Philosophy of Science (2022), **89**, 415–433
doi:10.1017/psa.2021.42

PSA PHILOSOPHY OF SCIENCE ASSOCIATION

PHILOSOPHY OF SCIENCE

ARTICLE

Ethnography, Archaeology, and the Late Pleistocene

Kim Sterelny

School of Philosophy, Australian National University, Canberra, Australia
Email: Kim.Sterelny@anu.edu.au

(Received 30 November 2020; revised 08 April 2021; accepted 23 June 2021; first published online 10 February 2022)

Abstract

The use of ethnography to understand archaeology is both prevalent and controversial. This paper develops an alternative approach, using ethnography to build and test a general theory of forager behaviors, and their variations in different conditions, one which can then be applied even to prehistoric sites differing from contemporary experience. Human behavioral ecology is chosen as the framework theory, and forager social learning as a case study. The argument is then applied to social learning in the late Pleistocene, and hence to a famous archaeological puzzle: the late Pleistocene acceleration of technical innovation and regional differentiation.

1. Ethnography, analogy, and theory

The late Pleistocene (from very approximately 150 kya) was a crucial and controversial period in human social life, for it was a time in which the pace of technological change and the extent of regional differentiation increased markedly. The control of form became astonishingly precise;[1] the range of worked materials increased, with bone, horn, and ivory becoming widely used; composite tools became a routine part of human toolkits, and material symbols became a regular aspect of human material culture. These changes are often summarized in the claim that at this stage human life became "behaviorally modern." It was once thought that these changes were very abrupt, probably signaling some upward step in intrinsic cognitive capacities. It is now known that these aspects of material culture had more ancient and dispersed origins, and few now attribute the changes to a genetically based cognitive upgrade.[2] Instead, the main candidate explanation is that these late Pleistocene changes were the result of enhanced social learning and hence more reliably cumulative culture, a view developed in different forms in Henrich (2016), Heyes (2018), Tennie et al. (2017), and Sterelny (2012). How is such a view developed and tested? In interpreting the Pleistocene, archaeologists have routinely appealed to ethnographic information.

[1] Google "Solutrean flake" for a stunning example.

[2] See McBrearty and Brooks (2000) for the crucial paper changing the old consensus; see Kuhn (2020) for a superb synthesis on the emergence of Palaeolithic technologies.

For example, Frank Marlowe explicitly sees the foraging life of the Hadza as a model of the Pleistocene foragers who foraged in the same area and in a similar physical and biological landscape (Marlowe 2010). Much more controversially, Francesco d'Errico and his co-authors have recently argued that the material culture of the Border Cave in South Africa is so strikingly similar to very recent San artefacts as to show strong cultural continuity, even though the Border cave deposits and the San are separated by over 40 k years (d'Errico et al. 2012).[3] The aim of this paper is to defend the relevance of ethnographic information in reconstructing late Pleistocene social worlds, and, in particular, reconstructing the organization of social learning in those worlds. That is particularly important in this case. For the hypothesis that the late Pleistocene saw a marked change in the reliability of cultural accumulation has so far rested heavily on formal models of cultural evolution (see especially Henrich 2004; Powell et al. 2009; Premo and Kuhn 2010).

In sum, this paper has three aims. (1) It defends the relevance of ethnographic information to archaeological interpretation through a detailed case study illustrating a more general method. (2) It links that case study to the Pleistocene innovation spike, supporting the claim that this spike depended on enhanced social learning. (3) The paper then details both the scope and the limits of the approach illustrated by the case study.

Despite its prevalence, the use of ethnographic data in archaeological reconstruction remains controversial. It has typically been taken to depend on analogy, that is, on the idea that past human cultures are relevantly similar to ethnographically known ones, and hence that we can legitimately extrapolate from (more or less) contemporary cases to more ancient ones. In turn, this is often seen as "presentist," implicitly denying the possibility that the social and economic lives of ancient humans were qualitatively different from those in the ethnographic record. In response, Alison Wylie, and more recently Adrian Currie, have argued that these similarity-based inferences can be sound and should be assessed on a case-by-case basis (Wylie 1982, 1985; Currie 2016). Both Wylie and Currie suggest that analogical inference is warranted to the extent that the observable similarity between an ethnographic and an archaeological case is evidence for a causal similarity. To take a specific instance discussed by Currie, it is argued that the Pleistocene cave art of glacial Western Europe is so strikingly similar to shamanistic imagery that we can infer that they are the result of a shared neuro-cognitive mechanism. As the two art traditions have a common causal base, we can use what we know about shamanistic symbolism to interpret that Pleistocene art. However, if we can use ethnographic data to construct and test claims about causal mechanisms, similarity between past and present is no longer essential. We can use ethnographic case studies to build, refine, and test a general model of forager social organization and the environmental factors that explain variation in that social organization. These environmental factors can be outside the contemporary range.

A focus on using ethnographic information to build a causal model has two advantages. First, historically recorded forager cultures are impressively varied. In documented times, foragers have negotiated an immense range of physical and

[3] This paper provoked a very hostile response in Pargeter et al. (2016), which led to a series of barbed exchanges.

biological environments: from the tropics to the high latitudes; from rain forest to tundra, to sea edges to desert; living largely in peace to permanent hostility to neighbors, and much in-between. This variation in the lifeways of ethnographic foragers (celebrated in Kelly [2013]) is a crucial resource for theory-building. It enables us to explore both the sensitivity and the insensitivity of forager lifeways to variation in the environment. This paper will argue that the forager education system is relatively insensitive to variations in the physical and biological environment. In a companion paper, I develop a parallel argument about a decidedly variable aspect of forager lives: their very differing levels of investment in subsistence technology (Sterelny 2021). That paper shows that high investment subsistence toolkits (often found in high latitude forager communities) are responses to resource portfolios that have restricted diversity, but contain high value targets whose locations are relatively predictable. So, this theory-applying strategy does not depend on identifying relatively invariant features of forager lifeways, even though in this paper the focal example is relatively invariant.

Second, it expands the relevance of ethnographic information. Many ancient environments were very different from recent ones. In places, that is true even of the Early and Mid Holocene. Suppose, for example, we aimed to reconstruct the lifeways of the Australian foragers of the late Pleistocene and earlier Holocene. We could not rely on similarities across time of technology and subsistence economy of the kind d'Errico and his colleagues claim to see between the recent San and the Border caves foragers. Nor could we rely (as does Marlowe in his discussion of the Hadza) on the enduring stability of the physical environment. Physically and biologically, Pleistocene and early Holocene Australia did not resemble contemporary conditions. For example, before the last glacial cycle took hold, large parts of inland Australia, whilst still being arid by the standards of other continents, were significantly less arid than now. Fifty thousand years ago, Lake Eyre and Lake Frome (now huge salt pans, very occasionally flooded) were not just full; they constituted a single huge body of inland water. As recently as 32 kya, Lake Frome was indeed a lake, with a volume 40 times that of recent ephemeral floods. In contrast, at the peak of the last ice age, the interior was not just colder but drier, with a weaker monsoon. Ethnographic information would be irrelevant to Australian Pleistocene or early Holocene foraging if its value depended on establishing similarities between present and past.

