Calculated or caring? Neanderthal healthcare in social context

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Abstract

Explanations for patterns of healed trauma in Neanderthals have been a matter of debate for several decades. Despite widespread evidence for recovery from injuries or survival despite impairments, apparent evidence for *healthcare* is given limited attention. Moreover, interpretations of Neanderthal's approach to injury and suffering sometimes assume a calculated or indifferent attitude to others. Here we review evidence for Neanderthal healthcare, drawing on a bioarchaeology of care approach and relating healthcare to other realms of Neanderthal social life. We argue that Neanderthal medical treatment and healthcare was widespread and part of a social context of strong pro-social bonds which was not distinctively different from healthcare seen in later contexts. We suggest that the time has come to accept Neanderthal healthcare as a compassionate and knowledgeable response to injury and illness, and to turn to other questions, such as cultural variation or the wider significance of healthcare in an evolutionary context.

Introduction - the Neanderthal healthcare debate

Discussions about Neanderthal healthcare provision have been part of a long standing argument into how similar or how different Neanderthals were to ourselves. Interpretations of extensive evidence of survival with or following severe/disabling pathology amongst Neanderthals have been particularly influenced by shifting academic attitudes towards these archaic humans, and whether they are considered part of our evolutionary story or a 'dead end'. Skepticism surrounding healthcare provision and its motivations is common, and typically to a greater degree than that observed with similar evidence in later contexts (Spikins, in press). Moreover, discussion has tended to focus on the details of pathology in isolation of its social or cultural context (Tilley 2015).

Neanderthal healthcare is a topic which, due to its apparently contentious nature, is only treated in summary and without discussion of the social behaviours surrounding the practice. Recovery from injury is often given scarce attention - the published discussion of a head injury in the St Césaire Neanderthal for example (Zollikofer et al. 2002) focuses almost entirely on implications of violence with only passing mention of recovery from this trauma, which would have taken weeks or months of care (Tilley 2015). Discussions of Neanderthal economic practices tend not to include healthcare, or as something difficult to explain. Furthermore the potential for an understanding of healthcare practices in Neanderthals to contribute to our understanding of their wider social behaviour, and of healthcare in an evolutionary context, remains to be realised.

There have been several different strands to a negative or skeptical perspective on Neanderthal healthcare. Although there are multiple cases of recovery from severe injury and survival despite notable impairment, some authors have critiqued interpretations that this evidence implies *active care* for Neanderthals. Dettwyler (1991) and DeGusta (2002; 2003) for example, argue that recovery from debilitating injury may not be evidence for active healthcare as Neanderthals may have been far better at self-provisioning than we assume. Others are skeptical about whether healthcare was provided as a caring response to need or suffering, only helping those who might contribute in the future (Berger and Trinkaus 1995; Wynn and Coolidge 2011). While Wynn and Coolidge (2011) note that care existed in Neanderthals, they describe their attitudes as 'callous'. Decisions about care have also been seen as difficult to explain given the costs of energy and resources. In a similar vein, Davies and Underdown (2006, 148–9) for example that "the extensive intragroup care needed to sustain such infirm members is surprising unless they provided some valuable service".

A recent contrasting perspective argues that the evidence for recovery and survival in Neanderthals is a reflection of managed health related care in a social context of caring relationships. A number of authors take this approach to the palaeopathological evidence. Hublin for example, refers to a 'prehistory of compassion', citing in support cases of survival despite traumatic injury (Hublin 2009). Thorpe (2016) and Doat (2016) likewise agree that evidence for recovery from injury and survival despite impairment should be accepted as evidence of care for the injured. Spikins (2015, 2017), Spikins et al. (2010) and Tilley (2015) argue that widespread evidence of recovery reflects evolved caring motivations to ease suffering.

Here we discuss interpretations of evidence for recovery from injury and survival despite impairment in Neanderthals, situating this evidence within the wider social context and assessing the

implications in terms of the social and cultural context of health related care. We consider whether such care was typically motivated by calculated or caring relationships, and its relationship to the wider cultural context of other elements of Neanderthal lifestyles.

