about limited Neanderthal mental capacities.

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