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Hunting Lessons: ethnography, archaeology and ‘raising the curtain’ to reveal how forager kids learn(ed) to hunt

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Abstract

The deep time record indicates that hunting played a key role in human evolution, including in the development of the life history of humans. The archaeological record preserves many different avenues for understanding early hunting including hunting gear, butchered prey, and art. As a complex skill, hunting likely involved a long learning period to develop competencies. While rare, there are some exceptional circumstances in which the toys and tools with which children and adolescents learned to hunt have preserved. In many cases though, we rely on ethnographic data to fill in gaps in understanding past children’s tangible and intangible culture of hunting, including how they developed skills which would have allowed them and their communities to survive and thrive. This paper reviews the relevant archaeological and ethnographic records of the hunting activities of forager children and adolescents, and explores areas where we see commonalities as well as divergences in these data. Ethnographies provide ‘real world’ data that can fill in intangible aspects of the deep past, while the archaeological record has its own unique stories to tell.

Key Words

Enskilment; Weapons; Children

Introduction

Archaeologists aim to imagine and recreate lifeways and experiences of past people and societies. We generally seek to build evidence-based foundations for these imaginings, whether we are bringing them to academic or public audiences, and whether in a written or visual medium. Picture in your mind's eye an archetypal past forager society. Hopefully some children appeared while envisioning the people. Perhaps you imagined children being loved and nurtured, playing games, getting sick and hurt, and learning - not just to survive but also to thrive. In *The Palaeolithic Societies of Europe*, Clive Gamble (1999) invited us to 'raise the curtain' and move beyond description towards interpretation of the relatively meagre Palaeolithic record. He argued that we can and should consider social questions, albeit without abandoning 'facts' in the narratives we build, stressing that 'facts are only meaningful when contained within stories' (Gamble 1999, p. 8). There is a rich publication record from the last few decades on the archaeology of forager children including new data and reinterpretations of existing evidence, bringing children into our social narratives of the Pleistocene (e.g. (Assaf, 2021; Cooney, 2012; Finlay, 1997; French & Nowell, 2022; Grimm, 2000; Högberg & Gärdenfors, 2015; Klaric, 2018; Langley, 2018, 2020; Lew-Levy et al., 2020; Milks et al., 2021; Nowell, 2015, 2016, 2020, 2021, 2022; Nowell & White, 2010; Park, 1998; Pigeot, 1990; G. G. Politis, 1999; Riede et al., 2018; Rivero, 2016; Sharpe & Van Gelder, 2004; Simonet, 2018; Spikins et al., 2014). Our 'imaginings' regarding children in the past comes in part from our own experience of children, who are rich contributors to our own cultures and communities. But those of us from Western cultures may lack an understanding of the worlds and ways of forager kids, and we necessarily turn to analogues including ethnohistorical and ethnographic accounts.

For most of human evolution, our genus was engaging in hunting and gathering (defined by the human relations area files (HRAF) as a society for which 86% or more of subsistence comes from hunting, gathering, and fishing). For these societies, hunting was a key feature of everyday life. Children, we also know, made up significant proportions of early societies (Baxter, 2008). Learning the complex skills involved in hunting is likely deeply entwined with life history, and in particular our uniquely long childhoods and adolescence (Kaplan et al., 2003; Koster et al., 2019; MacDonald,

2007). But still, when we reconstruct past hunting scenarios for key Pleistocene sites and periods, children are rarely mentioned.

In addition to a lack of engagement with the idea of childhood and adolescent hunters, at least beyond those studies identifying children's material culture and burials, a recent intersecting debate has emerged around the extent to which women engaged with hunting in the past. Research drawing on the archaeological and palaeoanthropological record suggest that female members of earlier human groups (including Pleistocene *Homo sapiens*) may have regularly engaged in hunting activities, at least in particular ecological and temporal contexts (e.g. Haas et al. 2020; Ocobock and Lacy 2023). Modern analogues including experimental research (Bebber et al. 2023), exploration of physiological constraints and advantages (Lacy and Ocobock 2024), and ethnographic reviews (e.g. Anderson et al. 2023; Venkataraman et al. 2024) further contribute to this discourse, widening the traditional image of male-only Pleistocene hunters to include both women and children, even if there remains a lack of clarity about the circumstances and technologies used by these 'alternative' hunters.

We can witness shifting perceptions of the age and gender of early hunters in artistic reconstructions of Pleistocene hunting. Traditionally, artistic visualisations of past hunting scenes have nearly always featured adult males; similarly, reconstructions of adult male Neanderthals and early *Homo sapiens* often feature a weapon in hand. Until recently, women and children were rarely depicted as hunters and/or with weapons. This trend is now changing (e.g. see Fig. 3.3. by Marina Lezcano in Nowell 2021 for a depiction of juveniles with weapons; see also the depiction of the Schöningen humans by Thomas Berendt in Bernatzky 2013 for a depiction of females wielding spears and children learning to make them). Visual reconstructions of the past fortify and promote underlying theories and often fill in where 'facts' are missing (Moser, 1992). They are reflective mirrors, showing our bias, and this bias suggests that we forget that adults needed to *learn* to hunt.

Enskilment, in which the novice does not just acquire knowledge but applies and aligns this through engagement with their social and natural environment is central to understanding how a skill such as hunting is learned (Ingold, 2000), While weapon technologies leave visible archaeological signatures, direct evidence of hunting strategies, enskilment, and identities of hunters can be virtually invisible. This is even more true for understanding how children learned the entire domain of hunting

including making weapons, deploying them (thrusting, throwing, firing, aiming), as well as acquiring broader ecological and ethological knowledge such as tracking, locating, and killing prey, and staying safe.

