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Is there more to human social learning than enhanced facilitation? Prolonged learning and its impact on culture

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Recent scholarship has sought to understand culture by studying attributes of social learning. While celebrating the role of pedagogy and other forms of facilitated learning in human cultural uniqueness, these studies have neglected instances of restricted and prolonged knowledge and skill acquisition. This article analyses illustrative cases of such learning in the ethnographic literature to assess their implications for cultural processes and products. Combined evidence from formal apprenticeship and the informal learning of hunter-gatherers indicates that though enhanced facilitation of learning is undeniable, an exclusive focus on it has resulted in a flawed concept of human culture and its social context. The cases cited suggest that mechanisms to extend learning constitute a vital source of cultural creativity and innovation that should be considered in social learning and culture discussions.

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Introduction

Our sense of what it means to be human is closely tied to how we think about culture. Lately, evolutionary discussions of culture have overwhelmingly centred on social learning (Palecek, 2020). So far, most scholarship investigating this relationship has focused on cooperation in teaching and other forms of enhanced facilitation (Tennie et al., 2009; Fogarty et al., 2011; Boyd et al., 2011; Thornton and McAuliffe, 2012; Gärdenfors and Höogberg, 2017). It has been argued that pedagogy and a capacity to approve and disapprove learners' actions improves the accuracy of cultural transmission, which, along with beneficial modifications, engenders the ratchet effect—an essential condition of cumulative cultural evolution (Tehrani and Riede, 2008; Tennie et al., 2009; Castro and Toro, 2014; Dalidowicz, 2015). These consequences are undeniable, but the current understanding of the relationship between complex human culture and learning mechanisms is incomplete because it fails to take into account instances when experts inhibit, rather than facilitate, learning. In this article, I begin to explore such instances by building on Henrich and Gil-White's (2001) insight that, in humans, social learning is embedded within political relations.

Henrich and Gil-White (2001) outlined the evolutionary dynamics of how prestige copying engenders the uniquely human prestige system. They proposed that contrary to animal dominance based on force, or threat of force, the human prestige system stems from deference granted in exchange for knowledge, information, and skill. They also stipulated that as collecting experience over a lifetime makes one more skilled and knowledgeable, this system favours elders. Furthermore, even though the prestige structure allows elders to retain their position beyond their physical prime, status in prestige systems is temporary. Elders in age-based political systems are always vulnerable to losing status to younger individuals. As Henrich and Gil-White (2001, p. 169) note, “changes in prestige rank result from ‘students’ surpassing former ‘teachers’” and declining skill levels in the elderly often leads to neglect. It follows that expediting learning is not always or necessarily in elders' best interest.

In this article, I will examine the ethnographic literature to identify strategies used by expert models to extend the learning process in two contexts: apprenticeship learning and the social learning of hunter-gatherers. The ethnographic literature of apprenticeship contains abundant descriptions illustrating prolonged learning and its impact on culture from craft complexity to linguistic embellishment and conceptual elaboration. Despite this evidence, formal apprenticeship, established mainly in sedentary hierarchical societies, has been considered too specialized to inform prehistoric archaeological investigations and theoretical discussions of culture (Bamforth and Finlay, 2008). However, we must also consider that irrespective of its formal structure, apprenticeship represents an institutionalized form of oblique learning—learning from adults other than parents—and that this makes formal apprenticeship commensurable with less formal settings such as those of egalitarian hunter-gatherers, the type of society most often considered in evolutionary discussions. The significance of oblique learning in giving our species an advantage is increasingly recognized (Creanza et al., 2013). However, to better understand this significance we need to further probe into oblique learning as a political arena where negotiations of experts and novices impact cultural processes. Demonstrating that mechanisms to lengthen learning are applicable beyond formal apprenticeship promotes this inquiry in the context of prehistoric archaeological records and discussions of human political society, culture, and uniqueness.