So, we need to build a general model and use that model in connection with Pleistocene environmental data to reconstruct the lifeways of past forager societies. Our best guiding theory is human behavioral ecology, broadly understood to include evolutionary game theory and life history theory. Crucially, this theoretical approach makes minimal, relatively uncontroversial assumptions about human action (Laland and Brown 2002). Its grounding assumption is that in environments that agents have long experienced, and when faced with decisions they and/or their social partners have faced many times in the past, their choices approximate those that would maximize their expected inclusive fitness.[4] This broad-church version of human behavioral ecology rests on the view that in well-practiced environments, humans are

[4] A quote from the depression era Australian politician Jack Lang captures this neatly: "In the race of life, *always back self-interest*—at least you know it's trying."

https://doi.org/10.1017/psa.2021.42 Published online by Cambridge University Press

intelligent and flexible enough to learn the choices that lead to the outcomes they welcome, and that the outcomes they welcome enhance their fitness.[5]

That said, behavioral ecology does have significant limitations over and above the requirement that environments are stable enough for agents to zero in on suitable responses. Agents must have access to relevant information and be autonomous enough to act on their choices. On the view developed here, we can use causal models based on behavioral ecology to interpret patterns of behavior when (i) the activities in question are central to fitness; (ii) they take place in environments in which agents have time and opportunity to identify their relevant affordances; and (iii) agents have sufficient autonomy to choose options that advance their own interests. I return to these constraints in the final section to test whether they undermine the main arguments of the paper and to consider the scope and the limits of this strategy for using ethnography to inform archaeology. For now, I aim to show the power of this approach through an example: the use of information about social learning amongst ethnographically known foragers to estimate the social learning environment of the late Pleistocene. I shall suggest that this supports the idea that the late Pleistocene acceleration of both innovation and differentiation reflects a social environment better adapted for efficient social learning.

2. The forager education system

The forager education system is both distinctive and relatively invariant, despite the variation in other aspects of forager life. A broad range of ethnographic sources converge on the following picture: (i) a forager's education develops over three main phases. As an infant and young toddler, a forager learns primarily from his/her parents (mostly the mother). From childhood to early adolescence (from approximately 4 yo to 12 yo), the young forager spends most of the day in a mixed age/mixed gender play-group. In this group, learning is a mix of collaboration, individual exploration, practice, peer-to-peer horizontal transmission, and with some information flowing through participation in adult activities. From early adolescence, gender segregation becomes more marked, and social learning becomes predominantly intergenerational, with a variable mix of oblique and vertical transmission. (ii) Forager children are free-range, with plenty of time to play and explore. In most cases, the playgroup operates with remarkably little adult supervision. Forager children do, indeed, forage, but their motivation is as much recreational and social as economic. Their targets and hence their profits reflect this. (iii) Forager children acquire a basic forager competence remarkably early. At about 12, they are not yet experts, as they are still to acquire only their most demanding skills (large game hunting, complex craft techniques, esoteric knowledge). (iv) Explicit teaching is important to a forager's education, but it is not the dominant form of social learning. It is mostly restricted to norm acquisition, esoteric knowledge, and the most challenging subsistence skills. (v) Notwithstanding the importance of the playgroup, children are not excluded from adult activities. Given the intimacy and compactness of mobile forager campsites, there is a lot of public information available, and children have the

[5] This idea is occasionally explicit in archaeology. See, for example, Gould (1980) and Hiscock (2008), even though they do not use the term "behavioral ecology."

https://doi.org/10.1017/psa.2021.42 Published online by Cambridge University Press

opportunity to look, to eavesdrop, to learn by helping, and to benefit from occasional advice. In the rest of this section, I will expand on this skeletal summary.

2.1 Three phases of social learning

The three-phase organization of social learning is now widely reported. The initial phase is mother-focused, with many ethnographic observations converging on the central role of the mother in the first few years (Konner 2005, 2011), though, especially after the baby becomes a toddler, others' support is important as well (Hrdy 2009). There is some explicit teaching, but parents also support social learning by constructing a learning niche. For example, Lew-Levy and colleagues note that in many forager cultures, parents provide their children with miniaturized versions of adult subsistence equipment, used in some combination of play and practice. This age-adjusted equipment included fishing lines, baskets, digging sticks, spears, and bows and arrows (Lew-Levy et al. 2017, 378). Their examples are mostly African, but there are Australian examples as well (Haagen 1994). Barry Hewlitt, Adam Boyette, Sheina Lew-Levy, and various co-authors have shown that predominantly vertical transmission fades out early, to be supplemented by collaborative and horizontal social learning in mixed age and gender playgroups. From about the age of four, children roam in groups, learning together, and with younger children learning from, and sometimes being explicitly taught by, older children (Lew-Levy et al. 2020).

While this work documents the importance of child-to-child learning, horizontal transmission has social support in an adapted learning niche. Horizontal transmission is effective in part because of the presence of public information and the tolerance of children in adult activities. For example, Danny Naveh gives a vivid description of two South Indian forager boys working out for themselves how to make and set traps, without asking for or getting adult advice. But that experimentation did not take place without adult support. One boy's father was the best and most persistent hunter in the village; the boy had often been out with him making and setting traps. Indeed, the report includes a description of one such occasion in which the boy, with his father, tried to make and set the traps himself. His father looked on, and without commenting, rebuilt the trap so it would work (Naveh 2016). This ethnography shows the freedom these children have to learn in their own way and pace, but it also shows youthful exploration has a lot of social support.

Children forage, but a good deal of the time spent foraging is, in part, recreational and social (though of course still providing social learning opportunities [Lew-Levy et al. 2020]). For example, Baka forager children (from Congo rainforests) spend a good deal of time rat hunting, searching through the forest for rat holes, then trying to smoke and dig the rats out. This is, no doubt, good practice at close observation—rats do not advertise their holes—but as the authors of this study note, children hunt rats in groups (adult males forage alone), and rat hunting delivers rather meagre returns (Hagino and Yamauchi 2016). But it is an entertainment. Tucker and Young's study of Mikea children in Southwest Madagascar tells a similar story: these children do forage for tubers in the exceptionally benign forests in which they are based. But they do so socially, only semi-seriously, and not for very long. That is shown by the enormous difference in adult versus child rates of return, even though they are targeting the same plant (Tucker and Young 2005).

https://doi.org/10.1017/psa.2021.42 Published online by Cambridge University Press

By the time children reach adolescence, they have mastered much of the foraging lore on which they will depend through their lives. But expertise continues to develop deep into adulthood, at least for the peak skills of forager life. A recent cross-cultural study of hunting found that the generic hunter's skill peaks at about 33, followed by a very slow decline, with presumably both experience and peer-peer interaction refining skill levels through the twenties, and compensating in part for physical decline later in life (Koster et al. 2020). These more challenging skills are acquired with adult help, though not necessarily parental help. For example, the Chabu hunt with spears in their seasonal African forests. Hunting is difficult and multi-faceted. To hunt successfully, a boy must acquire the strength and skill to throw a spear accurately at distances greater than 10 meters, must learn how to train a dog to hunt properly, must learn to track and navigate in the forest, understand how animals act and where they are to be found. In acquiring difficult skills of this kind, it is probable that oblique intergenerational social learning is often important. Many of these apprentice hunters report hunting with men other than their father and *because* these others are good at hunting and at teaching its skills. Such oblique social learning occurs in many forager communities (Garfield et al. 2016). In some cases, these models are chosen from a narrow pool of close personal associates, but in others, adolescent boys go beyond their immediate circles to learn from innovative hunters (Hewlett 2013, 2016). Oblique learning is not confined to subsistence skills. Jerome Lewis describes the custom of young Congo foragers of traveling to quite distant groups to learn and return with their distinctive "spirit-plays," music-theatre-ritual-party hybrids (Lewis 2019). While some degree of oblique transmission is a routine feature of adolescent skill acquisition, there is probably quite wide variation in its extent and character.