This overview is not designed or intended as a systematic cross-cultural meta-ethnography on child and adolescent forager hunting, several of which exist already (Kamp & Whittaker, 2020; Lew-Levy et al., 2017; e.g., MacDonald, 2007). Rather, I hope to explore the information that can be drawn from some of these previous reviews on recent and contemporary small-scale societies, alongside some additional published ethnographic data. I contextualise these ethnographic findings by reflecting on the archaeological record, first providing an overview of the (more or less) tangible archaeological evidence that kids in forager societies engaged with hunting activities in the past. I then give an overview of ethnographic evidence of hunting activities of forager children and adolescents. In addition to knowledge of manufacturing hunting technologies, successful hunters must develop physical strength and gross and fine motor competencies, and learn a vast amount of ethological and ecological knowledge. Ethnography fills in gaps where these processes are virtually unrecognisable archaeologically. Ethnography elucidates the play and enskilment of children and adolescents at different ages and stages and helps us understand mindsets around danger. Yet as I explore in the discussion, it also has limitations, and the archaeological record should not be dismissed or overlooked when it diverges from ethnographies. Other tools available to archaeologists, such as experimental approaches, may be better suited to expand our understanding, and particularly for the deepest past, we can also be courageous enough to embrace and acknowledge what might be unknowable.

Archaeological Evidence

The archaeological evidence linking forager children with hunting is organised here into five categories: children's hunting gear (both toys and tools), grave goods, repurposed adult weapon components, art, and the human fossil record. These categories vary in terms of the reliability of inferring connections between material culture and children's hunting-related activities. The distinction between toys, which are material objects used in play (Crawford 2009), and children's tools used for various

tasks including for learning through play, is fluid and can be challenging to differentiate. Therefore, toys and tools are generally addressed together in this paper (see Kenyon and Arnold 1985; Park 1998; Elliot 2009; Milks et al. 2021).

Children's hunting gear (toys and tools)

The meaning of miniatures in the archaeological record, and to what degree they can be attributed to children's activities, is explored in previous papers (e.g., Ellis, 1994; Ember & Cunnar, 2015; Langley, 2014; Milks et al., 2021; Park, 1998; Park & Mousseau, 2003; Politis, 1998, 1999; Stapert, 2007). Miniature weapon tips are particularly well-represented and include lithic projectile points (Dawe, 1997; Frison, 1970a, 1970b; Nami, 2007; 2010; Politis, 1998), Magdalenian and Mesolithic antler projectile points (Elliott, 2009, p. 101; Langley, 2014), and harpoon heads (Kenyon & Arnold, 1985; Park, 2006; Park & Mousseau, 2003). Small and poorly manufactured Fishtail projectile points from Argentina and Uruguayan sites are argued to be children's toy weapons (H. Nami, 2010; H. G. Nami, 2007; G. G. Politis, 1998). Nami (2007, 2013) proposes that abraded edges on some Fishtail points may have made them safer for kids to use. Although in some cases those weapon points may represent children's toys or tools, they can also be argued to be designed for hunting smaller game including by children (e.g. Park & Mousseau, 2003), bloodletting, as symbolic objects including as charms, or as a virtuosic display of skill (Ellis, 1994; Ember & Cunnar, 2015; Flegenheimer et al., 2015; Frison, 1970a, 1970b; Langley, 2014; Park & Mousseau, 2003). Therefore, miniaturised weapon components suited for smaller hands are particularly exciting, such as the small whalebone atlatl grips from Par-Tee (Oregon, USA) (Losey & Hull, 2019). In this case, the fact that these grips were made from a durable material which would have involved more manufacturing time points to these being functional children's enskilment tools rather than toys (Losey & Hull, 2019).

Exceptional preservation conditions have sometimes resulted in the recognition of wooden weapons and weapon components. For example, archaeological toys from the early Thule culture at the Nelson River site, Banks Island (Canada) include bows and wooden points and arrows (Kenyon & Arnold, 1985). Unlike adult bows, the small Thule toy bows were not spliced, further supporting an interpretation as toys (Kenyon & Arnold, 1985). In contrast Thule recurved baleen bows could have been functional tools for younger children to hunt with, while adolescents may have graduated to

wooden double-reflex bows (Kenyon & Arnold, 1985). Park (1998, 2006) also lists alongside toy bows and arrows a wide variety of miniature wooden Thule weapons including harpoons, spears, fishing spears, and darts. Rosendahl et al. (2006) explore the possibility that a much earlier wooden artefact fragment from the Magdalenian site of Mannheim (Germany) could represent a fragment from a child's bow, but the condition of this artefact makes such an assessment difficult. One of the throwing sticks from the ca. 300,000-year-old site of Schöningen (Germany) was proposed as a potential children's spear (Schoch et al., 2015). This is unlikely, as the throwing sticks are a distinct tool category from the spears (Leder et al. 2024). However, it remains possible that the lighter and smaller throwing sticks (Figure 1) may have been used by children to learn to accurately throw and hunt (Milks et al., 2023).

Figure 1. One of the double-pointed throwing sticks from Schöningen (Germany), which may have functioned as a hunting tool used by children. Modified after Milks et al, 2023. Reproduced under CC BY 4.0 license.

Also archaeologically evidenced is weapon manufacture and repair by children and/or adolescents. A small shaft smoother from the Late Prehistoric site of Head-Smashed-In Buffalo Jump, Alberta (Canada) gives a rare glimpse into how miniaturised tools were required for certain steps in making scaled-down weapons (Dawe, 1997). Similarly, a small Magdalenian antler tool, which strongly resembles *bâtons percés* (perforated batons), may have functioned as a small spear straightener (Langley, 2018). Children would also have needed to learn the important skills of retooling, recycling, and repairing weapon components. In her study of Magdalenian antler points from Isturitz and La Vache (both sites in France), Langley (2014) found that a small number bore signs of being poorly repaired at the base and argues this may show development of retooling skills amongst youngsters (Langley, 2018).