Prolonged learning in apprenticeship and its impact on culture

The research community has long hailed apprenticeship as an institution of learning enhancement (Goody, 1989; Singleton, 1989; Minar and Crown, 2001, p. 376; Stout, 2002, 2011; Marchand, 2008). Nonetheless, the following quote by Argenti (2002, p. 498) immediately calls attention to the contradictions in scholarly interpretations of apprenticeship learning. He observes that although apprenticeship is often “presumed to be a method of imparting knowledge... more often than not, it seems to incorporate within its structure the means of restricting its free flow”. Indicative of this restriction is that apprenticeship training is often considerably longer than the time required to acquire technical competence (Graves, 1989; Dilley, 1989; Aronson, 1989). The following studies of weaving apprenticeships illustrate this point. As Dilley (1989) notes, although apprenticeship is often years-long, there is no difference between weavers in terms of quality of work or price procured for the finished product after few months. In a similar vein, Aronson (1989) observes that, in 3 days, visiting American students acquired the basic weaving skills Baule apprentices spend years learning. Learners' continuing dependence on masters after the end of apprenticeship further underlines the discrepancy between technical skill acquisition and the length of involvement in the learning process (Marchand, 2008). Unswerving loyalty to masters may be encouraged via regular “presents of alcohol and food” as in the Chinese opera tradition (Stock, 2002, p. 16) or by having to rely on teachers for essential tools as among Oku carvers (Argenti, 2002).

This discrepancy is especially marked in the training of boys and young men, which often begins later and lasts longer than girls' apprenticeships. The difference is particularly striking when the crafts are matched for technical difficulty. Contrasting the starting age for weaving apprentices, Aronson (1989, p. 151) reports that 5-year-old females in Nigeria “may already be weaving cloth on the upright loom adults use,” while the apprenticeship of male Baule weavers in the Ivory Coast begins late, at around 8–10 years of age. Deafenbaugh (1989) describes a similarly late start for boys' apprenticeship among Hausa male weavers, with tasks systematically spread throughout the process. While these boys learn the easiest tasks between the ages of 10 and 15, they are not taught to work the loom until mid-adolescence, and less frequently performed tasks are acquired even later, often towards the end of the apprenticeship.

Control in apprenticeship extends from regulating access to raw materials, extraction, and production sites (Stout, 2002) to “disciplining bodies and minds” (Simpson, 2006, p. 153). As Haas (1989, p. 88, 104) notes, “members of the workgroup create an ordeal experience, deliberately denigrating and humiliating the newcomer and making their situation more difficult and frightening.” The neutral “rite of passage” framework scholars frequently use to analyse the “vicissitudes and hardships” of apprenticeship (McIntosh, 2009, p. 41; Haas, 1989; Coy, 1989) fails to accentuate that denigrating learners also widens the gap between novices and masters' skill sets and consequently lengthens the period of learning. This inference is consistent with Buechler's (1989, p. 44) remark that “it is to the master's advantage to maintain the asymmetry of the relationship as long as possible”. This observation is confirmed by Edward Simpson (2006, p. 160), who describes shipbuilding apprenticeship in western India as a process “from humiliation to promotion”. This process is often as if deliberately, extended. Simpson noted that novices' status is reduced in the first phase of training compared to their status when they entered apprenticeship. Researchers often remark that in apprenticeship, even “adults are treated like children” (Haas, 1989, p. 88), and as Graves (1989, p. 60)

comments, experts may “control the pace of learning in such a way as to convince the novice that learning is not complete”.

Experts may further delay the completion of learning by withholding information from novices. Admittedly, knowledge is not always deliberately suppressed (Deafenbaugh, 1989), and extraneous circumstances, such as threats from rival groups, may also require secrecy to protect craft monopolies (Aronson, 1989; Epstein, 1998; Stout, 2002). Nonetheless, studies show that blocking learners’ access—particularly to key and prestige components of learning—ensures the continuing superiority of experts, which often translates to political position and power. Secrecy and withholding information especially affect planning, described by Marchand (2008, p. 252) as the ability to “[conceptualize] projects in their entirety and at all scales of construction”. The ability to plan has been described as the most consequential skill for craftsmen’s esteem and the most fundamental disparity between teachers and learners. Although cognitive patterns enabling artisans to plan undoubtedly require long engagement with crafts, experts tend to further delay the critical overview necessary for novices to become proficient by withholding instruction and restricting information about critical aspects of the practice (Stout, 2002). As Wallaert-Pêtre (2001, p. 484) comments, apprentices often face segmented tasks, with “the chaîne opératoire ... [rarely] divulged as a whole”. In denying access to this information, experts exert control over strategic areas of the craft, increase learners’ dependence on their masters and teachers, and inevitably lengthen the learning process. Craft secrets become obstacles to learning. Withholding key information further mystifies the lore, increasing experts’ esteem in the eyes of learners. Marchand (2008, p. 254) relates that master masons “frequently make a spectacle of their blessing ritual by performing them overtly on site. Nevertheless, they seldom reveal the secret content of their recitations—even to one another, and sometimes only partially to their apprentices”. Hausa weaving apprenticeship similarly centres on “aspects of the craft which remain untaught” (Deafenbaugh, 1989, p. 167). Though craft secrets may affect any dimension of training, as Coy (1989, p. 3) emphasizes, “it is not the content of craft secrets that are so important as that there are ‘secrets’ at all”.

