Chapter 4

Strong differences in Neandertal and AMH cannot be inferred from ethnographic evidence for skill and learning in hunting

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Abstract

The majority of analyses of hominin learning processes focus on stone tools. However, stone tool production is just one of many skills that were important for forager survival and success in the past, of which hunting strategies are one of the few documented in the Palaeolithic record. This chapter focuses on hunting skills, as a supplement to lithic studies addressing learning processes in Neandertals and anatomically modern humans. Based on the ethnographic record, the content to be learned while hunting includes a wide range of different sorts of skills and information, some of which are situation-specific. The similarities and relatively subtle differences in the record for hunting behaviour between the Middle and Upper Palaeolithic make it unlikely that there was a substantial contrast in the content to be learned or processes involved in acquiring hunting skills. Among contemporary hunters, various older individuals undertake some teaching and also frequently provide small tools, take children on hunting trips, and tell hunting stories. Children enthusiastically engage in their own hunting exploits and games with weapons. The widespread distribution of such activities suggests benefits for the speed and quality of learning, among other factors. It is not unlikely that AMH and Neandertals, for whom hunting was an important skill, also employed some of these processes.

Keywords

Hunting, skill learning, ethnography, children, Middle and Upper Palaeolithic

4.1 Introduction

This volume addresses archaeological perspectives on Neandertal learning processes and implications for their replacement by anatomically modern humans (AMH). Differences

in learning processes could be expected to influence the acquisition of complex subsistence and technological skills, the capacity to improve upon such skills and to modify them to cope with changing circumstances. If such differences can be identified, they could help to explain Neandertal replacement by AMH, because they are likely to have influenced survival skills and the outcome of any competition for resources.

A number of possible differences in learning processes could have had strong effects on survival skills and the outcome of competition. The unique characteristics of humans, including the very diverse niches we occupy, are often attributed to a strong reliance on social learning (Hill et al. 2009). An important element of this is thought to be proficient imitation learning (Richerson and Boyd 2005: 108-110). This seems to involve a tendency to copy actions rather than outcomes (Horner and Whiten 2005) based on a distinctive motivation for imitative conformity (Tennie et al. 2009). However, it may be difficult to acquire very complex craft skills (for example, reconstruct rapid hand movements) by imitation alone (Sterelny 2012; Tehrani and Riede 2008) and teaching may improve social transmission of stone tool production while imitation does not (Morgan et al. 2015). Csibra and Gergely (2011), emphasise the benefits of teaching particularly when it is not clear why an individual performs a particular series of actions. While Sterelny (2012: 36–37) agrees on the importance of both individual adaptations for social learning and teaching (including communication), he points out that adults often enrich the learning environment rather than carry out direct instruction.

Some authors have suggested that learning from parents is very important for the transmission of complex skills. Because teaching requires effort and time investment on the part of the teacher, Shennan and Steele (1999) argue that more complex skill learning in human evolution developed alongside an increased investment in teaching by parents to young children. Other authors have modeled a number of mechanisms by which non-vertical transmission can lead to cultural adaptation (Richerson and Boyd 2005; Henrich and McElreath 2003). Teaching and regular cooperation in non-kin groups are more frequent among cooperatively breeding species (Hoppitt et al. 2008; Hill et al. 2009), and cooperative breeding in humans is likely to be associated both with teaching, trust in teachers and an inclination to help non-kin (Hill et al. 2009). All of this suggests that non-vertical transmission is likely to play a productive role in human culture. Play provides a

context for learning from other children (and presumably individual learning) although the role in social learning is not well understood (Hewlett et al. 2011; Kamei 2015).

Kaplan and colleagues (2000) argue that the high quality, difficult to acquire resources consumed by humans require high levels of skill, knowledge, strength and coordination while foraging. According to these authors, acquiring foraging skills takes hunter-gatherers all of childhood (and some of early adulthood), hence they suggest that a complex foraging niche co-evolved with a long developmental period (alternatively, a longer post-reproductive lifespan may have been key - (Blurton Jones et al. 1999)). The 'embodied capital' hypothesis does not specify the learning processes involved in the acquisition of complex foraging skills, but does suggest that the length of time available for learning, related to the developmental period, was important. However the time required might be reduced by relatively efficient learning processes.