Toy weapons and hunting gear in burial contexts

Sometimes, weapons and weapon components are not scaled down, but their placement in children's burials may link them to the lived lives of those children. Although ritual contexts can limit the scope of reliability of grave goods for understanding the lived lives of children (e.g., Lillehammer, 2010), they can still provide valuable insights about the socialisation of children, and potentially provide

links between real children from the past and their material culture. The ages and stages of childhood, adolescence and adulthood are both biologically and socially variable, and can be especially challenging to determine archaeologically (Halcrow & Tayles, 2008; Kamp, 2001; Lewis, 2007; Nowell, 2021; Nowell & French, 2020). For the sake of simplicity, this paper categorises the ages and stages of childhood as follows: infancy (approximately 0–2 years), early childhood (approximately 3–6 years), middle childhood (approximately 7–12 years), and adolescence (approximately 13–24 years) (French & Nowell, 2022; Milks et al., 2021).

Lithic projectile points are often found in burials, likely because they are easily recognisable and do not decay the way organic components of hunting gear do. While some Neanderthal remains are associated with lithic assemblages, including Levallois and Mousterian points which could have been spear tips (Nowell, 2021 Appendix 2), a lack of a clear association between the fossil remains and material culture renders it too challenging to confidently attribute them as deliberately deposited grave goods. In contrast, rare but notable burials of subadult *Homo sapiens* contain hunting toys or tools. In a recent review of pre-8000-year-old burials in the Americas with associated projectile points, Haas and colleagues (2020) collated data of 429 individuals buried at 107 different sites. Of these, 22 different sites contained a total of 27 child burials (Table S6 in Haas et al., 2020, SI), two of which associate children with hunting tools (Table 1). At Upward Sun River (Alaska, USA) two female burials of a foetus and a newborn are dated to ca. 11.5 cal. ka and were buried with two lithic projectile points (Haas et al., 2020; Potter et al., 2014). At the site of Anzick (Montana, USA) dated to ca. 12.7–12.6 cal. ka, a male boy of ca. 1-2 years old was associated with a large number of artifacts including Clovis fluted points (Table 1) (Haas et al., 2020; Morrow & Fiedel, 2006; Rasmussen et al., 2014; Wilke et al., 1991), a technology generally thought to have been used to tip spears and spearthrower (atlatl) darts (e.g., Eren et al., 2020). As Haas and colleagues (2020) point out, the Upward Sun River and Anzick burials are infants, and clearly, they were not using these weapons as either toys or tools. Rather it suggests that in their societies, infants of both sexes were associated with hunting technologies.

Table 1. Burials mentioned in the text, by childhood stage and weapon type (spears and spearthrowers).

	Infancy **0-2 years**	**Early childhood** **3-6 years**	**Middle childhood** **7-12 years**	**Adolescence** **13-24 years**
Spears			Sunghir 2 and 3 (Russia)	
Spearthrowers	Upward Sun River (Alaska, USA) Anzick (Montana, USA)		Arene Candide? (Italy)	Arene Candide? (Italy) Wilamaya Patjxa (Peru)

Burials of children in early and middle childhood with associated weapon technologies also exist. One of the earliest known examples of a sling was placed around the neck of a 6-year-old child buried in Lovelock Cave (Nevada, USA) and was interpreted by the authors as a toy (Heizer & Johnson, 1952). The Gravettian site of Sunghir (Russia) has a number of burials, including a double burial of two boys, Sunghir 2 aged ca. 10 years old and Sunghir 3 aged ca. 12 years old, putting them somewhere within middle childhood to early adolescence (French & Nowell, 2022; Trinkaus & Buzhilova, 2018). They were buried with an astonishing collection of 16 mammoth ivory spears, alongside a multitude of further rich grave offerings (Nowell, 2021; Trinkaus & Buzhilova, 2018). Interestingly, the spears placed in the grave vary in length between a very short 0.27 metres and 2.47 metres. Additional broken fragments of ivory spears in the cultural layers at Sunghir signifies that these were functional hunting tools for Sunghir people (Trinkaus & Buzhilova, 2018). The spears were mostly associated to the older boy (Sunghir 3), but possibly due to their length also extend alongside the younger boy (Trinkaus & Buzhilova, 2018). The significant variation in lengths suggests that if complete, some of the shorter weapons could be throwing sticks rather than spears (Bordes, 2014; Milks et al., 2023), or they could be symbolic miniatures. Regardless, internment with the longer adult-sized spears alongside the smaller weapons poses a conundrum and invites us to consider whether the boys would have or indeed could have used the largest spears in middle childhood/early adolescence, or whether at least some of the offerings are symbolic.

At Arene Candide (Italy), the Gravettian 'Young Prince', a boy aged between 12 and 18, was buried with multiple grave offerings including four elk antler *bâtons percés* (French & Nowell, 2022; Giacobini, 2007; Riel-Salvatore et al., 2018) which are often proposed as weapon shaft straightening tools (but see Lucas et al., 2019). A recently published adolescent female buried at the site of Wilamaya Patjxa (Peru) was aged between 17 and 19 years at time of death (Haas et al., 2020). She was buried with an array of hunting and butchery tools, including projectile points associated with big-game hunting using spearthrowers (atlatls). In a wider analysis, the authors found that female and male burials associated with weapon technologies in the Americas were at near-parity. While the authors class WMP6 as a 'young adult female' her estimated age may instead point to late adolescence, rather than adulthood (French & Nowell, 2022). Her extensive toolkit suggests that she was well-versed in hunting, butchering, and processing hides of big game animals.

Figure 2. The position of skeletal materials and grave goods of WMP6, Wilamaya Patjxa a burial of an adolescent female with associated projectile points (1 to 7). Photo credit: Randall Haas. Modified after Haas et al. 2020.