In addition to reducing learners’ status, master craftspeople may also enhance their own by increasing the complexity of production sequences, procedures, and lore via innovation. Technical complexity implies higher skill levels, and experts utilize it to elevate their status and delay apprentices’ mastery of crafts. Dietrich Stout’s (2002) study of stone adze makers of Langda, Irian Jaya, illustrates how skilled craftspeople may take advantage of technical complexity in maintaining their disparity with learners. Stout notes that in Langda, crafting stone adzes may be more critical for prestige than for utility. Of the two available techniques, knapping and grinding, skilled adze makers prefer knapping because its performance potentially elevates their position. As Stout (2002, p. 698, 705) relates, knapping requires more skill, and “a particularly successful flake removal” is often rewarded by public cheer. The size of adze heads also implies status, and experts hold a monopoly over producing large adze heads. Despite lacking any demonstrable functional advantage, these are “considered to be more difficult to produce and are more highly valued” than smaller adze heads.

Besides technical skills, nearly every detail surrounding a craft offers experts an opportunity to extend their status advantage.¹ An especially common method is to increase craft complexity by embellishing the mystical–mythical elements of skilled tasks through language (Dilley, 1989; Dow, 1989). The social learning literature has most often discussed language as a facilitation tool (Stout, 2002; Marchand, 2008). These discussions, however, overlook that language can also elaborate lore, obscure and

mystify skills, and consequently lengthen learning. Research shows that teachers in apprenticeship frequently abstain from verbal instruction. From potters to shamans, transmission mainly occurs through untutored informal nonverbal scaffolding (Singleton, 1989; Dow, 1989; Stock, 2002; Marchand, 2008). Masters tolerate novices’ presence but with little concern for their advancement (Argenti, 2002; Coy, 1989; Haas, 1989; Singleton, 1989; Stock, 2002). On the contrary, experts tend to discourage questioning and consider requests even for simple information as a challenge to their authority (Goody, 1989, p. 247). While it has been suggested that this is because aptitudes “cannot be transmitted in a... verbal manner”, the way skilled individuals use language to obfuscate and increase craft complexity casts doubt on the validity of this interpretation. Stout’s (2002) study of adze makers in Langda, Irian Jaya illustrates this use of language. Stout describes that skilled adze makers in Langda employ a large and varied vocabulary for raw materials and locations and assign each adze its ancestor and place-of-origin name. Stout (2002, p. 703) infers that this is to ease communication about the “details of their craft”. However, with each expert using a different set of terms and finding it difficult to recall, let alone interact with, this vocabulary suggests that naming might amplify the challenges of learning.² As Simpson (2006, p. 158) notes, complex terminology intimidates, disorients, and reduces the status of apprentices who are often “unfamiliar with the language, hierarchy, and the use of space”. Inventing lore and especially “withholding the meaning of argot” enhance experts’ prestige and slow down, even halt, the learning process (Graves, 1989, p. 60; see also Gamst, 1989; Dilley, 1989).