2.2 Free-range children

The ethnographic literature includes many descriptions of the relaxed and carefree character of early forager life, with much affection and tolerance, with very little harsh discipline (in contrast to the childhoods of subsistence farmers, though the Hadza may be a forager exception [Lew-Levy et al. 2020]). The playgroup is one aspect of this free-range, self-directed character of the life of foragers in their middle childhood. Indeed, it seems that in some of these communities, the freedom of the playgroup is not a mere absence of adult supervision. In these communities, there is a positive norm of respecting and encouraging children's autonomy, coupled with the belief that children learn best when they discover things, good and bad, for themselves. Nayaka foragers of India have this view of the importance of self-education (Naveh 2016). There are similar norms amongst the Wik (Cape York Peninsula, Australia), and the BaYaka and the Aka, both from Central Africa (Eickelkamp 2010; Lewis 2016; Boyette and Hewlett 2017).

2.3 Early competence

In early adolescence, children begin to live in a more exclusively adult and gendered world. But by that time, they have acquired a significant fraction of the skills that make a competent forager. Some skills are acquired (to western sensibilities) strikingly early: young San children can bait traps effectively, learning from their older peers (Lew-Levy et al. 2017, 381). San and Batek children as young as five make their

https://doi.org/10.1017/psa.2021.42 Published online by Cambridge University Press

own bows and arrows, equipment they use to hunt birds and lizards into their adolescence (382). Likewise, Bock describes both girls and boys, using different techniques, fishing independently of adult supervision and with fair success (Bock 2005). They did so in the Okovango Delta, waters that are well-stocked with Nile crocodiles as well as hippos. So this delta is not like the benign forest of Madagascar, where free-range roaming is safe for children (Tucker and Young 2005). The western deserts of Australia are entirely free of crocodiles, but heatstroke and dehydration can be equally fatal. Yet without adult supervision, Martu children hunted goannas in their rocky outcrops (Bird and Bird 2005). In Australia's north, well-supplied with crocodiles, Yolngu children, as young as 6 or 8, fished, foraged, and swam without needing adult oversight. Likewise, Wik children, in the far north of Queensland, made their own fires and fished for themselves (Lew-Levy et al. 2018). Foraging in the playgroup was probably as much social and recreational as economic, but it still taught crucial skills of natural history, the use of tools, bush navigation, and recognizing and avoiding dangers. These children had mastered a basic skill set at the entry to adolescence.

2.4 The role of teaching

It was once argued that teaching was, at most, a minor aspect of forager education. That view rested on a narrow and institutionalized conception of teaching. But there are other forms of teaching: the provision of miniaturized tools, informal advice and encouragement, the storytelling that is ubiquitous in forager lives. On a broader view of teaching as adaptive support for social learning, teaching is probably quite central to forager education (Lew-Levy et al. 2020). But explicit and deliberate teaching is important too, playing a role in three domains. These are: (i) the most challenging foraging skills, most obviously, large game hunting; (ii) learning the esoteric lore of the community and the more complex aspects of its symbolic culture; (iii) norm learning. We first discuss *hunting and advanced subsistence skills*. Chabu adolescents, discussed above, learn to hunt from adults, and that involves a good deal of explicit teaching. Novices learn their initial hunting lore through stories. As they move into adolescence, boys are provided with practice spears and then the real thing. When on hunts, adults point out and explain tracks; they demonstrate and explain the right grip for spears. Boys are tested on navigation in the forest and corrected if they misread locational cues. Finally, they are sometimes given the chance to make the final kill. It is no surprise that the skills of large game hunting are explicitly taught. For the costs of failure in trial-and-error learning are high. Large animals are encountered infrequently, one reason why many hunts fail. So, it is important that favorable encounters result in kills. Allowing an unschooled novice to be part of the killing team must reduce that success rate, while also increasing the risk to the hunters. The same considerations about cost apply to artisanship. When equipment is complex (and hence has high labor costs), and/or made from expensive raw materials, or where failure would be catastrophic, we expect explicit teaching to play a larger role. I have seen no reports of the route through which Inuit learn kayak-making, but since those boats are complex, made from scarce materials, and as failure kills, we would predict that those skills are explicitly and carefully taught. That is true of traditional navigation in the Marshall Islands of Oceania, as those islands are small and far apart (Genz et al. 2009). These skills are taught explicitly, through an apprenticeship

https://doi.org/10.1017/psa.2021.42 Published online by Cambridge University Press

system. Trial-and-error learning, even with social support, is contra-indicated when error is fatal.

Second*, the arcane and the arbitrary*. It is virtually impossible to decipher the more complex human symbolic systems without teaching. Kinship systems, for example, are notoriously complex. That is especially true of forager societies. These often have universal kinship systems, where any two community members are kin of some kind (Barnard 2011). So it is no surprise that kinship systems are explicitly taught (Ellis et al. 2017; Boyette and Hewlett 2018). It is not just their complexity that demands explicit teaching. Kin relations are social constructs, though based on a genealogical substrate. They are not independently discoverable objective features of the world. The same is true of esoteric knowledge. Adventurous-enough individuals might discover for themselves the routes linking reliable waterholes in the Western Desert, but they cannot *discover* the totemic dreamtime figures linked to those sites, nor the rights, obligations, practices, and prohibitions that derive from those links. These are not objective facts to discover. Thus, esoteric knowledge must be taught (see, for example, Meggitt [1965] and Gould [1969]; for a more general discussion, linking esoteric to ecological information, see Kelly [2015]).

Third, *norms*. It has been suggested that norms require explicit teaching, because social norms are opaque, not easily learned by observation and experiment (Salali et al. 2019). While that may be true of some obligations and taboos linked to kinship, in general, the social expectations foragers have of one another—willingness to share, non-coercive interaction—are evident in behavior. Rather, adults need to ensure the *internalization* of norms. Teaching norms aims to shape children's motivational structures, somewhat against their natural grain. The problem is less opacity than recalcitrance. Children have generous and prosocial impulses, and they also have aggressive, selfish, and self-centered impulses. One of the effects of the forager education system is to dial the first set of impulses up, and the second set down. Negative feedback—sharp response to children's acts—is mostly restricted to violations of forager norms of sharing and cooperation (Boyette and Hewlett 2017, 2018; Lew-Levy et al. 2018). In particular, generosity and sharing are taught early, that is, the San Hxaro practice of gift exchange (Lew-Levy et al. 2018). Moreover, forager stories carry moral lessons. While these are stories and are not meant to be taken literally, they *are* meant to be taken seriously, as is shown by the care and regularity with which they are told and their canonical form (Coe et al. 2006; Sugiyama 2017).

2.5 Social integration of children

Notwithstanding the importance of the playgroup and the freedom in mid-childhood to roam without adult oversight, children are not excluded from the adult sphere. As noted earlier, as children enter early adolescence, they tend to graduate into adult, gendered company, with boys in their mid or even early teens joining hunting parties, and girls foraging and engaging in domestic activities with adult women. Moreover, while forager children have a lot of free time, they are regularly asked to help out in the domestic economy, giving children opportunities to practice basic domestic skills, and to look and learn (Boyette 2016; Lew-Levy et al. 2017; Boyette and Hewlett 2018). In the evening, in camp, the physical organization of forager campsites enforces social integration. At night, social living is dense. Forager camps are typically compact.