Overall, the literature on human cultural learning suggests that a focus on imitation and teaching, and the development of an information rich 'learning environment' as well as a range of people to learn from and to some extent time available to learn could affect the capacity for adjusting to circumstances and degree of foraging and technological skill of Neandertals compared with AMH.

Typically, in this volume the majority of analyses of hominin learning processes focus on lithic studies. Lithics offer rich evidence for hominin behavior over the last 2.6 my (and possibly longer). Further, as Bamforth and Finlay (2008: 3) point out, 'A century or more of experimental replication… provides a sophisticated and detailed body of knowledge that helps to make sense out of the data provided by the archaeological record: we know what it takes to make flaked stone tools'. In addition, there is some evidence that the acquisition of knapping skills, even at the level evident in Lower Palaeolithic archaeology, requires extended practice (Nonaka et al. 2010). Experimental studies have provided insights into the cognitive processes involved in lithic production (Stout et al. 2000), and suggested that teaching improves social transmission of simple stone tool production skills but imitation and emulation do not (Morgan et al. 2015). Further, an ethnographic study has documented in detail the apprenticeship structure of learning ground stone axe production in Indonesian Irian Jaya (Stout 2002).

However, stone tool production is just one of many skills that were important for forager survival and success in the past. Of these, hunting strategies are one of the few other behaviours documented in the Palaeolithic record. As discussed further below, hunting by contemporary foragers is described as a complex skill, with a diverse and extensive learned content. In addition, hunting was probably particularly important for Neandertal and AMH survival in mid-latitude Europe, where the short growing season seasonally limits the availability of plant food (Roebroeks 2001). This article therefore explores the potential of hunting to further illuminate hominin learning processes.

Ethnographic analogy is one of the key approaches to hominin learning behaviours (Stout 2002). Ethnographers have the opportunity to observe and record learning behaviours in hunter-gatherer populations which share some important characteristics that are likely to have implications for learning strategies, including mobility, small population size, minimal hierarchy and lack of storage (Hewlett et al. 2011; Marlowe 2005). These populations also often practice traditional subsistence skills on a daily basis. Ethnographic accounts often highlight the complexity, social elements and variation in particular skills and activities. However, dedicated studies of learning by hunter-gatherers are very scarce, and some subtle differences in learning processes (e.g. imitation versus emulation) may not be observable through participant observation (Hewlett et al. 2011). In addition, hunter-gatherer populations have experienced widespread changes, and perhaps most importantly for studies of skill learning, use relatively complex technology (Marlowe 2005). This has implications for the strategies employed and probably also for how children learn to carry them out and to use tools.

This chapter focuses on learning hunting skills, as a supplement to lithic studies addressing learning processes in the Middle and Upper Palaeolithic. I will begin by outlining the content of hunting, with the aim of showing that there is quite a lot to learn and providing some pointers to possible learning processes. I will then summarise what we can say about how this content is acquired (what learning behaviours are involved) based on studies of current and recent hunter-gatherers, and place this in the broader context of studies of hunter-gatherer skill learning in general. These sections of the chapter are based on cross-cultural reviews of the ethnographic literature (MacDonald 2007a; MacDonald 2007b), focusing on hunter gatherers but also considering other

traditional subsistence societies, with some additional examples. I will then discuss the inferences that can be made about (potentially different) learning behaviours when comparing the Neanderthal and Modern Human archaeological records, starting with a brief review of the Middle and Upper Palaeolithic record for hunting.

4.2 What is the Content to be Learned When Hunting?

Descriptions of the hunting knowledge acquired by children and employed by adult hunters in a range of contexts (among Yanomamo and Huaorani hunter-gatherers in the Amazon, and San from north-west Botswana) give an impression of the range of content to be learned in order to be a successful hunter.

> ‘By the age of 14, a boy accompanies his brother or father into the forest to hunt. He knows what arrow point is most suited to specific animals and birds. He has a good sense of direction. He knows the sounds, footprints and markings of every animal. He has already heard their advice and wisdom as to the tracks of each animal, where they are likely to rest and roam, their scent, and what food they eat. (Once, while we were hiking in the depths of the rainforest, my guide showed me the prints of a tapir, then told me it had passed by recently and was likely a female.) Older boys are already physically strong enough to quickly pursue wild pigs or monkeys. If his arrow comes to rest in a tree, he can climb the tree with ease to retrieve it. In shooting an arrow, he has a good sense of where the arrow will land should he miss his mark. After shooting one arrow, he may rapidly pursue the animal, and return to the location of his first shot arrow some time later. He learns to call the two toucan species by placing a leaf in his hands and producing a shrill whistle. With a low hum he calms the trumpeter and curassow birds. Another whistle beckons the tapir, another the furry bearded smaller monkey.’ (Peters 1998, 90-91).
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> ‘By the time a boy is 5 years of age he should be proficient enough with a blowgun to hit consistently targets of fruit or leaves set up by his older male kinsmen. By the time he reaches puberty, he will have an extensive knowledge of the calls, nesting habits, breeding behavior, feeding cycles, and habitats of a large