Repurposed weapon components

Antler projectile point fragments at the Magdalenian site of Isturitz (France) were repurposed by creating perforations in them, either to be worn as pendants, or possibly as elements of toys (Langley, 2018). One example is a beautifully made *baguette demi-ronde* bearing a clear impact fracture from use as a weapon. It has a roughly-executed perforation that stands in contrast to its original expert shaping, indicating that a child could have picked up this broken weapon element and created the hole, turning it into a plaything or pendant (Langley, 2018). Other examples of antler points from the site are also repurposed, but with better-executed perforations and in some cases reworking of broken tips. Langley (2018) argues that those examples exhibiting greater skill in reworking previously-used weapon points could have been undertaken by adults, or alternatively by children with differing skill levels.

Art

Parietal and mobiliary art may also hold educational purposes for understanding ethology and hunting strategies, as a visual prop for storytelling and as holders of

visual information about pelts, tracks, and other features of prey animals in the landscape. Mithen (1988) and Guthrie (2005) both suggested that artistic depictions of animals and their traces had a functional educational purpose. Guthrie's (2005) idea that early artistic spaces were created by and for boys and men are generally rejected (e.g., Nowell, 2021 p. 133). Apart from the problematic and un-verifiable assumption that scenes represent violence and sex is new evidence that females, including girls, were present and engaged in making cave art (e.g. Van Gelder 2015; Cooney Williams & Janik 2018; Groënen, 1988; see also reviews in Milks et al., 2021; Nowell, 2021). Parietal art was very unlikely to be a didactic classroom setting with the cave walls functioning as a non-participatory Ice Age blackboards. Yet Nowell (2015; 2021; 2022) explores the role of art for children learning to decode images, as well as a visual scaffold for storytelling, with some scenes serving as 'an allegorical tale or a teaching tool for young hunters' (Nowell, 2021 p. 114). These spaces could have served as risk-free locales in which immersive absorption of knowledge of human-animal relationships took place.

Mobiliary art was traditionally interpreted as adult material culture, but recent research explores the potential that objects were made for children, and/or engaged with by children in a secondary use context (e.g., Langley, 2018; Riede et al., 2018). Examples from the European Upper Palaeolithic are made from a variety of materials and include representations of prey animals (e.g. Figure 3), predators such as cave lions and/or bears, and therianthropic figures, which are combinations of human and animal forms (e.g. Conard, 2011; Farbstein et al., 2012; Langley, 2018; Nowell, 2021 p. 51; Riede et al., 2018). Riede et al. (2018 p. 51) suggest that animal figurines 'drew attention to the behavioural characteristics of the animals'. Figurines likely had multiple purposes including as playthings (e.g. Riede et al. 2018; Riede et al. 2022; Langley 2018). As with partietal art, Nowell (2021, p. 52; 2022) proposes a role for such objects as visual elements during storytelling about animal behaviours, hunting, and environmental risks.

Figure 3. An example of a ceramic zoomorphic figurine from Epigravettian horizons at Vela Spila, Croatia. This figurine represents a torso and foreleg of an animal, potentially a horse or deer. Image from Farbstein et al. 2012. Reproduced under CC BY 4.0 license.

Human Fossil Record

A final area with more ambiguous links to hunting include physiological evidence from the fossil record including skeletal trauma, activity, and demographic patterning of age and sex of burials. Berger & Trinkaus (1995) famously proposed that almost all Neanderthal remains with an age-at-death of over 25-30 years have skeletal trauma. More recently Trinkaus (2012) qualified that Neanderthal trauma patterns were not particularly unique, and the idea that they are all related to hunting and to supposed inadequacies of Neanderthal hunting technology, should be abandoned. In the original paper, the age differentiation implied that Neanderthal youngsters were less likely to bear such trauma, potentially signalling a delay until adulthood of the most dangerous hunting situations. A subsequent study comparing Neanderthals and early Upper Palaeolithic *Homo sapiens* found similar patterns in trauma for both species, but with higher levels evidenced among males (Beier et al. 2018). Interestingly, they report a higher prevalence of trauma for young Neanderthals suggesting earlier mortality from trauma, while Upper Palaeolithic modern humans had little difference across age groups (Beier et al. 2018). In a review of Gravettian burials, French and Nowell (2022) find that while 59% of adolescent burials were males, the number jumps to 71% of adults, indicating a greater level of engagement by adult males with dangerous activities including big game hunting. At Sunghir, while the cause of death for both children buried with spears (Sunghir 2 and Sunghir 3) is unknown, both bear signs of skeletal abnormalities. While the older boy (Sunghir 3) suffered from shorter and bowed legs the robusticity of his long bones also points to high activity levels (Trinkaus & Buzhilova, 2018) which could relate to his early involvement in hunting. This mixed picture and a relatively meagre fossil record indicates that further research is needed to help clarify patterning amongst and between species, and across age groups.

Ethnography

Ethnographic reviews

MacDonald (2007) produced a key cross-cultural literature review of ethnographic childhood hunting, presented within a life history framework, the results of which are explored in greater detail below. In a cross-cultural ethnographic study using eHRAF, Ember & Cunnar (2015) explored children's work and play across

societies of four different subsistence types, including hunter-gatherers. They detail types and contexts of play, materials of objects and gender. They also detail work done by children between the ages of six and 10, finding that in general the amount of work done by children of this age varies by subsistence type. Kamp & Whittaker (2020) also used eHRAF, focusing specifically on mentions of weaponry linked to infancy and childhood. They summarise data from 42 societies that have data on spear and spearthrowers in relation to children, and data from 90 societies using bows. Their review evaluates ages and stages in relation to different weapon types, as well as gender, materials, skill acquisition, and self-provisioning.

Langley & Litster (2018) explore whether many objects interpreted as ritual may instead relate to children, and detail data from a cross-cultural analysis of children's play. Miniature weapons are a feature of children's material culture, with this category detailing rarely mentioned types such as bark missiles, blow pipes, pea shooters and throwing sticks. These atypical play weapons reflect the diversity of adult weapons, but it also shows that children may have toy weapons of their own that are not used by adults. Riede et al. (2022), also using eHRAF, conducted a review of 54 foraging communities documenting children's object use and play. Their review found that weapons were the most frequent object, and where gender is mentioned (n=98), weapons are exclusively used by boys. Weapons were also one of the most common types of composite objects in the sample.