In apprenticeship, the period of learning, and thereby experts’ status, may be further extended by deliberately limiting creative exploration by novices. Conceivably, innovation in apprenticeship is restricted to elders because it requires knowledge and experiences young novices do not yet possess (Hewlett, 2013; Kubota, 2016). Repetitive rehearsal and practice certainly enhance performance, while excessive innovation by beginners would discourage the learning of proper form and technique (Goody, 1989; Marchand, 2008; Simpson, 2006). Irrespective of these arguments, however, restricting young learners to faithfully reproducing established patterns and styles also delays their initiation into acquiring creative and artistic forms (Coy, 1989; Gamst, 1989; Simpson, 2006; Wallaert-Pêtre, 2001).³ Deafenbaugh’s (1989) study of Hausa weaving apprenticeship exposes the contradictions in pedagogy’s apparent goals of expedited and facilitated learning and experts’ desire to extend the learning process and, with it, their status. On the one hand, Hausa conceive of innovation as a “gift from god” that boosts the product’s quality and the innovator’s prestige. On the other hand, they consider it as a teachable skill on which practitioners’ career depends. Despite admitting that skilled craftspeople need this competence to succeed and despite adhering to the notion that innovation can be taught, “the apprenticeship structure *forbids*” students to “alter, change or improve upon anything” (Deafenbaugh, 1989, pp. 173–174, emphasis added). At the same time, however, complexity introduced by master weavers via alterations immediately becomes part of the lore for novices to absorb along with other aspects of the craft.⁴ This suggests that innovation is a built-in structural feature of apprenticeship learning that experts may utilize and deploy to their advantage.

Wallaert-Pêtre’s (2001) study of four Cameroon communities similarly undermines the pedagogical rationale behind the constraints imposed on learners’ creativity and highlights the significance of these constraints in supporting the political structure of age. In these communities, the extent to which experts discourage attempts at innovation and creativity by learners varies with the strength of the age-based political structure. In three

conventional communities with age structure intact, teachers forbade apprentices to inquire or innovate. Even to “question the elders—the owners of knowledge—[was] considered an offense to tradition” (Wallaert-Pêtre, 2001, p. 484). In the fourth community, however, where modernization had destabilized traditional structures of social relations, young learners were encouraged to ask questions, experiment, and challenge themselves by “[trying] out complex designs” (Wallaert-Pêtre, 2001, p. 404). This discrepancy reinforces the relationship between monopolizing creativity and the robusticity of elders’ status.

These examples from the apprenticeship literature highlight deliberate mechanisms through which experts prolong, rather than expedite, learning and illustrate how these mechanisms impact cultural processes and products. For the most part, however, discussions of power dynamics of masters and apprentices have failed to inspire deliberations of cultural uniqueness because assumptions about differences in formal and informal learning rendered them immaterial. However, as I hope to show below, extending the learning process is just as vital for hunter-gatherer elders as it is for an expert in formal apprenticeship.

Prolonged learning and the prestige skills of hunters and gatherers

In recent years, the number of studies on hunter-gatherers’ social learning has increased (e.g., Hewlett and Lamb, 2006; Terashima and Hewlett, 2016; Boyette and Hewlett, 2018). Focusing primarily on “socially defined small-scale, relatively egalitarian and traditionally foraging societies” (Lew-Levy et al., 2017a), these studies revealed that the social learning of these hunter-gatherers is unique in several respects. Hunter-gatherer children tend to acquire fundamental skills early, autonomously, and in a relaxed, indulgent atmosphere. While it is understood that learning is often a lifelong process (Bird-David, 2006; Bock, 2002; Hewlett et al., 2011), young hunter-gatherers usually become proficient in the necessary survival skills by the age of twenty, but often sooner. Although the age of self-sufficiency differs according to ecological conditions, hunter-gatherer children as young as 5–10 years old may be independently able to provide for themselves (Cavalli-Sforza, 1986; Blurton Jones and Marlowe, 2002; Bock, 2006; Tucker and Young, 2006). Even if at times parents, other adults, and older children actively facilitate learning (Garfield et al., 2016; Hewlett, 2016; Boyette and Hewlett, 2018), hunter-gatherer children most often acquire subsistence skills in mixed-age and gender groups of peers as part of play (Tucker and Young, 2006).