number of species, and will know which animals to expect around a given species of tree, both when it is flowering and when is it fruiting.

Undoubtedly, the Wao hunter depends more upon hearing than upon any other sense to locate potential game. He learns to distinguish among the animals in the canopy by the sounds they make as they move: the frequency of the movements, the loudness of the rustling leaves, the distance between movements, and the kind of tree the animal is in are all clues to the species. It is not unusual for hunters to know what kind of animal is present long before they see it or hear it call.' (Yost and Kelley 1983, 194)

'By the age of thirty a man enters the most productive period of his hunting career, which is likely to extend for at least fifteen years. During this time, he will walk between 1200 and 2100 miles a year in the pursuit of the fifty-five species of mammals, birds, reptiles, and insects considered edible. He will use various methods to capture animals living above and below the ground, including knocking them down with sticks, snaring them, chasing them with or without dogs, and hunting them in the classic style with poisoned arrows and spears. Relying on his own and other people's knowledge of environmental conditions, he will decide in which direction the hunters should go on a particular day. He may also pay close attention to magical sources—dreams and divination discs—that are thought to provide information on the whereabouts of animals… He may hunt alone or with others. When he hunts with others, he will use secret names to refer to animals being pursued, and the hunters will communicate by hand signals and whistles so as not to disturb the game.' (Shostak 1981, 84-85)

These descriptions indicate that the content to be learned is very diverse varying from physical skills – climbing a tree, rapid pursuit – to information about animal characteristics and behavior – from typical calls to food preferences – to territory, folk physics and communicative signals. Hunters are also described as being familiar with the habitats and landscape features of their region (MacDonald 2007b, 117-118). Some of the content described in these quotations is highly situation specific – for example, subtle variations in sound are crucial for locating prey in the Amazon rainforest. It is also diverse. As Shostak points out, human hunters cover a large area (much larger than the

territory exploited by apes although some carnivores can be as wide ranging (Grant et al. 1992)), hunt a large number of species; and employ diverse techniques (Kaplan et al. 2000), so there is a large bulk of information involved. It is also in-depth (for example, Blurton-Jones and Konner (1976) describe very detailed accounts by San hunters of how lions go about eating their prey). Extensive social as well as ecological knowledge is important in successful hunting – as described above, hunters sometimes use special signs and sounds to communicate without disturbing prey, and they also need to be familiar with the characteristics and likely responses of hunting partners, as well as the activities of a wider range of people possessing useful information. These quotations undoubtedly miss some important content, especially if the broader content of hunting is considered – some examples would include butchery techniques and how to distribute meat. Further, a number of authors emphasise the additional challenge of integrating various different aspects of hunting knowledge with new information and responding to distinctive, changing circumstances during a hunting episode – this capacity can also be seen as a part of the learned content of hunting (Puri 2005, 270). It seems likely that a similar diversity of learning processes should be used to learn such varied hunting content, and the integration of information and skills in particular circumstances is likely to depend on personal experience.

As Nelson describes, even an experienced hunter lacking some of this knowledge in a novel context may fail:

> 'Today's hunt was one of the first hunting experiences I have had where I could not figure out what was going on. All of the reasons behind the hunters' movements – their locating the moose, their circling round, their waiting here or stopping there – all of these things were complete mysteries to me while they were taking place. … I realized that moose hunting is anything but simple. It requires great knowledge of the moose, of tracking and stalking, of the country, and of certain techniques for locating, intercepting and driving the animal. A novice could fortuitously kill one now and then, but he would not be a real moose hunter until he had learned a great deal indeed'(Nelson 1973, 85-86).