Skepticism of Neanderthal care

The pathologies present in one particular individual, Shanidar 1 (dated to 45-70,000BP, from Shanidar Cave in Iraq) were particularly significant within initial interpretations of pathology as indicative of a wider social context of caring support for injury and impairment in Neanderthals. Shanidar 1 was aged between 35 and 50 when he died, but had suffered from a range of debilitating impairments (Crubézy and Trinkaus 1992, 411–412; Trinkaus and Zimmerman 1982, 61–62; Trinkaus 1983). This included a violent blow to the face, possibly as a young adult, leaving him blind or partially sighted in one eye, a withered right arm which had been fractured and healed resulting in the loss of his lower arm and hand and possible paralysis, and deformities in his leg and foot leading to a painful limp. The injuries occurred long before his death and showed signs of healing, with curvature of his right leg compensating for injuries to the right (Trinkaus and Zimmerman 1982, 67–68). He also suffered advanced degenerative joint disease. Shanidar 1 would have been limited in mobility, in manual tasks and in perceptual abilities, yet survived to an advanced age. Solecki (1971) and later Trinkaus and Shipman (1993) concluded that someone so badly injured could not have survived without daily provision of food and assistance. Moreover Shanidar 1 was not alone in surviving trauma: Shanidar 3 similarly sustained injury likely requiring care (Trinkaus and Zimmerman 1982, 75; Trinkaus 1983) and many other Neanderthals showed evidence of recovery from serious injury. Given the prevalence of injury and survival across the skeletal sample of Neanderthals Trinkaus and Zimmerman commented (1982, 75) Neanderthals *'had achieved a level of societal development in which disabled individuals were well cared for by other members of the social group'.*

Skepticism about the social implications of recovery emerged as Neanderthals fell to the wayside of human ancestry following the acceptance of mitochondrial DNA evidence in the early 1990s (Cann, Stoneking, and Wilson 1987). Shanidar I's pathologies remained uncontested, but debates tended to focus in detail on questions in the interpretation of a small number of specific cases, and arguments that some Neanderthals may have been independent *despite* trauma. The implication was that Shanidar 1 might be an atypical case and Neanderthals were unusually tough. Degusta (2002) for example cast doubt on interpretations of care for the Bau de l'Aubesier 11 Neanderthal who had lost nearly all her lower teeth before death, as well as suffering painful abscesses (Lebel et al. 2001). He argued against inferring care-giving from others such as in foraging and processing of specific foods on the basis that primates forage for themselves and survive despite tooth loss. Lebel's counterargument (Lebel and Trinkaus 2002) that primates with similar degrees of tooth loss do not survive remains contested (DeGusta 2003; Thorpe 2016).

Interpretations of caring motivations for support and recovery were also reinterpreted. Berger and Trinkaus (1995) and Trinkaus (2012) highlighted an apparent lack of individuals with debilitating lower leg injuries at death as evidence for abandonment. Trinkaus comments that 'abandonment of older individuals who could no longer move with the social group is likely to have been common. This would have occurred especially in cases of severe lower limb injury' (Trinkaus 1995, 138)

Further findings as well as analyses of existing specimens have added to the picture of recovery/survival despite pathology or impairments in Neanderthals. However an apparent ubiquity of trauma in this skeletal sample has also been a subject of debate. Neanderthals are often described as a population disadvantaged by unusually high levels of traumatic injury (Berger and Trinkaus 1995; Pettitt 2000; Nakahashi 2017), a feature commonly assumed to have contributed to their demise. Nakahashi even argues that exceptionally high trauma rates and thus impairments may have affected Neanderthals culturally, limiting their their mobility to the extent of constraining transmission of their culture (Nakahashi 2017). Rather than cultural choice or response to social bonds any healthcare practices can seem a desperate necessity in the face of extreme adversity.

An unbiased approach to the social interpretation of recovery from trauma in Neanderthals has tended to be elusive, particularly with ideas of modern human superiority often colouring interpretations (Villa and Roebroeks 2014). Evidence for interbreeding between archaic humans and our own species and a level of contribution of Neanderthal DNA to modern populations if anything further complicates interpretations (Green et al. 2010). The social implications of care-giving in Neanderthals remains a contentious area.

Re-assessing interpretations of healthcare practices

Neanderthals occupied Europe and Asia from around 300,000 to 30,000bp, and naturally their cultures (Ruebens and Wragg Sykes 2016) and subsistence practices (Weyrich et al. 2017) showed regional and chronological variation. Nonetheless across the known sample of individuals Neanderthals suffered from various pathologies, with it being rare to reach adulthood without a significant injury for example (Trinkaus and Zimmerman 1982; Pettitt 2000). Conditions range from the relatively minor (such as dental caries ((Arnaud et al. 2017; Lebel and Trinkaus 2002, 665)) to the severe (such as breakage of major weight bearing bones). Recovery in some cases would occur without any intervention or be possible through self care, whilst in other cases might require help from others. This help may have taken various forms, such as food provisioning, an extended period of rest and immobilisation or active nursing, with pathology sometimes leading to long term impairments affecting typical activities and requiring accommodation from the rest of the group. Certain key specimens with severe pathologies have attracted most attention.