Despite the rich data from these studies, reviews also reveal biases and gaps in the research literature of hunter-gatherers’ social learning. As Lew-Levy et al. comment (2017b), this area of research reflects the interests of a handful of researchers whose studies focused predominantly on Africa. In addition, it is a body of research directed mainly at subsistence skills, while complex and specialized skills, the acquisition of which is often initiated later, have been comparatively neglected (Lew-Levy et al., 2020a). To analytically differentiate these two types of skill sets, it is useful to apply Stout’s (2005) distinction between “everyday” skills and “expert learning” but with a different emphasis. While Stout (2005, p. 337, emphasis in the original) characterizes the latter as “highly structured *deliberate practice*... often designed by a coach or teacher”, I define these contrasting skill sets based on their respective implications for elders’ status.

In one of the most influential typologies of the later part of the twentieth century, James Woodburn (1982) differentiated two categories of hunter-gatherers: “delayed return” hunter-gatherers with marked generational systems and “immediate-return” hunter-gatherers, among whom individual autonomy undermines dependences and obligations deriving from kinship and age. This

distinction has resulted in studies highlighting the unique social organization of immediate-return hunter-gatherers while de-emphasizing their social structure. Yet, even if these small mobile groups of hunter-gatherers do not recognize formal age groups (O’Donnell and McNeill, 1984), age, nonetheless, constitutes their primary principle of social differentiation. Political relations in these groups are regulated both by relative age and complementary generational roles. The literature of hunter-gatherers attests that “elders,” who, among men, tend to be middle-aged, rather than old, individuals, are generally treated with respect and often assume leadership role (Lee, 1979; Maybury-Lewis, 1984; Endicott, 2017).⁵ Elders’ status, however, is vulnerable, and the effort to uphold it may explain their attitudes toward the acquisition of everyday subsistence and expert prestige skills. While hunter-gatherer elders benefit from the speedy acquisition of essential subsistence skills and sharing, they profit more from a more deliberately paced acquisition of non-essential skills by learners.

Young foragers do not only procure resources but also share what they produce. Instead of expressing an “egalitarian ethic,” as it has been customarily interpreted (Woodburn, 1982), hunter-gatherers insistence on general sharing may contribute to equality by upholding the age structure. In recent years, discussions around grandmothering have made it evident that older individuals’ continuous contribution is vital in hunter-gatherer groups (Hawkes et al., 1997; Bliege Bird and Bird, 2008). At the same time, it is also acknowledged that hunter-gatherers’ ability to provide for themselves declines with age (Bock, 2006; Pandaya, 2005; Layton, 2008).⁶ Among immediate-return hunter-gatherers, whose personal obligations—often due to their frequent interactions with neighbouring farmers—are undermined by individual autonomy, general sharing rules counterbalance this decline and ensure that elders in the group are supported beyond their physical means (Dallos, 2011). The rigour with which otherwise easy-going hunter-gatherer adults teach and consistently enforce sharing attitudes and practices from a very early age (Boyette and Hewlett, 2018) highlights this significance. This approach to sharing contrasts with elders’ attitudes toward non-essential prestige skills, as evidenced by the examples below.

Before turning to these examples, it is important to emphasize that extended learning of prestige skills does not necessarily imply an absence of pedagogy. Even though, as Boyette and Hewlett (2018, p. 788) observe, “direct instruction (both verbal and non-verbal...) most often occurs in domains of complex ecological knowledge or subsistence skills”, parents and other adults also facilitate the learning of cultural expertise in the areas of kinship, religious knowledge, technical competence, and medicine. Moreover, as predicted by Henrich and Gil-White (2001), this direct teaching has apparent benefits for elders’ status. While not showered with “public praise,” the best teachers among hunter-gatherers are nonetheless often rewarded with esteem and deference (Hewlett, 2013, 2016; Kubota, 2016). Whether, like masters in formal apprenticeship, hunter-gatherer elders use the novice-teacher relationship to extend this period of deference via cultural innovation is not easy to verify due to a dearth of studies explicitly targeting this dynamic. However, the following examples demonstrate that enhancing the complexity of lore and withholding information in the transmission of complex prestige skills such as ceremonial hunting, healing, ritual knowledge, and technical expertise might also occur among hunters and gatherers.