In particular, a number of authors particularly stress the breadth and attention to detail of hunter-gatherer knowledge of animal behavior (Blurton Jones and Konner 1976,

338-339; Tanner 1979, 43; Gusinde 1931, 1593). ‘Every Mistassini hunter knows by observation and teaching the natural habits of the animal species he encounters. Sights and sounds when in the bush are constantly interpreted in terms of information about plant and animal populations’ (Tanner 1979, 43). Knowledge of animal behaviour includes physical characteristics, calls, tracks, food preferences and relationships with other species of animals and plants (Mithen 1990, 73; Silberbauer 1981, 64). Hunting draws on knowledge about seasonal variation in animal behaviour, including diet, habitat preferences, social grouping, life history and mobility (Lee 1979, 212; Nelson 1973, 86-88). Seasonal variation and inter-species relationships in particular may take considerable time to observe (Frison 1998, 14578). The many different signs observed and interpreted speedily and efficiently and the knowledge of animal behavior used to track moving game have also impressed many anthropologists (Biesele and Barclay 2001; Lee 1979, 212; Liebenberg 1990). Some hunter-gatherers know a great deal about animals of economic value and less about other species (Mithen 1990, 73; Silberbauer 1981, 65-66), an example is the great knowledge about moose described by Nelson above. However, !Kung hunter-gatherers are described as very curious about animal behaviour in general, including information that may or may not be relevant in hunting (Blurton Jones and Konner 1976). Changeability in animal behaviour – for example a later departure or different route for a seasonal migration – mean that information must be updated. Some shortcuts may be taken in making decisions about hunting – for example, Mithen (1990, 64-65) describes the use of ‘calendar plants’ for ‘rule of thumb’ decisions about mobility and subsistence. Nevertheless, it is clear both that some knowledge about animal behavior is important in hunting and that this forms part of a wider range of content. Since information about animal behaviour can be shared linguistically, and a lot of information is needed, some of which it would take a long time to observe, social learning should have large advantages, although individual observation could also be important for staying up-to-date.

The content involved in using hunting weapons is of interest because of their archaeological visibility. Recent hunters employ a wide range of weapon systems, and the content to be learned to use different weapons varies. Spears are primarily used as thrusting spears (Churchill 1993), and the main challenges are to get close enough to the

animal in the first place and in and out safely. Using projectile weapons such as a bow and arrow still involves getting quite close to the prey (Churchill 1993, 18), 'keen eyesight and a steady hand' (Tayanin and Lindell 1991), a sense of the likely trajectory, assessment of the effects of wind or obstacles, and choosing a good target for partially obscured prey. 'Effective blowgunning demands the development of precision through the coordination of respiratory muscle control and 'intuitive' aiming' (Yost and Kelley 1983)'. While some of the techniques involved could be demonstrated effective deployment in particular situations is likely to be based on extensive practice.

This very diverse content to be learned in hunting presents a challenge in connecting recent hunting practices and learning to what happened in the past. While it is possible to identify very specific requirements of the task of stone tool manufacture, this is harder for hunting. Some broad categories of content, for example knowledge of animal behaviour, are always necessary, however what is involved varies a great deal between different contexts and there is no chance of finding a direct analogy given the changes in for example technology. Further, it seems possible that it is the whole package of content, and integrating different elements of hunting knowledge on the go, that is challenging.

Hunters vary quite substantially in skill and hunting success. According to van Beek (1987, 97), differences in individual ability and attitude to hunting and fishing are evident by age 12 among Bedamuni horticulturalists, and adult men encourage keener hunters by providing new tools. Lee (Lee 1979, 243) noted that 34% of San hunters were responsible for 79% of kudu killed. Similarly, according to Kent (1996), some San hunters bring in game on more than 30% of hunting trips and regularly bring in duiker and other medium-large animals, and also obtain higher volumes of meat weight per hunting attempt and observation day. These hunters do not necessarily spend more time hunting. In later discussion of the differences that can be inferred between Neandertal and AMH hunting, it is worth noting that a certain amount of variation between individuals is likely anyway.

4.3 What Can We Say about How this Content is Acquired (What Learning Behaviours are Involved) Based on Studies of Current and Recent Hunter-Gatherers?