Houses, huts, and shelters are small, often without walls, and closely packed (with the exception of some Australian foragers). By WEIRD standards, they have tiny amounts of room per person, even in their beds (Hewlett et al. 2019). There is little privacy. As consequence, children are not excluded from the adult world and have many opportunities to observe and eavesdrop, to benefit from public information.

The forager system, then, is relatively invariant across physical and biological differences, and qualitatively similar systems are found in different regions, in cultures separated by tens of millennia. I shall argue below that these similarities are converging adaptive responses to the challenge of raising competent foragers with limited resources. But while the system is relatively insensitive to environmental difference, it is very sensitive to subsistence organization. The children of subsistence farmers lead very disciplined lives and are integrated into the workforce much more rapidly. This is probably because forager children have more to learn (subsistence farming is de-skilled compared to foraging, one reason why children can be used for farm-work) and because the efficiency of adult foraging makes children's economic contribution less critical. Indeed, the forager-farmer contrast shows that child-rearing practices are not stabilized by cultural inheritance alone. Hence, the common forager pattern cannot be explained just by deep inheritance from the Pleistocene; even if some elements have deep cultural roots, it has been selectively stabilized.

3. Optimized social learning?

One's overwhelming impression of the forager education system is of its great efficiency. It is impressively fit for purpose. First: the three-phase organization of the forager learning is very cost effective for adults. There is no escape from the burden of babies and infants, falling mainly on the mother. But through middle childhood (from about four to about twelve), children are largely educated through the playgroup. They learn through a combination of informational trickle-down from older children, collaborative problem solving, practice, and trial and error exploration, somewhat leavened by observation, eavesdropping, and the provision of equipment by the adult world. The playgroup is self-sustaining, as older children fade into early adolescence, infants toddle in. Consequently, foragers largely escape the opportunity costs of having to educate their children (as distinct from their infants and their adolescents). As children emerge into adolescence, explicit teaching becomes more important. However, except perhaps from some cases of the transmission of esoteric knowledge, this teaching is rarely sustained or high cost. Chabu men do indeed explain navigation, point out and identify tracks, and demonstrate the correct grip on a spear. But these are brief episodes in the course of a hunt. Likewise, storytelling is inexpensive by design, confined to nights (and seasons) where there is little else to do. Young foragers need food, shelter, and clothes, but they are cheap to educate; perhaps the greatest cost is the provision of equipment with which to practice.

Second, the forager education system seems to have an extraordinarily high success rate. While there is clearly variation in skill level, there seems to be no ethnographic reports of forager children who just do not get it, who never become passably competent at the skills essential to their lives, given their gender and community. Unless shamans count, there are no reports of amiable incompetents who have to

https://doi.org/10.1017/psa.2021.42 Published online by Cambridge University Press

be fed and protected by others, though of course infanticide weeds out obviously doomed babies (Hrdy 1999). The system achieves this near-universal success despite the fact that forager children have a lot to learn. As Peter Richerson and Rob Boyd regularly point out, foragers need rich and detailed knowledge of their local patch (Richerson and Boyd 2005; Boyd 2018). Motivation is part of the explanation of near universal competence. Forager children are highly motivated to acquire forager skills (they may be less motivated to internalize forager norms, hence the heavier footprint of teaching and negative feedback). Allowing children to learn at their own time and pace, sometimes in collaboration with friends, enhances the desire to learn. However, it may also be significant that the skills in question rarely require brutal drudgery. Men enjoy hunting, perhaps even when it is not the most efficient means of subsistence (Smith et al. 2003). Likewise, women forage together enjoyably and socially (Lowe 2002). Many activities that derive from foraging are contemporary sports and recreations. That is not true of the subsistence farming of grains and other starches. No-one goes hoeing recreationally, let alone turns it into an Olympic sport. Subsistence farming often requires many hours of drudgery in the sun, and where they can, farmers often force others to do this work. The more regimented and disciplined character of farming childhoods may be linked to the unappealing character of farming labor. Forager children are motivated to learn, in part because they are learning skills they will *enjoy* exercising as adults, not just skills that are *required* of them as adults.

Third, the forager education system is resilient. Despite the small size of forager camps, there is ample redundancy, especially for the more basic skills. Social information is available through many modes. These include imitation and demonstration (the Dene, for example, apparently demonstrate tool-making carefully but without explanation [Lew-Levy et al. 2017, 376]); emulation (the Gidra apparently provide their children with their first bow-arrow set, but expect them to use this as a template in producing replacements [Lew-Levy et al. 2017, 382]); provisioning with real and toy equipment; advice; and explicit instruction. Once children are part of the playgroup, social information flows from many sources and with lots of collaborative symmetrical learning (Lew-Levy et al. 2020). Moreover, for the most part, learning is not time pressured. At least for the routine skills of daily life, the physical intimacy of forager camps, and the tolerance by adults of children tagging along in adult activities, ensures that there are many opportunities to look and experiment. The acquisition of core forager competences does not depend on the high-fidelity flow of information from model to novice in any specific learning episode. There are many second chances.

In sum, the three-phase organization of social learning is one in which children have a lot of autonomy to shape their own days, learn at their own pace by their own efforts, but with social support from adults and peers. They then become gradually integrated into adult pursuits in their teens, with more explicit teaching. That organization results in children becoming competent adults at minimal educational cost to their parental generation. Can we project that organization back to late Pleistocene foragers? I suggest below that the forager pattern was largely in place in the late Pleistocene, and *only* in the late Pleistocene, for it depends both on the efficiency of forager foraging and on socio-cultural adaptations that were probably in place only then. If so, this strengthens the case for the social learning account of the late Pleistocene innovation acceleration, for that acceleration would then be concurrent with the emergence of communities optimized for such learning.

4. Forager education in the late Pleistocene

The forager education system has important prerequisites that collectively scaffold the adaptive organization of forager education. These include:

(i) elaborated kinship systems. These provide mothers with material and social support that ease the burdens of babies and infants, and they help integrate children into their social world. While mothers are the primary carers of the very young, forager children have regular and close physical contact with their fathers and other relatives (Hewlett et al. 2019).

(ii) The playgroup and free-range childhood depend on the generally peaceable nature of forager social worlds. Forager mothers very rarely must worry about infanticide[6] or other forms of child-directed violence. This is far from universally true of primate mothers (Hrdy 1999, 2009).

(iii) The three-phase organization of learning depends on the open and fluid character of forager residence. This makes it possible for mothers (and other kin) to support adult daughters in different camps and gives foragers entering adolescence access to a much wider circle of potential models. Movement between residential groups pools information: adolescents hear about potential models outside their immediate circle and sometimes have a chance to learn from those models. Moreover, while basic competence probably depends only on the skills and information present in a single residential group, the fact that groups are networked, with information flowing between them, makes the preservation of information and skill more resilient (Shennan 2008; Premo and Kuhn 2010) and supports fine-tuning expertise (Henrich 2004).

(iv) Time to play and explore depend on the prosperity of forager subsistence economies (Sahlins 1968). Most adult foragers do not have to work long and hard to gather just enough for themselves and their dependents. Richard Gould reports that even Western Desert Australian foragers, living as they do in a profoundly inhospitable environment, rarely have to work more than four hours a day (Gould 1980, 78–89). If foragers were living on the very edge of necessity, there would be much stronger pressure to integrate children into the subsistence economy (as in farming and herding cultures).

(v) Some forms of teaching are independent of language. But explicit teaching obviously depends on the prior establishment of language and other tools of human communication.