In most instances, hunting constitutes an “everyday” subsistence skill to be mastered early. Nevertheless, in certain cases, hunting can be instrumental in elevating men’s position in the age-status system. For instance, as Bliege Bird and Bird (2008, p. 655) note, Martu men of the Western Desert, Australia, “hunt as a

political strategy, using a form of ‘competitive magnanimity’ to rise in the ritual hierarchy and demonstrate their capacity to keep sacred knowledge”. In contrast to the more common, early acquisition of purely subsistence-related hunting skills, this is a lengthy process, during which men *gradually* gain access to sacred knowledge by successfully hunting and sharing big game. Similarly, the communal Aka elephant hunt described in a classic study by Hewlett and Cavalli-Sforza (1986) is a recognizable prestige skill emphasizing ritual elements and reproducing conservative traditional form. These characteristics are especially prominent when hunting is connected to boys’ initiation, as in the age-structured ceremonial hunt of Xavante of Brazil (Welch, 2015). In this case as well, novices’ participation is delayed. Young initiates, for whom hunting with fire is allegedly organized so that they learn the technique before marriage, are prohibited from participating. Instead, they must remain in the camp attending to menial chores and learning sophisticated lore associated with fire hunting (Welch, 2015, p. 184). As in apprenticeship, this lore is transmitted to them in stages, ostensibly, to observe “age-appropriate constraints” on learning.

In emphasizing informal acquisition of skills, scholars may fail to grant sufficient weight to the implications of age-structured learning. For instance, in his study of Bolu spirit play of Mbendjele BaYaka children, Jerome Lewis (2016, p. 157) stresses the lack of formalized instruction. He argues that “cultural learning can be organized without [teachers and] recourse to figures of authority”. At the same time, however, he also relates that BaYaka assigns roles in spirit play performances according to age groups: while elders manage the performances, adult men are responsible for “calling the spirits,” and younger participants are “challenged to learn special dance moves” (Lewis, 2016, p. 150). As in the previous examples, the learning of secret lore surrounding performance is arranged according to age grades, with each stage marked by initiation into the “hidden aspects of these cults” (Lewis, 2016, p. 152). During performances, teachers emphasize technique and precision, and as BaYaka boys approach later adolescence, they begin to receive “advice from elders concerning the particular techniques or dance movements” (Lewis, 2016, p. 150). Elders insist that “complex interweaving melodies [are] perfectly sung” (Lewis, 2016, p. 151), and bad singers are labelled “song thieves”. The complexity of lore has been enhanced by generations of elders who added “songs, dances, riddles, special vocabularies, secret lore, and mystical skills associated with each spirit play,” as well as knowledge of the mythical past transmitted in the form of sung fables (*gano*) (Lewis, 2016, p. 152). Consequently, even if these rituals do not constitute a coherent belief system, the sequencing of acquisition and embellishment of lore indicates an extended learning process that supports the authority structure of age.⁷

As described in the apprenticeship literature, expert strategies are often marked less by verbalizing formalized knowledge than by withholding information. Similarly, among hunter-gatherers, elders may withhold specialized knowledge, such as toolmaking. Instruction in constructing multicomponent tools often commences later than in subsistence skills (Milne, 2005; Stout, 2002; Lew-Levy et al., 2017a). Even though hunter-gatherer children usually learn how to use tools, including weapons, early, they do not necessarily know how to make these (Hewlett and Lamb, 2006; Konner, 2006). Adults frequently construct practice tools for young learners from different and lower-quality materials than their adult counterparts (Little and Lancy, 2016; Lew-Levy et al., 2017a). Often, toolmaking is the prerogative of elders, who might carefully protect their craft. Even though hunter-gatherer experts tend to refrain from the extreme disciplinary measures of intimidation seen in formal apprenticeship, they have been known to vigorously and sometimes violently control access to resources needed to practice a skill. For instance, as Stout (2002,

p. 702) relates, among adze makers in Langda, “in the past men had been killed for using [rough-outs] without permission”.⁸

While the role of extended learning in sustaining the generation system may be readily acknowledged among the delayed-return hunter-gatherers such as those in Aboriginal Australia or the hunter-horticulturists of Amazonia, New Guinea, and Southeast Asia, to many, age-related control in acquiring knowledge is less apparent among the “immediate return” hunter-gatherers of Asia and Africa. Peter Gardner (1966, p. 398) comments on the absence of age-based authority deriving from the transmission of knowledge among Paliyan of South India:

Field investigation revealed that informants lacked either the ability or desire to repeat songs, prayers, or rituals verbatim. I ascertained that there was no tabu on repetition; the informants provided a unique version each time because they placed no value on a set or traditional version. This type of individualism recurred in other spheres: there were no formalized bodies of knowledge; greater respect was not accorded those who had accumulated lore with age... and traditional usages and concern with precedents were subordinated to individual, ad hoc, rational decision making.