4.3.1 Acquisition of hunting skills by current and recent hunter-gatherers

> ‘Boys are socialized at a very early age to aspire to be good hunters. When a boy is age five he plays with a small bow and a reed-like arrow that his father or brother has made for him. Holding his arrow point some 12 centimetres from a beetle, bug or cockroach in or near the yãno he aims and shoots. By the time he is eight years of age he will own an authentic bow and arrow, a smaller version of his father’s. Around the village, at the river bank, in the field, and in the wider open space of the mission post these youth pursue a variety of birds the size of sparrows and robins with great excitement and laughter. After almost every shot they excitedly shout, ‘Ooohh, I almost got him.’ Such activity can last several hours, and it is all part of honing their skills.’ (Peters 1998, 90).

As described here for Yanomami children, the youngest children play (with gusto) at tracking or hunting animals within a restricted area: in or around the camp or village and (sometimes when they are a bit older) around the fields or gardens and nearby paths (MacDonald 2007a, 393). In many cases adults or older children provide scaled down versions of hunting tools for children to play with (MacDonald 2007a, 390). There are many descriptions, like the one above, of children playing with miniature hunting weapons, or shooting at small prey, in areas around the village, forest camp, or fields and gardens (MacDonald 2007a). Sometimes older children or adults also teach young children how to use a hunting tool – for example, a photo by Marshall shows a San mother holding the arms of her very small son in position on a bow and arrow (Marshall 1976, 131). A description of how Kpelle children learn trapping skills illustrates the other subtle ways in which other people may influence a child’s learning by providing a model, raw materials, opportunities to practice, and a little advice.

> ‘At first, the boy merely tags along, as his father checks his traps, learning to attend to the salient stimuli of game and bush... Later, he will help his father gather materials to make the trap, then he assists in making and setting them. All this while, there is very little verbal interchange between the two. Then, the son

> will try to make his own trap. He can expect to get some advice and criticism from his father but not much… ' (Lancy 1996, 146-7)

Children acquire some manufacturing skills before they are ten (sometimes making parts of a trap or other tool), others in adolescence or adulthood (Hewlett and Cavalli-Sforza 1986; Tayanin and Lindell 1991, 16).

Martu children above the age of five often search for and pursue game animals, and are successful hunters within the constraints set by height and walking speed (Bird and Bliege Bird 2005). In a number of cases children start to accompany adults, most frequently fathers, on hunting trips and to check traps at around this age (MacDonald 2007a, 393-394); they may be carried on hunting and gathering trips by parents even earlier (Goodale 1971, 35). According to Puri (2005, 281), at age five and above adults emphasise general skills relating to survival, 'marking a trail, lighting a fire, sharpening a knife or spear, cutting and preparing rattan, building a shelter, what to do if hurt or lost.' On hunting trips, adults may answer some questions, point out plants or signs that show the presence of an animal, and are in one case described as giving active instruction (MacDonald 2007a, 392). When they allow children to accompany them, Penan hunters may hunt at any time of the day and combine hunting with other activities, contexts in which there is less pressure to remain silent (Puri 2005, 233-234).

Children learn to identify the animals in their environment, their behavior, habitats and tracks, by observation, often while play-hunting with peers (Lee 1979, 236; van Beek 1987, 96; Tayanin and Lindell 1991, 15). Children imitate bird and animal calls, and study and copy animal tracks (MacDonald 2007a, 392). According to Liebenberg (1990, 69), older San boys spend a lot of time studying animal tracks; following the spoor of insects, scorpions, and, later, small mammals; and reconstructing their feeding patterns and habits. Various authors note that children can identify, locate, and know about the behavior of many plants and animals in their environment by about age 10, or before adolescence (MacDonald 2007a, 392).

In some cases children participate in games or exercises involving shooting at targets (MacDonald 2007a). For example, 'In the age range 9 to 12 other games are played, now exclusively by boys, that teach hunting skills and that may include adolescent males as

well. N/ebiis a kind of javelin toss played by a number of boys: Each throws a light wand and bounces it off the ground to see who can throw it the farthest. /N!au ("spear") is a target-practice game in which a rough wooden spear with a ball of padding at the end is hurled back and forth between two teams of boys to see whose aim is the most accurate' (Lee 1972). While 'aim games' are more frequent in groups practicing hunting (Bock and Johnson 2004) no studies have quantitatively addressed the relationship between game playing and skill level.