Injury, disease or lasting impairments were a familiar element of Neanderthal lives. However we argue that the significance of healthcare has been overlooked and interpretations of a limited or calculated response to healthcare needs in Neanderthals have been influenced by preconceptions of Neanderthals as ‘different’ and even brutish. A detailed consideration of the evidence in its social and cultural context reveals a different picture.

Bioarchaeology of care analyses (Tilley 2012; Tilley and Cameron 2014) of two Neanderthal individuals from south-west France, La Chapelle aux Saints 1 (LCS1, 50-60,000bp) and La Ferrassie 1 (LF1, 43- 45,000bp) suggest both likely received extensive care in response to their experiences of pathology (Tilley 2015, 219–257).

Analysis of LCS1 (figure 1), a male aged between 25 and 40 years old at death, revealed that he suffered from extensive tooth loss and severe, chronic periodontal disease; temporomandibular

joint arthritis; severe osteoarthritis in lower cervical and upper thoracic vertebrae, and moderate to severe degeneration of lower thoracic vertebrae; osteoarthritis in both shoulder joints; a rib fracture in the mid-thoracic region; degeneration in the fifth proximal inter-phalangeal joint of the right foot; and severe degeneration and likely chronic osteomyelitis in the left hip (Tilley 2015, 228).

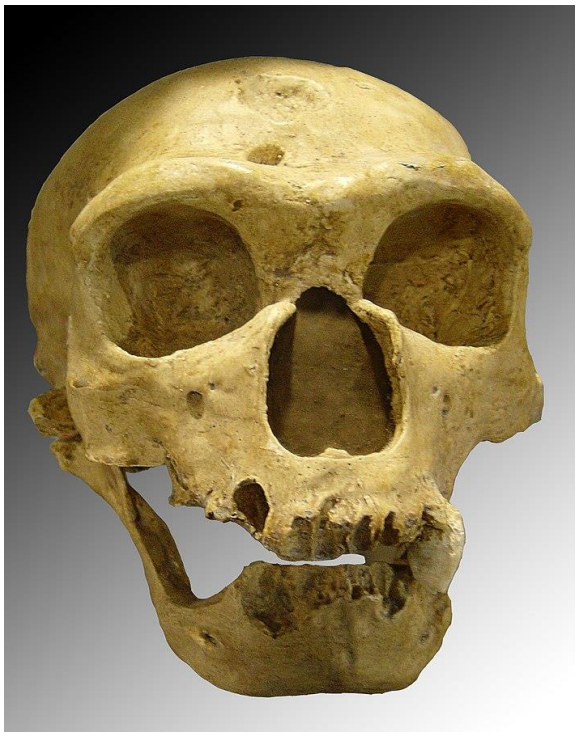

Figure 1. Figure 1: The crania of the La Chapelle aux Saints Neanderthal
Credit: https://upload.wikimedia.org/wikipedia/commons/e/e0/Homo_sapiens_neanderthalensis.jpg
By Luna04 (Own work) [GFDL (http://www.gnu.org/copyleft/fdl.html), CC-BY-SA-3.0

Care for LCS1 likely comprised 'direct support' (such as fever management, hygiene maintenance, repositioning and manipulation) during debilitating health crises associated with flare-up of infection and/or experience of severe pain , and 'accommodation' such as providing suitable food and, very probably, taking measures to ensure he was not left behind when the group moved camp. Degenerative disease in the spine and shoulders would have affected LCS1's upper body function, likely restricting performance in areas requiring upper body flexibility and strength (such as hunting, transport of items between camps). LCS1's diseased left hip, his most serious pathology, would have imposed significant pain-based and mechanical restrictions on the use of his left leg in actions requiring weight-bearing, balance and mobility. While likely remaining ambulatory until the end, he could not have participated in hunting. Evidence from patterns of dental wear at l'Hortus (France), Spy (Belgium), and El Sidrón (Spain) supports the concept of a distribution of tasks according to different abilities or roles in domestic contexts (Estalrrich and Rosas 2015). LCS1 is thus likely been able to perform other tasks, such as food processing, manufacturing tools or clothing or childcare. Underlying infection (localised and systemic) would have taken a progressive toll on health and strength over the last 12 months of life, and his ability to contribute to the group would have decreased accordingly. He was nonetheless clearly part of the group until death, with his articulated remains subsequently carefully buried, see Rendu et al. (2014), (Dibble et al. 2015; Rendu et al. 2016 for further debate).