In a series of reviews, Sheina Lew-Levi and colleagues explore how forager children acquire subsistence skills (Lew-Levy et al., 2017; Lew-Levy, Kissler, et al., 2019; Lew-Levy et al., 2023). Learning to hunt begins in infancy and progresses through adolescence and into adulthood (Lew-Levy et al., 2017, 2023), but in societies where there are ample opportunities to observe and participate in food production, knowledge seems to be in place by early adolescence with further refinements taking place with increased age (Lew-Levy et al., 2023). Social learning, including in peer groups and involving child-to-child teaching, is key for learning to hunt and tends to occur prior to individual learning (Lew-Levy, Kissler, et al., 2019; Lew-Levy et al., 2023). Children acquire skills through observation, peer-group play, and games oriented around learning to throw and hit targets. Although it is rare for learning other skills, direct instruction may feature particularly in complex tasks including learning to hunt (Dira & Hewlett, 2016; Lew-Levy et al., 2017, 2022, 2023). Relationships between experience, body size and strength and age appear complex (Lew-Levy et al., 2023)

and it is as yet unclear whether this would vary by weapon system, prey type and size and environment.

Ages and Stages

The ages and stages at which children receive or make toys and tools and learn is a particularly important period for learning, as there are significant neurological changes that occur including the pruning of neural pathways to focus on those behaviours and skills that are being practised and developed at that time (Nowell & French, 2020). Yet, they are in a particular phase where they still enjoy neural plasticity, allowing them to rapidly acquire new skills with ease (Nowell & French, 2020). Making a first kill can be an important step for a child in terms of their role in a community (Langley, 2018).

According to Kamp & Whittaker's (2020) review (in which they amalgamate spears and spearthrowers due to a dearth of data on the latter), these weapons are not played with until ages seven to eight, and aren't used for hunting until adolescence, while their modern competition data suggests kids can be competent with a spearthrower from age six. To this we can add recent ethnographic studies of spear hunting to enlarge our understanding of spear use in childhood. In terms of hand-held spears used for throwing and thrusting, we have evidence of learning stages from the Chabu and Manja in Ethiopia, as well as BaYaka communities. For the Chabu, children in early childhood, aged six and seven, begin learning to spear hunt by listening to stories, and through role-play (Figure 2) (Dira & Hewlett, 2016). In middle childhood, from around seven to eight years old, they begin actively hunting small animals with the use of traps. Children's spears amongst both the Manja and Chabu are plain untipped wooden spears and are weighted and sized according to the child's size and preference (Sahle et al., 2023). Spear hunting larger prey begins in later middle childhood, from the ages of nine to 12, and is linked to both physiological maturity and exposure to hunting in peer groups (Dira and Hewlett 2016). Chabu and Manja adolescents begin using iron-tipped javelins in early adolescence and become more active spear hunters from ages 14 to 15 (Dira and Hewlett 2016; Sahle, Ahmed and Dira, 2023). However, Chabu adolescents are not permitted to actively engage in a particular type of spear hunting during the rainy season, as this involves preying on sleeping animals and they are not yet trusted to not wake the animals (Dira & Hewlett 2016; Sahle, Ahmed and Dira, 2023).

Table 2. A simplified summary ethnographic data on different ways that children and adolescents engage with weapons across stages. Sources: Holmberg, 1978; Bugarin, 2005; Crittenden *et al.*, 2013; Crittenden, 2016; Dira and Hewlett, 2016; Hagino and Yamauchi, 2016; Imamura and Akiyama, 2016; Lew-Levy *et al.*, 2017, 2021; Bombjaková *et al.*, 2020; Kamp and Whittaker, 2020; Sahle, Ahmed and Dira, 2023.

	Infancy **0-2 years**	**Early childhood** **3-6 years**	**Middle childhood** **7-12 years**	**Adolescence** **13-24 years**
Spears		Role-play, spearing invertebrates, target-oriented games, accompanying older children on hunts	Active spear-hunting starts, initially hunting small grame using traps (e.g. birds) and also without (rats). Spear throwing and handling practice begins using simplified smaller wooden spears and sticks.	For spear throwing (javelins) young adolescents start with lighter javelins to hunt smaller game (e.g. duiker). Older adolescents hunt medium-sized game using weapons made of the same materials and of the same size as adult spears.
Bow-and-arrows	Start to receive gifts of bow-and-arrows	Play with bow-and-arrows, hunt small game such as birds and lizards. Learn to make own bow-and-arrow sets, and practice hitting targets	Start hunting larger game using either smaller, or adult-sized bows. Begin hunting alone.	Start to hunt more challenging prey. Also begin using more dangerous technologies such as poisons and barbed points.

Amongst the BaYaka, children start playing with lightweight reed spears in early childhood, first spearing butterflies and grasshoppers in and near camp (Lew-Levy

and Milks unpublished data; Bombjaková *et al.*, 2020). They also accompany older children to hunt small game, still with the use of reed spears, and play target-practice throwing games, which are also played by adults (Lew-Levy et al., 2021). Active hunting begins in middle childhood in peer groups, focusing on hunting rats in the camp gardens or nearby forest (Bombjaková et al., 2020; Hagino & Yamauchi, 2016; Lew-Levy et al., 2021). By adolescence, the learning trajectory becomes more focused on learning in the forest from adults hunting larger game with the use of adult-sized iron-tipped spears (Lew-Levy et al., 2021, 2022). An in-depth analysis of teaching adolescents to spear hunt also showed an inverse relationship between teaching and age, with less teaching occurring for each year of age, and more opportunities to lead spear hunts (Lew-Levy et al., 2022).