In many cases, there is a change in types of hunting activities around adolescence, and the range of people they accompany becomes more diverse. San and Nunamiut boys first accompany their fathers and other male relatives around age 12 (MacDonald 2007a, 394). In cases where children accompany adults on expeditions at an earlier age, further changes often occur around age 12, including accompanying older adolescents and peers on hunting and fishing trips further afield, and joining collective hunts (MacDonald 2007a, 393-395). According to van Beek (1987, 96), 'boys spend a lot of time on these hunting expeditions. This is certainly necessary too, as they have a great appetite for animal food.' Young adults are more likely to go on solitary hunting expeditions, further from the settlement and after large game (MacDonald 2007a, 395).

Men frequently tell stories about hunting, while repairing their equipment or relaxing in the evening (Marshall 1976, 130; Tayanin and Lindell 1991, 16; van Beek 1987, 95, 136-7). As discussed by MacDonald (2007, 392), in most of these groups, children listen to stories about hunting told by the men. The following description of Bedamuni storytelling gives a good impression of the social context and content of these tales:

> 'boys will always sit around the longhouse listening to stories about hunting told by the adults . . . The adults, sitting around a fireplace smoking tobacco pipes, will often recount recent experiences of hunting trips, and they usually elaborate with relish on the more hilarious details of near misses and hunting accidents. Salient features of animal behaviour, their idiosyncracies, and often necessary tactical improvisations, are described in much detail.' (van Beek 1987: 95)

Hunting stories are said to contain information about animal behaviour and how to kill animals, and advanced hunting techniques, and also place hunting within the correct ideological worldview (Lee 1979: 236; Lewis 2009: 238; van Beek 1987: 95).

There is quite a lot of variation in the extent to which the learning of hunting skills is differentiated for boys and girls, and when this occurs (MacDonald 2007b, 396). Small hunting weapons are sometimes provided to boys and girls and more often to boys only. Children's hunting groups can include all ages and both sexes (Bird and Bliege Bird 2005). Competitive games involving hunting weapons tend to be played by boys (Bock and Johnson 2004, 71; Lee 1979, 236). Generally after adolescence there is more difference between boys and girls subsistence activities, and only boys are taken on hunting trips with adult males (MacDonald 2007a). However, Agta boys and girls both begin hunting large game after puberty (Estioko-Griffin and Griffin 1981).

While many hunting skills are learned in childhood and adolescence, a number of studies have shown that men in their thirties and forties have the highest returns for hunting (Ohtsuka 1989; Walker et al. 2002). Adult men continue to be very interested in animal behavior (Blurton-Jones and Konner 1976). Additional experience with animal behavior and hunting strategies could contribute to high hunting success of men in this age range, while at the same time they may have more reason to hunt more efficiently for larger families (Bliege Bird and Bird 2002, 114; Gubser 1965).

4.3.2 Learning Hunting Skills in the Broader Context of Research on Hunter-gatherer Learning and Subsistence Skill

Current research on hunter-gatherer learning of a wider range of subsistence and other skills provides some indications of what this review might be missing as well as confirming patterns. As discussed above, it has been suggested that teaching is an innate and relatively unique feature of human cognition, suggesting that it should be widespread among hunter-gatherers. The literature reviewed here and in MacDonald (2007a) includes a few mentions of explicit teaching of hunting skills, mostly to small children, although examples are scarce and not described in detail. In a recent review, Hewlett and colleagues describe teaching in infancy, particularly for small sized tools; in addition, when interviewed, hunter-gatherers say that they learned the majority of skills from

parents. However, teaching is relatively rare compared with observation and imitation (Hewlett et al. 2011). They suggest that teaching among hunter-gatherers may have been neglected because it is often perceived as relatively formal and involving linguistic instruction. Further, the examples of teaching presented in their review were mostly captured by video and focal follows, not techniques such as participant observation which predominate in ethnographic research. It seems likely that my literature review of ethnographic sources relating to hunting misses some examples of teaching, although it should not necessarily be expected to be frequent.

It is worth noting that even by providing small tools adults can contribute to an 'enriched environment' for learning, which may also include a chance to listen to experts, exposure to a specialist vocabulary, partially constructed tools and raw materials (Sterelny 2012, 39-40). Parents who can direct their children's learning and productive activities, for example by providing tools, can balance current productivity and learning across the household (Bock 2002; Bock 2005). My review indicates that provision of hunting tools is a very widespread practice, and this fits into a general pattern of provision of subsistence tools (Bock 2005; Hewlett et al. 2011). Taking children on hunting trips and telling hunting stories can also be considered in this light. Irrespective of the role of teaching *per se*, such activities by adults and older children contribute to children's learning of hunting and other subsistence skills.