It is difficult to date the origin of these scaffolds, but they are ubiquitous across known forager cultures, and that strongly suggests that these scaffolds were available

[6] With the exception of seriously developmentally compromised babies and perhaps girl babies in the very far north (Kelly 2013b).

https://doi.org/10.1017/psa.2021.42 Published online by Cambridge University Press

to the African foragers that emerged from Africa and settled the world, beginning sometime around 100 kya–80 kya. It is conceivable that these scaffolds were convergently assembled after the out-of-Africa migration. But the great variety of forager physical, biological, and demographic environments suggests inheritance from the African homeland rather than parallel cultural evolution. We can assume then, with reasonable confidence, that these background enabling conditions were in place for late Pleistocene foragers (say, those living 100 kya–12 kya). But they were probably not in place much before that. Subsisting in difficult environments (full desert, very high latitudes, and, a little counter-intuitively, dense rainforests) depends on very high levels of foraging technique and on extensive networks of social support, especially in regions that are both challenging and unpredictably variable. These networks are made possible by the open and fluid character of forager residential practices. While there are always uncertainties about negative evidence, humans do not seem to have established in such habitats before the late Pleistocene (Gamble 2013), suggesting that the essential props of the forager education pattern were not fully in place until then.

These considerations suggest that late Pleistocene forager education was probably broadly similar to the ethnographic template. Important elements of the forager pattern are consequences of the basic demography and economy of forager life: life in a physically compact, emotionally intimate camp of somewhere between 30 and 50 individuals. As Kelly has shown, it is no accident that forager bands are roughly that size. It is a consequence of energetic and ecological constraints that would have acted in the Pleistocene too (Kelly 2013). In groups of that size, playgroups *must* be mixed in age and gender; there are not enough children for narrower sorting.[7] Likewise, the ready availability of public information is a consequence of the physical compactness and intimacy of forager camps. The same physical intimacy implies the availability of many models, and many modes, through which information can flow from the more informed to the less informed. Pleistocene children would have similar opportunities to observe and eavesdrop. Pleistocene adults were probably as tolerant of children handling their tools and raw materials, as tolerant of onlooking and eavesdropping, as willing to supply tools for practice, play and use, as than those known from ethnography. For it is in adults' interest that children self-educate. Self-education reduces the costs of children to their parents, especially if learning-by-doing enables children to partially supply their own needs. Likewise, we can expect Pleistocene forager children to be as highly motivated to learn adult skills as those known from ethnography and for the same reasons. It is also probable that Pleistocene children's time budgets were relaxed in similar ways, again for reasons that parallel those of contemporary foragers. Forager life is time rich in most seasons, for mobile forager group size is constrained by the resource envelop of the least productive season. Moreover, many forager cultures manage risk by more-or-less compulsory sharing (Lewis et al. 2014). This dis-incentivizes hard work. A forager and his/her family will get little fitness benefit by working harder than their peers, for they are providing a public rather than a private good. The consequence is a relaxed adult time budget for much of the year.

[7] In larger camps with more children, children do tend to sort more by gender (Lew-Levy et al. 2020).

In brief, most of the factors that explain the stability of the ethnographically-described forager education system were also factors in the late Pleistocene. There are two exceptions, and those exceptions imply that Pleistocene forager education was somewhat more expensive to the adult generation. The foragers described in the reports on which I have drawn were all to some degree connected to the market economy. Their toolkit incorporated materials sourced through that economy. Martu men hunted with rifles from vehicles. That is an extreme case, but the Chabu, while making their own spears, tipped them with metal, which they did not forge. Pleistocene foragers had to make all their own equipment and source the necessary raw materials (or perhaps only almost all: there might have been some trade). So, the artisan skill load was higher, and acquiring these skills probably required more explicit instruction. Second, Pleistocene habitats were probably more dangerous. The Pleistocene predator guild was significantly larger than that of the late Holocene, and some of its larger members were probably less wary of humans. The survivors have had 10,000+ more years to learn to avoid us. Could the playgroup have been quite so free-range and independent of adult supervision and protection in Pleistocene forests and woodlands? I suspect not. These considerations suggest a Pleistocene education system quite similar to that attested from ethnography, but with a larger footprint of adult teaching in the acquisition of craft skills and somewhat greater adult vigilance over the mixed age and gender playgroup. However, as noted above, forager childhoods even at 200 kya may have been very different. Ethnography thus supports the idea that the late Pleistocene acceleration of technical innovation depended on enhanced social learning.

5. Caveats, scope, and limitations

These inferences are only as good as broad-church behavioral ecology, the framework on which they depend. While that framework has many strengths, it has real limitations too, and it is time to consider whether my conclusions about the late Pleistocene are undermined by those limits. To begin with, behavioral ecology is essentially an equilibrium theory: if the environment is changing rapidly or agents are migrating into novel environments, adaptive lags and other misfires are likely to be common and important. However, while climate change in both the late Pleistocene and Holocene has been challenging, forager economic organization and risk management are very resilient, and the forager education pattern seems to be fairly insensitive to environmental difference.

Second, behavioral ecology is an individualist, bottom-up approach to social theorizing: patterns in social life are aggregated outcomes of individual decisions. This approach has limits when applied to communities structured by social hierarchy and by institutions (Lewens 2015). But in forager communities, (adult) individual choice is not seriously constrained by power difference and institutions of inequality (though of course agents must consider others' responses to their choices). So, it is well-suited to explaining forager social life. Third, even if individual agents are making optimal decisions, optimization is always optimization under constraint. Choices are constrained by available technology and by the social environment, and one reason why behavioral ecology is such a powerful tool is that its use reveals puzzles and paradoxes. We seem to see far from optimal patterns of action in familiar environments.

https://doi.org/10.1017/psa.2021.42 Published online by Cambridge University Press

These anomalies reveal unexpected and subtle constraints on choice, and this is a most important virtue of the behavioral ecology framework (Gould 1980).[8] One such subtle constraint is the availability of information. The informational environment must be transparent enough for the experienced agent to be able to estimate, with reasonable reliability, the costs and benefits of particular choices. This is not always available, even in familiar environments. Arguably, the male gerontocracy of Central Australia depends on information asymmetries in that culture (Keen 2006; Sterelny 2015). However, forager adults probably have a good appreciation of the requirements of competence, of how difficult skills are to acquire, of the extent to which particular children have mastered the forager curriculum, and of the interactions of other adults in the band with those children. These are compact, intimate communities (Boehm 1999). It is unlikely that informational constraints limited adaptive choice in social learning and teaching, either in ethnographically known forager cultures or the final Pleistocene.

Finally, in identifying a social practice as adaptive, it is always necessary to ask: adaptive for whom? The fitness interests of parents and their children overlap, but they are not identical. In general, parents optimize their fitness by spreading their resources across their children. However, each child would prefer a disproportionate share of that resource envelope. Even in relatively egalitarian communities, a system of the distribution of resources that is adaptive for some is not necessarily adaptive for all. But the forager pattern of education seems genuinely win-win, a good education for the children at a low price to the parents. One reason is that information is not like food. Interpreting a track for one boy does not diminish the capacity to show it to another. Indeed, demonstration, explanation, and advice are efficient; they need not be one-on-one. Parents are not forced into difficult resource allocation decisions. However, while it is true that information shared is not information lost, an agent sharing information loses a relative fitness advantage over others. For subsistence skills, that potential advantage does not seem to lead to information hoarding. Such hoarding might not be a practical option, as it would be hard to exploit information while keeping it private, and there are social rewards for informational generosity, with prestige accruing to those who share their expertise (Henrich and Gil-White 2001). Moreover, there will often be multiple social sources of that information, as well as the prospect of relearning from the material world itself. Finally, mobile foragers manage risk by relying on aid from others to protect against bad luck and trouble. It may be imprudent to hoard information that decreases the foraging efficiency of those on whom you may depend. In short, the forager system of educating *subsistence skills* is adaptive for the members of forager communities, and for that reason, late Pleistocene foragers probably organized subsistence information flow in a similar way.[9]

Putting all this together, the limits of the behavioral ecology framework do not undermine the conclusion of section 4: the Holocene template is likely to fit the late Pleistocene as well. More generally, this framework provides a worked model for the

[8] One of his examples of such an anomaly is the role of domesticated dogs in Australian forager lives: in some environments they play an important role in hunting, in guarding, and in warning of strangers nearby. But none of this seems true in Australia. He suggests a nearly neutral model of Aboriginal dog domestication: minor benefits, but minor costs as well.