According to Kamp & Whittaker's (2020) review, bows get gifted to children as young as two, and are played with and used to hunt small game such as birds from age three. From age 10, they show examples of children big-game hunting with adult-sized bows, with the most dangerous weapons including use of barbed points and poisons reserved for adolescents. They conclude that bow-and-arrows start being used at younger ages than spears partly because they are easier to use.

Imamura & Akiyama (2016) also report that for the central Kalahari San, boys receive gifts of toy bows and arrows around ages two and three. In early childhood, they begin hunting birds and lizards, and continue hunting with their own small bows-and-arrows until the end of middle childhood (Bugarin, 2005; Imamura & Akiyama, 2016). Similarly, Sirionó boys are gifted bow-and-arrows by their fathers around age three, but they do not yet use them, instead practising hitting targets in early childhood, and progressing to hunting small game in middle childhood (Holmberg, 1978, p. 185; Politis, 1998). Amongst the Hadza, boys are gifted bow-and-arrows as soon as they can walk independently (Crittenden, 2016; Crittenden et al., 2013). In early and middle childhood, Hadza boys practise their hunting skills in camp, where they target small prey including birds and mice (Crittenden, 2016; Crittenden et al., 2013). By later middle childhood, around ages 10 to 12, Hadza boys begin hunting alone, which roughly corresponds to their adolescent growth spurt (Crittenden et al., 2013). During adolescence they begin hunting hyrax, galagoes and larger birds (Crittenden, 2016; Crittenden et al., 2013), which would still be classified as small prey.

Overall, children learn to hunt with both spears and bow-and-arrows, with this scaffolded according to age and stage. While there is certainly cross-cultural variability

which should not be ignored, learning to hunt with spears and bow-and-arrows have some commonalities. Both systems begin to be learned in early childhood (ages three to six) through play, in or near camp. The children start hunting insects and very small prey like lizards and small birds, and also play target-practice games with both spears and bow-and-arrows. In middle childhood, children still use scaled down child-sized weapons, but in some instances adult-sized bows and arrows are used in middle childhood, whereas this is not recorded for spears. In contrast, young adolescents may only be using lighter weight spears, with adult-sized weapons not being fully used until later (Sahle et al., 2023).

There are a few other key differences between spears and bow-and-arrows. Firstly, there were no examples of infants being gifted spears, while this was reported in several societies for bows. Secondly, Kamp & Whittaker (2020) note that for some societies using bows, hunting of large game may begin in middle childhood, but for spear-using societies we see no examples of large-game hunting until adolescence. This could relate to the possibility that spears require greater body size and strength to use effectively than bows do, but this is a question that would be best answered through experimental research with children and adolescents. A significant ethnographic gap exists on learning to hunt with spearthrower-and-dart weapons.

Teaching and Learning

For very early learning, MacDonald (2007) points to widespread evidence for very young children being carried on foraging trips, and such knowledge does not require any physical engagement by these youngsters. She also found high variability in terms of ages at which children accompany adults on hunts, and this is likely influenced by their physical ability to keep up. Despite the variability of age for commencement of accompanying hunting trips, with the end of middle childhood and start of adolescence she highlights a pattern of intensification of boys' engagement with hunting activities (MacDonald 2007).

MacDonald (2007) suggested that there is a limited role for teaching in learning to hunt. Rather, learning took place through play and games (MacDonald 2007). However, new data on teaching and learning to make and use weapons suggests that a scaffolding approach may result in increased teaching in adolescence, and there may be cross-cultural variability in relation to direct teaching. Amongst the Chabu, learning to spear hunt in early and middle childhood is collaborative and includes

storytelling, role-playing and hunting small game (Dira & Hewlett 2016). But in adolescence, boys have more opportunities to practise spear hunting and butchering of larger game, and this involves demonstrations and explanations (Dira & Hewlett 2016). Physically, boys are taught through demonstration and correction how to hold spears (Dira & Hewlett 2016). In a review of how hunter-gatherer children learn subsistence skills, Lew-Levy and colleagues (2017) also find evidence of direct instruction in adolescence. In a focused study on how BaYaka adolescents learn to spear hunt, Lew-Levy et al. (2022) show the dominance of 'costly teaching' in hunting forays, including the use of instruction, demonstration, assistance, and pedagogical questioning. Particularly notable is the importance of language for all these types of teaching. Like for the Chabu, Lew-Levy et al. (2022) recorded that how to throw and thrust, as well as how to walk and stalk with spears formed part of the teaching. Both demonstration and practice feature in learning to use these adult-sized spears (Lew-Levy et al. 2022).

To learn ecological and ethological knowledge, MacDonald (2007) found that observation was a key means of acquiring knowledge both in play areas in or near camp, and by accompanying adults on hunting trips. Again, MacDonald (2007) emphasises a limited role for teaching, with learning taking place through observation, personal experience, and storytelling. Yet, it is clear from more recent studies that in adolescence, teaching can play a significant role in acquiring ecological and ethological knowledge (Lew-Levy et al. 2022).

Danger

While archaeologists may sometimes emphasise the danger of technologies themselves, ethnography tells a more nuanced story. Foragers may be less concerned with the danger of objects than we might assume from a Western perspective (Boyette & Lew-Levy, 2020; Hewlett et al., 2011; Lancy, 2016; Lew-Levy, Crittenden, et al., 2019; Lew-Levy et al., 2017, 2021). Instead, concerns around safety tend to focus on situational danger, including encounters with dangerous animals like snakes and predators, proximity to injured prey, and other dangerous scenarios such as getting lost, having access to water, and weather conditions (Dira & Hewlett, 2016; Imamura & Akiyama, 2016; MacDonald, 2007). Potentially, dangerous environments may contribute to how much children contribute to a given society's economy (Ember & Cunnar, 2015), and certainly it can play a role in the age that children join adult hunting

expeditions (Dira & Hewlett, 2016; MacDonald, 2007). Amongst Chabu, fathers are the ones to tell their sons about the dangers of hunting, and age is a significant factor in deciding when it is safe for their sons to begin hunting (Dira & Hewlett, 2016). Children are also sometimes prohibited by their fathers from beginning to participate in spear hunting if they are deemed to be not yet ready, and this is related to risk and safety (Dira & Hewlett, 2016). Hunting large game is considered to be especially risky. Risky scenarios involving learning to hunt may be mitigated during childhood through object and role play in or near camp, something which is recorded for many societies (Crittenden, 2016; Crittenden et al., 2013; Dira & Hewlett, 2016; Ember & Cunnar, 2015; Riede et al., 2018).