Analysis of LF1, a male aged around 40-55 at death revealed evidence of minor periodontal pathology, consisting of circumscribed apical abscesses on the left mandible, with some alveolar resorption on the mandible more generally and possibly on the maxilla (taphonomic damage makes this difficult to assess); minor osteoarthritic changes to the lower spine and right elbow joint (most of the major joint surfaces are damaged and therefore not assessable); a healed fracture of the greater trochanter of the right femur; and the presence of active systemic disease at the time of death (Tilley 2015, 241).

Skeletal evidence suggests LF1 received care on at least two occasions during his life. The first involved a short term disability - a comminuted fracture of the greater trochanter of the right femur. (Tilley 2015; Trinkaus 1985) which caused compromised movement of the leg, hip and leg pain, and several weeks of limited mobility and was likely to required some support from other group members for up to 2-3 months. LF1's second diagnosis was more serious as periostitis on proximal and distal surfaces of upper and lower limb bones (see Figure 2) suggest LF1 was in the 'early stages of an acute form of HPO [hypertrophic pulmonary osteoarthropathy], with a duration of the disease at the time of death of 2-14 months' (Fennell and Trinkaus 1997, 994). Although HPO has clinical implications in its own right, it is a syndrome secondary to more serious underlying pathology, most commonly pulmonary or cardiac disease (Assis, Santos, and Roberts 2011). The following symptoms are almost always associated (if indirectly) with HPO: depressed immune function; loss of energy, with fatigue following minor activity; difficulties in sleeping; localised and/or generalised pain and discomfort; problems with maintaining homeostasis; loss of appetite and weight; and fevers and other physiological symptoms associated with acute (intermittent) disease crises (Amital et al. 2004). Conservatively, it can be assumed that over the last months of LF1's life his disease impinged on all facets of everyday experience. He would have become incapable of hunting or foraging, and therefore wholly dependent on others for food. Reduced energy levels would eventually make independent mobility over even short distances difficult or impossible. This same lack of energy, combined with acute and/or chronic pain and likely loss of psychological as well as physical resilience, would render more sedentary tasks increasingly difficult to accomplish. Dedicated care, including monitoring, massage, manipulation and repositioning, fever management, and hygiene maintenance, would be required during acute episodes. His complex mortuary treatment shows he was not abandoned: LF1's articulated remains indicate interment shortly after death (figure 3).

(a)

(b)

Figure 2 (a, b): Examples of periosteal proliferation on LF1 (a) distal right tibia (posterior view); (b) distal left femur (posterior view) (Tilley 2015:244).

Providing care for the most severe pathologies of both LCS1 and LF1 was undoubtedly 'costly' in economic terms and argue against any calculated 'payoff' for the energy invested in care. Tilley (2015) argues that both instances, group members - undoubtedly familiar with signs of pathology and capable of calculating odds of recovery - would at some stage have become aware their kinsmen were unlikely to be restored to health. Their care could have had no goal other than providing practical and emotional support to ease the passage of dying.