[9] These considerations apply much less cleanly to esoteric knowledge. Its control typically advantages some and disadvantages others. There is quite often restricted access to esoteric knowledge in forager societies and no clear general pattern.

https://doi.org/10.1017/psa.2021.42 Published online by Cambridge University Press

use of ethnographic information in interpreting Holocene and Pleistocene sites. In the introduction, I suggested that we can use behavioral ecology to interpret the past when the activities in focus are central to fitness, when the agents have learned enough to navigate their environments competently, and when they have enough autonomy to act in their own interests. These conditions are satisfied in this case. However, this framework is limited in important ways. For one thing, these models are somewhat coarse-grained. Signaling theory, for example, can tell us that material symbols functioning within a community will vary in systematic ways from those functioning between communities (Kuhn and Stiner 2007a, 2007b). But it cannot tell us what those signals meant to and for those agents. Given the arbitrariness of the relationship between sign and target, and hence the many degrees of freedom in establishing sign systems, we have every reason to be skeptical about the many attempts to interpret the meaning of the material symbols of cultures like Catalhoyuk (Whitehouse and Hodder 2010), or Neolithic megaliths like Stonehenge[10] or Gobekli Tepe. It is not just that we do not have to hand a theory that allows us to interpret arbitrary signs; we have theoretical reason to suspect that there is no such theory. Consequently, I am very skeptical of one prominent use of ethnographic information, its use in the interpretation of rock art (VanPool 2009; Bednarik 2011; Berrocal 2011). As Adrian Currie pointed out, in some cases the inference is based on the supposition of cultural continuity between the makers of rock art and their ethnographically described descendants. But even if the historical connection is real, we lack evidence for the stability of interpretative traditions over millennial time spans (Hiscock 2020). When shamanistic iconography is used to interpret the art of glacial Europe, the causal model is even more fragile, since it depends on the assumption that a fine-grained neural architecture is common to the Pleistocene inhabitants of glacial Europe and some near-contemporary forager populations. That assumption seems undermined by accumulating evidence of neural plasticity (discussed in an archaeological context in d'Errico and Colage [2018]).

However, this framework is not limited to forager subsistence and its skills. For example, Robert Kelly, building on the work of Bruce Winterhalder, has developed a model of the factors that condition interactions between communities (Kelly 2013). The core idea links the risk of unpredictable variation in conditions to the spatial extent of that variation. When variation-driving factors are *localized*, good and bad times for one community tend not to be experienced by neighboring communities. In those circumstances, the rewards for intercommunal cooperation are high, predicting the existence of material exchange networks and other ways of maintaining cooperative connections. When variance is determined by *regional factors*, bad times here are bad times next door, and opportunities for mutual benefit are limited. Moreover, when variance is high, bad times are times of genuine stress, perhaps crisis. This is a scenario predicting high degrees of territoriality and high risks of conflict. As Kelly shows, this general model is well-supported in the ethnographic record, and he uses it to interpret the archaeological record of Wyoming (Kelly 2013; Pelton et al. 2019). There, fluctuations in both population size and climate exposed those

[10] As shown by the cool scepticism of Wylie's discussion of recent attempts to decipher Stonehenge (Wylie 2013).

https://doi.org/10.1017/psa.2021.42 Published online by Cambridge University Press

communities to both cooperation-favoring and territoriality-favoring conditions, arguably reflected in fluctuations in the flow of exotic materials like obsidian.

I have argued that the use of ethnography to interpret the archaeological record can accommodate deep differences between present and past lives and that the relevance of ethnographic information is enhanced by the great variation documented in that record. I have used a specific example developed in some detail to support a cultural learning explanation of late Pleistocene social change. But in one fundamental respect Wylie and Currie are right. There is no one-size-fits-all assessment of inferences from ethnography to archaeology. Each case must be assessed on its specific merits. The strength of such an inference depends on the fit between the specific case and the general causal model and the degree to which that model is supported.

Acknowledgments. This paper had its origins at a workshop on children and innovation in the archaeological record, so I thank the organisers, Michelle Langley, April Nowell, and Felix Reide for the initial idea; Carl Brusse, Peter Hiscock, Anton Killin, Ross Pain, and Ron Planer for feedback on drafts; the ANU philosophy community to whom the paper was presented, and the ARC for their ongoing support for my work on human evolution.

References

Barnard, Alan. 2011. *Social Anthropology and Human Origins*. Cambridge: Cambridge University Press.

Bednarik, Robert G. 2011. "Ethnographic Analogy in Rock Art Interpretation." *Man in India* 91 (2):223–34.

Berrocal, M. C. 2011. "Analogical Evidence and Shamanism in Archaeological Interpretation: South African and European Palaeolithic Rock Art." *Norwegian Archaeological Review* 44 (1):1–20.

Bird, Rebecca, and Donald Bird. 2005. "Martu Children's Hunting Strategies in the Western Desert, Australia." In *Hunter-Gatherer Childhoods: Evolutionary, Developmental and Cultural Perspectives*, edited by Barry Hewlett and Mihael Lamb, 129–146. New Brunswick: Aldine.

Bock, John. 2005. "What Makes a Competent Adult Forager." In *Hunter Gatherer Childhoods: Evolutionary, Developmental and Cultural Perspectives*, edited by Barry Hewlett and Mihael Lamb, 109–128. New York: Aldine.

Boehm, Chris. 1999. *Hierarchy in the Forest*. Cambridge, MA: Harvard University Press.

Boyd, Robert. 2018. *A Different Kind of Animal*. Princeton: Princeton University Press.

Boyette, Adam. 2016. "Children's Play and Culture Learning in an Egalitarian Foraging Society." *Child Development* 87 (3):759–69.

Boyette, Adam, and Barry Hewlett. 2017. "Autonomy, Equality, and Teaching among Aka Foragers and Ngandu Farmers of the Congo Basin." *Human Nature* 28 (3):289–322.

Boyette, Adam, and Barry Hewlett. 2018. "Teaching in Hunter-Gatherers." *Review of Philosophy and Psychology* 9 (4):771–97.

Coe, Kathryn, Nancy E. Aiken, and Craig Palmer. 2006. "Once Upon a Time: Ancestors and the Evolutionary Significance of Stories." *Anthropological Forum* 16 (1):21–40.