Making weapons

For the BaYaka, although it is noted that children will repair their broken reed spears (Lew-Levy, Boyette, et al., 2019) it is unclear whether the child, peers or adults make children's and adolescents' spears, nor how the materials for these are selected (these questions form part of a current research project). Amongst the Chabu, iron-tipped spears, including shaping the wooden shafts, are made by fathers for their sons (Dira & Hewlett, 2016; Sahle et al., 2023), but again it is not clear whether children make their own wooden spears, nor at what age learning to make them commences. For bow-and-arrows, learning to make them begins in early childhood in many societies, but this process can be an extended one (Bugarin, 2005; Crittenden, 2016; Lew-Levy et al., 2017; Politis, 1998). Children's weapons and other hunting technology such as nets and traps appear to be made almost exclusively from organic materials (Ember & Cunnar, 2015; Kamp & Whittaker, 2020), a pattern that might be true for children's material culture as a whole (Riede et al., 2022). Spears and bow-and-arrow sets include miniature toys and scaled-down functional tools (Ember & Cunnar, 2015; Imamura & Akiyama, 2016; Kamp & Whittaker, 2020; Langley, 2018; Lew-Levy et al., 2017, 2020; Nowell, 2021; Sahle et al., 2023). There are also notable differences in the likely performance of such weapons, including their energy and tip material, both affecting performance. As already noted, for BaYaka, Chabu and Manja those in early and middle childhood use wooden and reed spears instead of iron-tipped spears. Amongst the Hadza, younger boys' first arrows are made of grass, tipped with beeswax so that they are properly weighted for flight (Crittenden, 2016). This suggests

that in many cases the weapons are designed with children's play and small-prey hunting in mind.

Small game hunting and the self-provisioning child

That forager children can spend a significant amount of time self-provisioning is well-documented, but how much they do this varies cross-culturally (Ember & Cunnar, 2015; Lew-Levy et al., 2017). Some studies provide finer-grained details about how kids do this, what they are hunting and gathering, and to what extent this contributes to their overall caloric intake. Crittenden (2016) found that although Hadza children are well-known for self-provisioning, only 19% of their calories come from birds including fledgling weaverbirds that are collected after trapping using sap, and only 3% of their calories come from other small prey (Crittenden 2016). In general kids often cook and share what they hunt amongst the peer group (Imamura & Akiyama, 2016; Kamp & Whittaker, 2020).

Questions remain about the relationships between body size and strength, hunting skills and type of prey that children hunt (Crittenden, 2016; Crittenden et al., 2013). This is especially relevant for understanding childhood learning and self-provisioning in relation to different weapon systems' requirements in terms of body size, grip strength, height, and the cognitive and motor skill challenges of different weapon systems (Bebber et al., 2023; Lombard, 2015).

Gender

Ethnographically, there is variability in terms of sexual division of labour and engagement by both men and women, and boys and girls, in hunting. Some societies practise a strict division of labour, with hunting being solely a male activity, while in others both genders hunt (e.g. Anderson et al. 2023; Crittenden, 2016; Lew-Levy, Boyette, *et al.*, 2019; MacDonald, 2007; Sahle, Ahmed and Dira, 2023; Venkataraman et al. 2024). Although how and when women hunt in small-scale societies often differs from how men hunt, they do hunt using both bow-and-arrows and spears, and even if it is relatively rare this does include big game hunting (Anderson et al. 2023; S. Lew-Levy, pers. comm.; MacDonald 2007; Venkataraman et al. 2024).

While recent reviews (Anderson et al. 2023; Lacy and Ocobock 2024; Venkataraman et al. 2024) engage in how the presence of infants and children may or may not hinder female hunting, these reviews do not effectively engage in how this

might affect how children, and specifically girls, acquire relevant hunting skills. Imamura & Akiyama (2016) note that while San women appear to only begin hunting after marriage, they likely learned how to do so while on foraging trips in childhood, a suggestion that warrants further research. Several studies emphasise the strong association of weapons with boys' material cultural activities (Kamp & Whittaker, 2020; MacDonald, 2007; Riede et al., 2022). Yet, girls too play at hunting, hunt in peer groups, and with adults (MacDonald 2007). According to a cross-cultural comparison of Hadza and BaYaka children's play time, while it is true that boys in both cultures engage in hunting play more than girls, it is also true that girls play at hunting more than boys play house (Table 4 in Lew-Levy, Boyette, et al., 2019). The overall pattern does seem that in recent and contemporary societies, boys play with weapons more, and invest more time in the skills needed to learn to hunt. Yet potentially if women's hunting has been less well-recorded ethnographically, this affects our understanding of when and how girls and women learn these skills and technologies (Stiner et al., 2000).