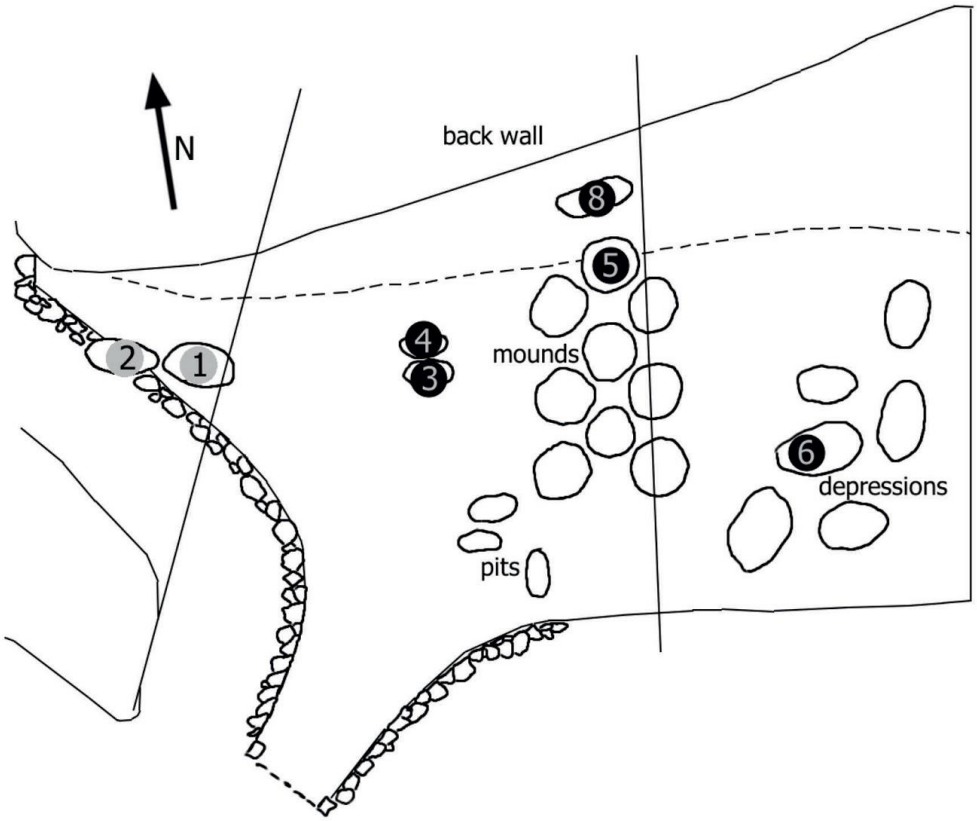

Figure 3. Plan of La Ferrassie 'cemetery' with the position of five child burials and two adult burials, LF1 is marked ‘1’ (drawing by Gail Hitchens, redrawn from Heim 1982).

Although not subject to detailed study of this kind, the pathologies in other Neanderthals also provide evidence for varied types of care and accommodation. Many of these individuals with severe pathology are likely to have required practices such as provisioning, maintaining body temperature, facilitation of sleep and rest, ensuring safety, maintaining or assisting mobility, maintenance of personal hygiene, maintaining posture and maintaining physiological functioning (such as by staunching wounds) (Tilley 2015, 81–2). Shanidar 3 is likely to have required a period of healthcare provision and later accommodation around constraints of mobility due to their foot pathology for example. La Ferrassie 2, the young female adult buried in close proximity to LF1, displays evidence of a proximal fracture of the right fibula that is completely healed, although with significant distortion (Heim 1976b). In a conservative scenario, this injury would cause pain on weight-bearing and would restrict, although probably not prevent, locomotion – but it would have precluded direct participation in primary economic activity (hunting) for around 6–8 weeks (Tilley 2015, 257). These cases as well as the numerous cases of notable long standing impairments which are likely to have required accommodation also argue against a calculated approach to who might be economically ‘valuable’ in future.

Other considerations of the wider archaeological evidence also casts doubt on interpretations of selective abandonment. For one thing the sample size is small, with a pattern of a lack of lower limb injuries not being unlikely to occur in any case by chance (Spikins 2015). For another whilst no individual within the known Neanderthal skeletal sample was demonstrably immobile from a lower

limb injury *at death* there are several individuals who suffered from severely restricted mobility and possibly complete immobilisation for at least some period of time. A significant limitation in mobility is likely to have occurred over a long timeframe as a consequence of injury or disease in the case of La Ferrassie 1 (probably on two occasions), La Ferrassie 2, Tabun 1, La Chapelle-aux-Saints 1 and Shanidar 1 for example. That these individuals were *later* mobile following a severe injury or disease does not imply a *lack* of care for severe lower leg injuries when they occur. Indeed, later mobility following such an injury could alternatively imply particularly successful care and recovery. Lastly, preservation bias is also likely to have affected interpretations of selective abandonment of individuals incapacitated by lower limb injuries. Most well preserved skeletal material comes from rock-shelter sites, which like Shanidar itself (figure 4) are difficult to access even for those without lower limb impairments. In modern hunter-gatherers such as the Baka, individuals with severely impaired lower limb mobility undertake particular tasks or forage in accessible locations (Toda 2011, 2013). Neanderthals already needed to accommodate slow mobility in young children (Shaw et al. 2016). It is far more probable that the relative absence of those with immobilising lower leg injury in the archaeological record is a result of these individuals not joining those using difficult to access rockshelters and caves than their selective abandonment.