Currie, Adrian. 2016. "Ethnographic Analogy, the Comparative Method, and Archaeological Special Pleading." *Studies in History and Philosophy of Science Part A* 55:84–94.

d'Errico, Francesco, Lucinda Backwell, Paola Villa, Ilaria Degano, Jeannette J. Lucejko, Marion K. Bamford, Thomas F. G. Higham et al. 2012. "Early Evidence of San Material Culture Represented by Organic Artifacts from Border Cave, South Africa." *Proceedings of the National Academy of Science* 109 (33):13214–219.

d'Errico, Francesco, and Ivan Colage. 2018. "Cultural Exaptation and Cultural Neural Reuse: A Mechanism for the Emergence of Modern Culture and Behavior." *Biological Theory* 13 (4):213–227.

Eickelkamp, Ulricke. 2010. "Children and Youth in Aboriginal Australia: An Overview of the Literature." *Anthropological Forum* 20 (2):147–66.

Ellis, E. M., Jennifer Green, and Inge Kral. 2017. "Family in Mind: Socio-spatial Knowledge in a Ngaatjatjarra/Ngaanyatjarra Children's Game." *Research on Children and Social Interaction* 1 (2):164–98.

Gamble, Clive. 2013. *Settling the Earth*. Cambridge: Cambridge University Press.

Garfield, Zachary, Melissa Garfield, and Barry Hewlett. 2016. "A Cross-Cultural Analysis of Hunter-Gatherer Social Learning." In *Social Learning and Innovation in Contemporary Hunter-Gatherers*, edited by Hideaki Terashima and Barry Hewlett, 19–34. Dordrecht: Springer.

Genz, Joseph, Jerome Aucan, Mark Merrifield, Ben Finney, Korent Joel, and Alson Kelen. 2009. "Wave Navigation in The Marshall Islands: Comparing Indigenous and Western Scientific Knowledge of The Ocean." *Oceanography* 22 (2):234–45.

Gould, Richard A. 1969. *Yiwara: Foragers of the Australian Desert.* Sydney & London: Collins.

Gould, Richard A. 1980. *Living Archaeology.* Cambridge: Cambridge University Press.

Haagen, Claudia. 1994. *Bush Toys: Aboriginal Children at Play.* Canberra: Aboriginal Studies Press.

Hagino, Izumi, and Taro Yamauchi. 2016. "High Motivation and Low Gain: Food Procurement from Rainforest Foraging by Baka Hunter-Gatherer Children." In *Social Learning and Innovation in Contemporary Hunter-Gatherers*, edited by Hideaki Terashima and Barry Hewlett, 135–44. Dordrecht: Springer.

Henrich, Joseph. 2004. "Demography and Cultural Evolution: Why Adaptive Cultural Processes Produced Maladaptive Losses in Tasmania." *American Antiquity* 69 (2):197–221.

Henrich, Joseph. 2016. *The Secret of Our Success: How Culture is driving Human Evolution, Domesticating Our Species and Making Us Smarter.* Princeton: Princeton University Press.

Henrich, Joseph, and Francesco Gil-White. 2001. "The Evolution of Prestige: Freely Conferred Deference as a Mechanism for Enhancing the Benefits of Cultural Transmission." *Evolution and Human Behavior* 22 (3):165–96.

Hewlett, Barry. 2013. "Ekeloko, the Spirit to Create: Innovation and Social Learning Among Aka Adolescents of the Central African Rainforest." In *Dynamics of Learning in Neanderthals and Modern Humans*, edited by Takeru Akazawa, Yoshihiro Nishiaki, and Kenichi Aoki, 187–95. Tokyo: Springer.

Hewlett, Barry. 2016. "Social Learning and Innovation in Hunter-Gatherers." In *Social Learning and Innovation in Contemporary Hunter-Gatherers*, edited by Hideaki Terashima and Barry Hewlett, 1–15. Dordrecht: Springer.

Hewlett, Barry, Janet Hudson, Adam Boyette, and Hillary Fouts. 2019. "Intimate Living: Sharing Space among Aka and other Hunter-Gatherers." In *Towards a Broader View of Hunter-Gatherer Sharing*, edited by Noa Lavi and David Friesem, 40–56. Cambridge: McDonald Institute for Archaeological Research.

Heyes, Cecilia. 2018. *Cognitive Gadgets: The Cultural Evolution of Thinking.* Cambridge: Harvard University Press.

Hiscock, Peter. 2006. "Blunt and to the Point: Changing Technological Strategies on Holocene Australia." In *Archaeology of Oceania: Australia and the Pacific Islands*, edited by Ian Lilley 69–95. Oxford: Blackwell.

Hiscock, Peter. 2008. *Archaeology of Ancient Australia.* London: Routledge.

Hiscock, Peter. 2020. "Mysticism and Reality in Aboriginal Myth. Evolution and Dynamism in Australian Aboriginal Religion." *Religion Brain & Behavior* 10 (3):321–44.

Hopkinson, Tim, April Nowell, and Michael White. 2013. "Life Histories, Metapopulation Ecology and Innovation in the Acheulian." *PaleoAnthropology* 2013:61–76.

Hrdy, Sarah B. 1999. *Mother Nature: A History of Mothers, Infants, and Natural Selection.* New York: Pantheon Books.

Hrdy, Sarah B. 2009. *Mothers and Others: The Evolutionary Origins of Mutual Understanding.* Cambridge: Harvard University Press.

Keen, Ian. 2006. "Constraints on the Development of Enduring Inequalities in Late Holocene Australia." *Current Anthropology* 47 (1):7–38.

Kelly, Lyn. 2015. *Knowledge and Power in Prehistoric Societies: Orality, Memory, and the Transmission of Culture.* Cambridge: Cambridge University Press.

Kelly, Robert. 2013. *The Lifeways of Hunter-Gatherers: The Foraging Spectrum*. Cambridge, Cambridge University Press.

Kelly, Robert, Spencer Pelton, and Erick Robinson. 2019. "Studying Sharing from the Archaeological Record: Problems and Potential of Scale." In *Towards a Broader View of Hunter-Gatherer Sharing*, edited by Noa Lavi and David Friesem, 143–52. Cambridge: McDonald Institute.

Knauft, Bruce. 2005. *The Gebusi: Lives Transformed in a Rainforest World.* New York: McGraw-Hill.

Konner, Melvin. 2005. "Hunter Gatherer Infancy and Childhood: The !Kung and Others." In *Hunter Gatherer Childhoods*, edited by Barry Hewlett and Michael Lamb, 19–63. New Brunswick: Aldine.

Konner, Melvin. 2011. *Evolution of Childhood.* Cambridge: Harvard University Press.

Koster, Jeremy, Richard McElreath, Kim Hill, Douglas Yu, Glenn Shepard Jr., Nathalie van Vliet, Michael Gurven et al. 2020. "The Life History of Human Foraging: Cross-cultural and Individual Variation." *Science Advances* 6 (26):eaax9070.

Kuhn, Steven. 2020. *The Evolution of Paleolithic Technologies*. London: Routledge.

Kuhn, Steven, and Mary C. Stiner. 2007a. "Body Ornamentation as Information Technology: Towards an Understanding of the Significance of Early Beads." In *Rethinking the Human Revolution*, edited by Paul Mellars, Karen Boyle, Ofer Bar-Yosef, and Chris Stringer, 45–54. Cambridge: McDonald Institute for Archaeological Research.

Kuhn, Steven, and Mary C. Stiner. 2007b. "Palaeolithic Ornaments: Implications for Cognition, Demography and Identity." *Diogenes* 214 (2):40–8.

Laland, Kevin, and Gillian Brown. 2002. *Sense and Nonsense: Evolutionary Perspectives on Human Behaviour*. Oxford: Oxford University Press.