Discussion

The archaeological record of pre-sapiens humans has little direct evidence of how children learned a skill as key as hunting. While a few indications of enskilment exist for lithics manufacture, we have few weapons that are fully preserved. Complete archaeological wooden spears tend to be comparable to if not larger than ethnographic examples (Milks, 2018). Wooden throwing sticks are much smaller weapons, and in theory could have been used by children to learn key hunting skills (Milks et al., 2023). The evidence that we can bring to bear on this is admittedly scant, and we must take care. While we can and should propose alternatives to a picture restricted to adult male hunting, given that people do need to learn to hunt and it is a difficult skillset to acquire, we cannot know for certain who was hunting at a given site. Tools do not come out of the ground imprinted with 'male' or 'female', 'adult' or 'child'. Yet, footprints at Schöningen show that juveniles were present at the lakeshore of this key Middle Pleistocene hunting locale (Altamura et al., 2023). They imagined this mixed-age group as foragers and/or scavengers, and not as they write a "group of adult hunters engaged in a courageous hunting trip" (Altamura et al., 2023, p. 22). Yet, the archaeological and ethnographic evidence consistently shows children and

adolescents did and still do regularly engage in hunting activities, with adolescents in particular learning to hunt big game. This serves as a reminder that for the deep past, and especially for pre-sapiens hominins, we need hold multiple possible scenarios in play. For example at Schöningen, this should include the potential for children engaging in hunting, butchering, woodworking, and processing activities evidenced there (e.g. Leder et al., 2024).

For later *Homo sapiens* sites and fossil remains, evidence is still rare, but is undeniably richer than earlier periods in human evolution. A geographical bias is apparent, with no archaeological examples from this review providing evidence of kids hunting in Oceania, eastern Asia, and Africa. Other domains of learning, such as flintknapping and art hint at how children might have learned other skills through experimentation, play, and teaching (for reviews see Milks et al., 2021; Nowell, 2021). Oddly, while we have ample ethnographic evidence regarding bow-and-arrow use and almost none for the spearthrower, we have the opposite problem archaeologically. Admittedly, the data associating archaeological evidence of the spearthrower with children and females is largely thanks to Haas et al.'s (2020) recent review, which focused on projectile points in the early Americas. A similar review for later burials of the Americas and the Eurasian Mesolithic could ameliorate this data gap. There are further examples of archaeological miniature weapons unassociated with burials, many (but not all) of which look likely to be toys. Although limited in scope, archaeological data also point to different ages and stages of when children may have engaged with hunting technologies. Where the archaeological record seems to differ the most from ethnography is that hunting gear is associated with both genders, including in later adolescence. While the evidence is scant, boys were not buried with hunting gear (n=3) more often than girls (n=4).

The ethnographic record, as shown in this review, is deeply useful for filling in these archaeological gaps, and for highlighting potential behaviours and enskilment. It has shown us both patterning and variability with respect to onset of juvenile engagement with hunting, and how learning is scaffolded through play such as hunting invertebrates, birds and small game, and target practice games. Learning in adolescence can involve costly teaching including verbal instruction and demonstration to cover skills and knowledge of how to deploy weapons effectively,

how to track and find prey, how to make a kill, and how to remain safe. Riede et al. (2022) rightly point out an ethnographic bias towards weapons; potentially there is also a bias in the ethnographic record towards male hunting. Ethnographers might record male-associated hunting gear more than other tools because they are conspicuous objects, and ethnographers may have been further biased by their own interests. When women are hunting in different ways, and with different technologies such as with nets, traps, dogs, clubs, knives, and poisons (Anderson et al., 2023; G. Politis & Alberti, 2007), archaeologists might be specifically missing signatures of women's hunting, and in turn girls' learning of those skills (Stiner et al., 2000). This is because these technologies are usually taphonomically unlikely to survive (nets, traps, clubs, poisons), are archaeologically non-gendered (nets, traps, dogs, clubs, knives, and poisons), or are multifunctional (e.g. knives).

Interestingly, objections to female hunting in the past also sometimes rely on strength arguments, with the assumption that weapons need larger and more powerful adult male bodies for successful use. In theory, this could turn out to be truer of hand-delivered spears though than mechanically projected weapons such as spearthrowers-and-darts and bow-and-arrows. This feeds into questions around childhood engagement with hunting, with many archaeologists experimentally exploring how physiology and weapon success intersect (Bebber et al., 2023; Grund, 2017; Milks et al., 2019; Whittaker & Kamp, 2006). So far, the data suggest that a mechanically projected weapon, and especially the spearthrower, is easier to learn to use and to successfully deploy, which would enable more effective use by children and female hunters (Bebber et al., 2023; Grund, 2017; Losey & Hull, 2019; Whittaker & Kamp, 2006). Arguably these weapons may also reduce time budgeting required to learn for all members of a society, freeing up time for other tasks, and/or reducing the need for larger body sizes, muscle mass and/or strength. In this case, particularly because of the dearth of ethnographic data on spearthrowers, experimentation may help fill in knowledge gaps.

As shown in this and other reviews, the archaeological record can be a rich source of evidence, and may not always track ethnographic patterns which can be attributed to differences between contemporary foraging lifeways with those from the past. For one thing, there are no perfect modern ecological and environmental

analogues for Pleistocene Eurasia. Neanderthal physiologies, diets, technologies, and cultural preferences are demonstrably different to those of contemporary forager societies (French 2019). As Haas et al. (2020) point out, meat-heavy diets, which many Pleistocene humans including our own species followed, might have necessitated very different hunting practices including for sexual division of labour (see also Bebber et al. 2023). In addition, there are many aspects of contemporary forager societies which would lead us to pause and reflect on using them as analogues. Weapon materials have shifted almost universally from organics and stone to metal, mobility is likely very limited compared to that of Pleistocene humans, and the attendance of recent and contemporary forager children in formal Western-style schools (universal education) may also affecting their ability to gain competencies in skills such as hunting (e.g. Tehrani and Riede, 2008 Ninkova et al. 2024). All this to say that while the ethnographic record is rich in data that the archaeological record lacks, there remain inevitable limitations.

Promising areas for archaeological research on learning to hunt include further explorations of associations between infant, child and adolescent burials with hunting technologies, alongside a careful consideration of the human fossil record including of childhood trauma and activity patterns. Experimental archaeology also has an exciting role to play, especially if we can open this field up to working more with children and adolescents. Ethnographic lessons on hunting invite new questions about the hidden cultures – material and otherwise - and help us to further 'raise the curtain' on the lives of people, including children from long ago.

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