Figure 4. Shanidar Cave, like most cave and rockshelter sites where near complete Neanderthal skeletons have been recovered, is a difficult to access location even for the healthy and fully able. Individuals with severe and entirely immobilizing leg injury are likely to have stayed in more accessible locations rather than their absence in the record implying abandonment.

Lastly, a closer consideration also casts doubt on the concept of unusual levels of injury (and unusually harsh lifestyles) in Neanderthals. Whilst injuries *are* common in Neanderthals the rates of trauma are not unusually high within the wider context of similar hominins, both earlier archaics and early modern humans. Like other archaic and earlier humans Neanderthals lived physically demanding lives which involved high mobility (Shaw and Stock 2013) and encounters with often dangerous prey as well as predators (Camarós et al. 2015). There is no notable difference in adult mortality between Neanderthals and early modern humans (Trinkaus 2011). Serious pathological conditions are common across archaic and early human populations (Wu et al. 2011). Estabrook

comments *"The idea that Neandertals are more frequently traumatized than modern populations is based on little evidence, but it has been well received is because it dovetails nicely with this paradigm [of Neanderthals as 'dumb']" (2009, 337)*. There is no reason to assume the healthcare practices were driven by notably high rates of traumatic injury or that life was *unusually harsh* for Neanderthals.

As well as supporting an argument for an 'uncalculating' approach to healthcare the archaeological evidence also supports the notion that Neanderthals had a medical competence, consistent with a pattern of high rates of healing and low levels of infection (Trinkaus and Zimmerman 1982, 75). The presence of interproximal grooves in teeth support the use of toothpicks to reduce irritation in inflamed gums in cases of periodontal disease for example (Lebel and Trinkaus 2002, 665; Lebel et al. 2001, 11100; Lozano et al. 2013). The analysis of dental calculus has evidenced the presence of bitter tasting plants with minimal nutritional value, suggesting possible medicinal consumption (Hardy et al. 2012; Hardy, Buckley, and Huffman 2013). Poplar found in dental calculus of a Neanderthal from El Sidrón with a dental abscess also demonstrated the likely use of painkillers in the form of salicylic acid, the active ingredient in aspirin (Weyrich et al. 2017).

More speculatively, the mastery of tar production (Grünberg 2002; Boëda et al. 2008; Mazza et al. 2006) may suggest an awareness of the health benefits in chewing this substance, both as an antiseptic and in maintaining the teeth (Aveling and Heron 1999). Similarly, the use of ochre is now well demonstrated (Zilhão et al. 2010) and this substance can be used as an antiseptic when applied to wounds (Velo 1984).

In short, a closer consideration of trauma, recovery and impairment and their social implications shows no good evidence to support an interpretation of Neanderthal healthcare as unusually callous or calculating. Rather there is good evidence for individuals with injuries and impairments being supported and accommodated, often with considerable effort, skill and knowledge. Rather than being enigmatically costly in terms of resources and effort Neanderthal healthcare overall is likely to have made a significant contribution to maintaining the viability of small hunting and gathering groups.

A broader social and cultural perspective on healthcare practices in Neanderthals

A broader social and cultural perspective can yield significant insights into the likely context of Neanderthal healthcare.

From a large scale evolutionary perspective substantial investments in healthcare is not surprising. Strong pro-social bonds and care for those who are vulnerable are recognised as key elements contributing to human success, and pre-date Neanderthal populations. In effect strong bonds provide a social buffer against individual shortfalls in resources, health or capacity to raise young and provide a distinct evolutionary advantage (Crittenden and Marlowe 2013; Hare 2017). Apparently 'costly' cases are a necessary element of how pro-social bonds 'work' through trust to reduce individual risk (Manapat, Nowak, and Rand 2013; Spikins 2015, in press.; Jordan et al. 2016). Healthcare, food sharing and care of vulnerable children are likely to be intimately related, and to have emerged early in human evolution. Food sharing and risky hunting emerged at least 1.3 million