Lew-Levy, Sheina, Stephen M. Kissler, Adam H. Boyette, Alyssa N. Crittenden, Ibrahim A. Mabulla, and Barry S. Hewlett. 2020. "Who Teaches Children to Forage? Exploring the Primacy of Child-to-child Teaching Among Hadza and BaYaka Hunter-Gatherers of Tanzania and Congo." *Evolution and Human Behavior* 41 (1):12–22.

Lew-Levy, Shiena, Adam Boyette, Alan Crittenden, Barry Hewlett, and Michael Lamb. 2020. "Gender-Typed and Gender-Segregated Play Among Tanzanian Hadza and Congolese BaYaka Hunter-Gatherer Children and Adolescents." *Child Development* 91 (4):1284–301.

Lew-Levy, Shiena, Noa Lavi, Rachel Reckin, Jurgi Cristóbal-Azkarate, and Kate Ellis-Davies. 2018. "How Do Hunter- Gatherer Children Learn Social and Gender Norms? A Meta- Ethnographic Review." *Cross-Cultural Research* 52 (2):213–55.

Lew-Levy, Shiena, Rachel Reckin, Noa Lavi, Jurgi Cristóbal-Azkarate, and Kate Ellis-Davies. 2017. "How Do Hunter-Gatherer Children Learn Subsistence Skills? A Meta-Ethnographic Review." *Human Nature* 28 (4):367–94.

Lewens, Tim. 2015. *Cultural Evolution: Conceptual Challenges*. Oxford: Oxford University Press.

Lewis, Hannah M., Lucio Vinicius, Janis Strods, Ruth Mace, and Andrea B. Migliano. 2014. "High Mobility Explains Demand Sharing and Enforced Cooperation in Egalitarian Hunter-gatherers." *Nature Communications* 5 (1):5789.

Lewis, Jerome. 2016. "Play, Music, and Taboo in the Reproduction of an Egalitarian Society." In *Social Learning and Innovation in Contemporary Hunter-Gatherers*, edited by Hideaki Terashima and Barry Hewlett, 147–58. Dordrecht: Springer.

Lewis, Jerome. 2019. "Sharing Pleasures to Share Rare Things: Hunter-gatherers' Dual Distribution Systems in Africa." In *Towards a Broader View of Hunter-Gatherer Sharing*, edited by Noa Lavi and David Friesem, 99–112. Cambridge: McDonald Institute.

Lowe, Pat. 2002. *Hunters and Trackers of the Australian Desert*. Dural, NSW: Rosenberg Publishing.

Marlowe, Frank W. 2010. *The Hadza: Hunter-Gatherers of Tanzania*. Berkeley: University of California Press.

McBrearty, Sally, and Allison Brooks. 2000. "The Revolution That Wasn't: A New Interpretation of the Origin of Modern Human Behavior." *Journal of Human Evolution* 39 (5):453–63.

Meggitt, Mervyn. 1965. *Desert People: A Study of the Walbiri Aborigines of Central Australia*. Sydney: Angus and Robinson.

Naveh, Danny. 2016. "Social and Epistemological Dimensions of Learning Among Nayaka Hunter-Gatherers." In *Social Learning and Innovation in Contemporary Hunter-Gatherers: Evolutionary and Ethnographic Perspectives*, edited by Hideaki Terashima and Barry Hewlett, 125–34. Dordrecht: Springer.

Nowell, April, and Michael White. 2010. "Growing Up in the Middle Pleistocene." In *Stone Tools and the Evolution of Human Cognition*, edited by April Nowell and Ian Davidson, 67–82. Boulder: University of Colorado Press.

Pargeter, Justin, Alex MacKay, Peter Mitchell, and John Shea. 2016. "Primordialism and the 'Pleistocene San' of southern Africa." *Antiquity* 90 (352):1072–9.

Powell, Alan, Stephen Shennan, and Michael Thomas. 2009. "Late Pleistocene Demography and the Appearance of Modern Human Behavior." *Science* 324 (5932):1298–301.

Premo, Luke S., and Steven Kuhn. 2010. "Modeling Effects of Local Extinctions on Culture Change and Diversity in the Paleolithic." *PLOS One* 5(12):e15582.

Richerson, Peter J., and Robert Boyd. 2005. *Not By Genes Alone: How Culture Transformed Human Evolution*. Chicago: University of Chicago Press.

Sahlins, Marshall. 1968. "Notes on the Original Affluent Society." In *Man the Hunter*, edited by Richard Lee and Irvan DeVore, 85–89. New York: Aldine Publishing Company.

Salali, Gul Deniz, Nikhil Chaudhary, Jairo Bouer, James Thompson, Lucio Vinicius, and Andrea B. Migliano. 2019. "Development of Social Learning and Play in BaYaka Hunter-gatherers of Congo." *Scientific Reports* 9(1):11080.

Shennan, Stephen. 2008. "Canoes and Cultural Evolution." *Proceedings of the National Academy of Sciences* 105 (9):3175–6.

Smith, Eric A., Rebecca B. Bird, and Donald Bird. 2003. "The Benefits of Costly Signaling: Meriam Turtle Hunters." *Behavioral Ecology* 14 (1):116–26.

Sterelny, Kim. 2007. "SNAFUS: An Evolutionary Perspective." *Biological Theory* 2 (3):317–28.

Sterelny, Kim. 2012. *The Evolved Apprentice*. Cambridge: MIT Press.

Sterelny, Kim. 2015. "Optimizing Engines: Rational Choice in The Neolithic?" *Philosophy of Science* 82 (3):402–23.

Sterelny, Kim. 2021. "Foragers and Their Tools: Risk, Technology and Complexity." *Topics in Cognitive Science* 13 (4):728–49.

Sugiyama, Michelle S. 2017. "Oral Storytelling as Evidence of Pedagogy in Forager Societies." *Frontiers in Psychology* 8:471

Tennie, Claudio, Luke S. Premo, David Braun, and Shanon McPherron. 2017. "Early Stone Tools and Cultural Transmission: Resetting the Null Hypothesis, with commentaries and a response." *Current Anthropology* 58 (5):652–72.

Tucker, Bram, and Alyson Young. 2005. "Growing up Mikea: Children's Time Allocation and Tuber Foraging in Southwestern Madagascar." In Hunter Gatherer Childhoods, edited by Barry Hewlett and Michael Lamb, 147–71. New Brunswick, Aldine.

VanPool, Christine. 2009. "The Signs of the Sacred: Identifying Shamans Using Archaeological Evidence." *Journal of Anthropological Archaeology* 28 (2):177–90.

Whitehouse, Harvey, and Ian Hodder. 2010. "Modes of Religiosity at Catalhoyuk." In *Religion in the Emergence of Civilization*, edited by Ian Hodder, 122–45. Cambridge: Cambridge University Press.

Wrangham, Richard. 2017. "Control of Fire in the Paleolithic: Evaluating the Cooking Hypothesis." *Current Anthropology* 58 (S16):S303–13.

Wylie, Alison. 1982. "An Analogy by Any Other Name is Just as Analogical." *Journal of Anthropological Archaeology* 1 (4):382–401.

Wylie, Alison. 1985. "The Reaction against Analogy." *Advances in Archaeological Method and Theory.* 8:63–111.

Wylie, Alison. 2013. "Collateral Evidence: Ethnographic Analogy Revisited." John Mulvaney Lecture, Australian National University.

Cite this article: Sterelny, Kim. 2022. "Ethnography, Archaeology, and the Late Pleistocene." *Philosophy of Science* 89 (3):415–433. https://doi.org/10.1017/psa.2021.42