In interviews hunter-gatherers report learning a large proportion of skills from parents (Hewlett et al. 2011). Hewlett et al. (2011) suggest that horizontal transmission is likely to become more important than vertical transmission as children get older, because data on who is proximal to hunter-gatherer children indicates that after age 5 children spend increasing amounts of time with other adults and kids. This literature review identifies some examples in which this describes the pattern well, and also highlights some variation, for example, older children teaching very young children to use small hunting weapons, and adolescents whose first adult hunting trips are with older male relatives, most frequently fathers.

Instigated by the 'embodied capital' hypothesis discussed above, there is an ongoing debate as to whether hunter-gatherer subsistence skills take all of childhood to master. Quantitative analyses of several components of hunting skill show that success at target

archery is not affected by lack of practice and is mainly explained by weight, that indirect encounters for example with tracks are influenced by body size and strength, while direct encounters, kill and caloric return rates correlate with age, suggesting that experience contributes to success in these more complicated aspects of hunting (Blurton-Jones and Konner 1976; Gurven et al. 2006). However, Martu children are effective hunters with their success limited only by height and weight (Bird and Bliege Bird 2005). From the age at which they begin foraging in mixed groups of children young Hadza can obtain up to 50% of their own food, and retrieve increasing amounts with age (Crittenden et al. 2009). Some Hadza children actually acquire a surplus of food. Literature review suggests that some skills are acquired very early on (for example, some ability to hit a target, knowledge of names and characteristics of a range of animals), others in adolescence, while adults may acquire some new techniques and information and further proficiency. Children are certainly described as spending a lot of time on relevant activities – for example, shooting with small hunting weapons or 'aim games' – however other factors may play a role – the descriptions suggest that such activities are fun. The quantitative studies discussed above produce a varied picture of the time required to learn hunting and gathering skills. It is not yet entirely clear whether adult and child hunting strategies differ because the former take a while to learn, or demand more strength, and variation and changes in motivation seem to play an important role (Bird and Bliege Bird 2005; Crittenden et al. 2009). In addition, the benefits of learning and foraging may vary throughout the developmental trajectory (Bock 2002).

4.4 What can be Inferred on (Potentially Different) Learning Behaviours When Comparing the Neanderthal and Modern Human Archaeological Records?

The first convincing evidence for hunting by hominins in Europe comes from the site of Schöningen, Germany, dating to 300,000-350,000 years ago, where multiple wooden spears have been discovered associated with the remains of more than 20 horses (Thieme 1997; van Kolfschoten 2014; Voormolen 2008). After 250,000 years ago, Neandertals were successfully hunting a wide range of large herbivores (Gaudzinski-Windheuser and

Niven 2009). Many faunal assemblages are characterized by broad species diversity, however there are also assemblages dominated by a single species. These include bovid-dominated assemblages, at which mainly prime-aged individuals are represented, suggesting selective and systematic exploitation of these animals over a long time period (Farizy et al. 1994; Gaudzinski 1995; Gaudzinski-Windheuser and Niven 2009; Jaubert and Brugal 1990), and less selective seasonal mass killing of entire herds (Gaudzinski and Roebroeks 2000). The different faunal assemblages suggest a general strategy focusing on high quality animals (Gaudzinski-Windheuser and Niven 2009). This is also supported by isotopic studies based on which Neandertals have been described as 'top level carnivores'

(Richards et al. 2000). Use of small prey for food dates back to the Plio-Pleistocene, but is generally sporadic; however, at Bolomor Cave traces of exploitation have been located on rabbit, tortoise and water fowl throughout a long sequence, sometimes making up more than half the minimum number of individuals, although not necessarily the majority of the diet (Blasco and Fernández Peris 2012). This includes relatively high proportions of fast-moving small creatures such as rabbits, which in other regions seem to be abundant only in the UP (Stiner et al. 2000). Neandertal hunting weapons included wooden and stone-tipped spears (Rots 2013; Thieme and Veil 1985), used as thrusting and possibly combined thrusting and throwing weapons (Rots 2009; Rots 2013). While wooden spears may sound relatively simple to manufacture, several stages of planning and production and multiple hours are likely to have been devoted to working the raw material (Haidle 2009; Veil 1991). Such weapons are used by current hunter-gatherers in circumstances in which the prey is placed at a disadvantage, often through use of natural features, in ambushes and pursuit hunting, and in situations in which some characteristic of the animal's behaviour can be exploited (Churchill 1993).