years ago for example (Domínguez-Rodrigo et al. 2014) and its emergence is associated with shared childcare and increasing group investments in vulnerable young (Hrdy 2011), as well as likely egalitarianism (Whiten and Erdal 2012). A homo ergaster from Olduvai dating to around 1.6 million years ago for example was provisioned and protected from predators for several weeks despite severe pain and loss of consciousness arising from hypervitaminosis A (Walker, Zimmerman, and Leakey 1982; Spikins, Rutherford, and Needham 2010). Moreover by around 400,000 years ago, there is good evidence for support for injury and impairment from the site of Sima de los Huesos in northern Spain. Here a child with craniosynostosis was supported for several years (Gracia et al. 2009), as well as an individual with deafness and an elderly man who would have found walking extremely difficult and painful due to a damaged hip (Bonmatí et al. 2010, 2011). This earlier context of care within highly collaborative early humans helps to illustrate that primate comparisons fail to be relevant to Neanderthals - unlike other primates hominins forage cooperatively, care for offspring who are vulnerable both at birth and for an extended period of infancy, and accommodate the risks imposed by both hunting large game as well as defence from predators. (Bonmatí et al. 2011, 145) argue the treatment of those with impairments in all other species of human are likely to have been much closer to that seen in our own species than that seen in primates.

In modern hunting and gathering societies healthcare is effectively inseparable from sharing in its many different forms (Spikins, in press) arguing that healthcare can never be fully understood outside of its social and cultural context. Though healthcare has received less attention it is as essential to group survival as other behaviours such as food sharing or childcare (Sugiyama 2004). In such contexts everyone needs support at some time, with such support taking different forms. Investments in others' wellbeing and motivations to help those we care about may not 'pay off' in an instance, but do so over evolutionary timescales, as by demonstrating a willingness to take costs on other's behalves any individual ensures willing help for themselves when needed. Any injured group member are as much an opportunity (to display one's generosity and willingness to help) as they are a cost (R. M. Nesse 2009). Amongst the Ache of Paraguay for example even the young adult males, the most healthy sector of society, are unable to hunt on around one day in every three due to illness and injury (Gurven et al. 2000). Their food provisioning at these times is impossible to separate from care for injury or illness, and is simply part of how communities work together to accommodate vulnerabilities. Generosity to others, in terms of time and resources, is essential to survival and social life, with most trusted and generous hunters most willingly looked after when elderly for example (Gurven et al. 2000). Likewise even those who have impairments which severely affect mobility are accommodated and perform alternative roles and tasks amongst the Baka (Toda 2011, 2013). Calculating someone's functional or economic value would be seen as untrustworthy, much as it is in modern close relationships (Nesse 2001; Manapat, Nowak, and Rand 2013; Spikins, in press).

For Neanderthals food sharing, hunting, childcare and healthcare are likely to have been inseparable elements of social relationships based on strong social bonds and willingness to take risks and give up time or resources to improve others' survival. The relationships between these different realms of life in which shared investments in the wellbeing of others were essential are rarely explored, but it is not difficult to see that *comparable* social and emotional investments in others' wellbeing are made in each of these realms, with these investments equally essential to how collaboration works (Smith et al. 2017). Risking injury in hunting, spending time in caring for others' infants, giving away

food resources, accommodating those with impairments or caring for the ill or injured are all 'costs' on behalf of others which are essential to the survival of mobile hunter-gatherer groups. The same motivations to 'look out for' and 'look after' each other structure these intimately related realms.

The ecology of Neanderthals may even have made such investments in others wellbeing particularly critical to survival. A combination of typically arid mid latitude ecosystems alongside Neanderthal robust physique and high energy requirements (Churchill 2014) led to a dependence on collaborative hunting (and sharing) of large game in most regions for example (G. M. Smith 2015). Hunting of such game without the benefit of long range projectiles was notably dangerous with some individuals inevitably risking serious injury on behalf of others. At sites such as La Cotte de St Brelade (Jersey) Neanderthal reliance on investments in other's wellbeing to survive are clearly apparent. Here in Layer 5, MNI of 11 mammoths and two woolly rhinoceros were recovered, interpreted as a result of planned hominin hunting and subsequent butchery (K. Scott 1980; B. Scott et al. 2015; Shaw et al. 2016). Planned hunting of dangerous animals such as mammoth and woolly rhino depended on hunters being willing to risk injury or death and it is difficult to imagine this being possible without both strong bonds and a confidence that care for injury would be forthcoming. Even hunting of other less dangerous game, such as ibex, carried risks of injury (de los Terreros et al. 2014). Foraging or even surviving alone were unlikely to be options even for the most healthy and able. Middle Palaeolithic environments in Europe may well have been one of the contexts in which buffering risks through healthcare may have been been most essential to survival.

Moreover the structure of Neanderthal social groups may even have led to more intense internal social bonds than might be typical of modern hunter-gatherers. Whilst it is challenging to reconstruct demography in the Palaeolithic (see French 2016), El Sidrón cave in northern Spain does provide a unique insight into the composition of Neanderthal groups. Dating to 49,000 BP, the site has produced the remains of 13 individuals, including seven adults, three adolescents, two juveniles and one infant (Rosas et al. 2013). Genetic analysis (Lalueza-Fox et al. 2011) and the occurrence of rare congenital conditions (Dean et al. 2013; Ríos et al. 2015) all support the case for a closely related, contemporaneous social group. The relatively small size of the El Sidrón 'family' is also consistent with broader archaeological evidence (Spikins, Hitchens, and Needham 2017). The potential intimacy of these groups is further emphasised when viewed at a regional scale, where patterns of Neanderthal mobility gleaned from the movement of raw materials consistently suggest a local focus (e.g. Burke 2006; Conard, Bolus, and Münzel 2012; Henry 2012). Social and emotional ties are likely to have been focused within the group throughout their lifetime (Spikins et al. 2014), 124), with most members of groups closely related (Spikins, Hitchens, and Needham 2017).

Other evidence supports the concept that care for the vulnerable was a key element of Neanderthal social life, as reflected in the treatment of the young. The portrayal of particularly short and stressful lives for children has become increasingly insupportable, with evidence arguing against interpretations of rapid development (Rosas et al. 2017), frequent trauma (Estabrook 2009) and excessive dietary stress (Dobrovolskaya 2014). The treatment of Neanderthal children in death offers a picture of considerable care, far from previous views of infants simply being 'dumped' (e.g. Pettitt 2000, 359). The 10 month old infant recovered from Amud Cave in Israel for example, was found laid on its right side and buried within a small niche in the cave wall, with a red deer maxilla on its pelvis (Hovers et al. 1995). Several of the five children buried at La Ferrassie in France were also laid into

depressions, including an infant less than one year old, possibly associated with three flint scrapers (Heim 1976a). This is in addition to the two infants at Dederiyeh cave, one of which had a small flint placed upon its chest and a stone slab possibly laid under its head (Akazawa and Muhesen 2002).

Neanderthal burial practices also clearly demonstrates a care for the body *after* death. Pettitt (2011) for example notes the presence of complex and diverse mortuary practice, including the caching of remains, secondary processing such as defleshing and cannibalism, and at least 30 intentional burials, some of which possibly included grave goods. Pettitt (2011, 136–137) notes the importance of the body in Neanderthal society as the locus through which social relationships were negotiated. It is perhaps unsurprising then that patterns of care evident through cases of trauma are extended into further complex treatments of the body of at death. Given this linkage between the living and dead, it is likely that mortuary practice extended elements of the same socio-emotional framework that engendered care for the living into death.

The wider cultural context of Neanderthal social lives casts healthcare not as an anomaly requiring explanation, but rather as a reasonable expectation given their interdependence, widespread investments in others' wellbeing and a caring, knowledgeable and organised approach to survival.

Conclusions

Neanderthal healthcare has been treated with either skepticism or with assumptions that despite evidence for widespread recovery from illness and injury such care was at best carried out with a callous and calculating attitude. Here we argue however that care for illness and injury, and support of impairments in Neanderthals was widespread, and motivated by similar close social bonds to those in our own species. A social perspective on Neanderthal healthcare contributes to our understanding of Neanderthals as living in groups with deep investments in each others wellbeing and with a competence to apply knowledgeable approaches to preserve health.

Neanderthal healthcare is significant not in its *distinctiveness* compared to that of biologically modern humans in later periods but in its *similarity*. Neanderthals appear to share a common human emotional and practical response to vulnerability and suffering of those that they were close to, attitudes also reflected in care of children, attitudes to the body at death through burial and other mortuary treatment. The very similarity of Neanderthal healthcare to that of later periods has important implications however - that organised, knowledgeable and caring healthcare is not unique to our species but rather has a long evolutionary history. Healthcare provisioning is likely to have been significant in reducing mortality and ameliorating risks in resource acquisition far into the distant past.

We argue that it is time to bring Neanderthal healthcare 'in from the cold' and discuss its broader implications within our understanding of Neanderthal social relationships and with within wider discussions of healthcare in the human past.

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