Comparison with faunal assemblages from the earlier part of the Upper Palaeolithic does not reveal any clear differences in hunting strategies. For example, at Grotte XVI species diversity stayed at around 8-9 species throughout the Middle Palaeolithic and Aurignacian, and there are no marked differences in relative abundances, skeletal part abundance, distribution of cutmarks or skeletal fragmentation (Grayson and Delpech

2003). Similarly, Middle and earlier Upper Palaeolithic (MP and UP) reindeer dominated assemblages are similar in the high frequency of prime-aged individuals and frequent evidence for marrow processing by bone breakage (Gaudzinski-Windheuser and Niven 2009). In both examples, the contrasts between Early and Late UP assemblages were much more pronounced than those with the MP. In the early UP evidence for small game exploitation is as scarce as in the Middle Palaeolithic; again, evidence for a real change comes in the late UP when small game, fish and birds became important components of the diet (Gaudzinski-Windheuser and Niven 2009). In most individuals in the available sample isotope analysis indicates that most of the protein in their diet came from terrestrial meat sources, although in several cases acquatic resources also made a substantial contribution (Richards 2009). However, from the beginning of the UP the importance of projectile technology is documented by the wide range of lithic, bone, antler and ivory points, which changed in design relatively rapidly through time (Teyssandier et al. 2010), although a projectile delivery system – the spearthrower – first appears in the late UP (Knecht 1997). This may have opened up new hunting strategies, making it possible to hunt smaller prey more efficiently (Churchill 1993), although, as discussed above, Neandertals certainly did this too.

The similarities and relatively subtle differences in the record for hunting behaviour between the MP and UP make it unlikely that a substantial contrast in the content to be learned or processes involved in acquiring hunting skills can be demonstrated. With reference to the implications of changes in hunting technology, Binford (2007) argues that, ‘I might even suggest that the less sophisticated the technology, the greater the necessary dependence upon a complete knowledge of prey behaviour for insuring a steady food supply. With an AK47 you don’t have to know so much!’ As discussed above, knowledge of animal behaviour is an important part of the content of hunting, and if Binford is correct it is unlikely to have been any less important for Neandertals than AMH. Learning to make the main hunting weapons was probably not trivial for Neandertals or AMH, although the greater diversity of forms and materials may have presented some additional challenges for AMH children. A greater emphasis on projectiles suggests an increased need to understand trajectories and take into account effects of wind or obscured sight, while to use a thrusting weapon successfully it is

necessary to anticipate the movements of an animal; neither is obviously less challenging. With access to similar learning processes, the skill of contemporary hunters varies substantially, and it seems quite possible that the differences between AMH and Neandertals were no greater or even smaller.

Perhaps a more productive question concerns whether we can say anything about learning processes that early AMH and Neandertal hunters are likely to have shared. Recent hunter-gatherers and other traditional hunters use a range of technology and other aids that was not available for AMH and Neandertal hunters, including bow and arrow, guns, and dogs, substantially reducing pursuit time. While this might increase some of the diversity of content to be learned, for example the use of more different tools and strategies, it seems likely to have if anything reduced for example the depth of knowledge of animal behaviour needed to get close to and secure prey. Any suggestion about learning processes in the past is subject to the limits of the comparative approach – anthropological approaches are not suitable for demonstrating that any process is essential, and given the scarcity of quantitative information literature review is not suited to assessing the extent of benefits of particular learning processes in terms of speed or effectiveness of learning. Learned content is diverse and was undoubtedly so in the past. Contribution of a range of older individuals to children's learning by providing hunting tools, taking children on hunting trips where they have an opportunity to observe hunting strategies and the environment, and telling hunting stories, is very widespread. Similarly, children frequently engage eagerly in activities that provide opportunities for practice and peer learning as well as fun, such as extensive hunting, games involving aiming at a target, observation of animal behaviour. It seems plausible that these activities have some benefits for the speed and thoroughness of learning, although other factors such as entertainment or the child's contribution to household subsistence play a role. It is not unlikely that AMH and Neandertals, for whom hunting was an important skill, also employed some of these processes.

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