Although elders’ authority to impose rules and dominate younger men in these groups may be more limited than in delayed-return societies, they may still ensure their monopoly by *withholding* knowledge. As Gardner (1966, p. 398) continues, “It is worth noting that Paliyans communicate very little at all times and become almost silent by the age of 40”. This silence of Paliyan elders may imply that they wish to protect their expertise by refusing to share it. While the absence of contextual information makes this difficult to ascertain for Paliyan, my research among immediate return Lanoh forest collector traders of Peninsular Malaysia would seem to support this interpretation.

Lanoh toolkit consists of digging sticks, machetes (obtained from neighbouring agriculturists) and blowpipes. By their mid-teens, young Lanoh men are proficient in hunting with blowpipes. At the same time, learning to construct instruments is postponed, and blowpipe production is the privilege and exclusive domain of elders.⁹ Even in this age group, capable blowpipe makers were rare and group members relied on the expertise of two elders; one was skilled at constructing blowpipes while the other at locating quality bamboo at secret places in the forest. As in other small hunter-gatherer groups, the ability and means of Lanoh elders to enforce interpersonal dependencies and obligations was limited, and unlike adze makers in Langda, Lanoh elders avoided force in controlling tool production. Nonetheless, these experts boosted their reputation by embellishing their skills and belittling those of younger men. They also suppressed the free flow of information by withholding specialized knowledge. Like experts in apprenticeship, they deceived, evaded, and mystified the craft to safeguard their knowledge.

To better understand variations in hunter-gatherers’ learning and why cultural norms influence technological design even at the detriment of efficiency (Harris et al., 2021) requires more focused research on oblique learning, especially concerning the acquisition of non-essential cultural knowledge and skills. As Lew-Levy et al. note (2020b, p. 12), despite “autonomous exploration... play, and innovation-seeking in adolescence”, except for child-size technologies, young hunter-gatherers seldom innovate (Lew-Levy et al. 2017a, p. 378). At the same time, innovations by adults are “transmitted primarily to adolescents”, and especially male adolescents are keen to seek out models who are good innovators, often travelling far and wide. Further studies are needed to focus on what happens in encounters with these models. Such research, exploring what is essentially a political

relationship between adolescent learners and elders, is not only critical in filling existing gaps in the social learning literature of hunter-gatherers, but may also influence discussions of prehistoric evidence.

Prestige skills in the context of prehistoric evidence

The above ethnographic cases indicate that the integration of social learning into age politics is widespread, if not universal, in modern humans. Apprenticeship, and even formal schooling, retain the idiom of age-structure also seen in small egalitarian groups of hunter-gatherers, and examples of extended learning and associated mechanisms impacting culture occur in varied settings in industrial societies as well (Gamst, 1989; Haas, 1989; Rudolph, 1994). The ethnographic cases cited also revealed two significant implications of the integration of social learning within age-politics: prestige skills—cultural production decoupled from functionality associated with subsistence skills—and prolonged learning linked to later childhood acquisition. Incorporating this evidence into social learning theory, however, requires that these implications of extended learning are verified in the context of prehistoric archaeological evidence. Although in contemporary humans, most innovations related to extended learning of prestige skills occur in oral tradition that leaves no trace in the archaeological record, in the following I will highlight areas where awareness of prestige skills and extended learning may contribute to critical discussions of prehistoric cultural change and life history trajectories.

Lately, scholars have extensively relied on social learning and cumulative culture theories in interpreting prehistoric change (Mesoudi et al., 2006; Sterelny, 2011; Pradhan et al., 2012; Nielsen, 2018; van Schaik et al., 2019). Many now believe and convincingly argue, for instance, that Acheulean industries beginning approximately 1.6 million years ago reflect more efficient skill transmission, and even active teaching (Finkel and Barkai, 2018).¹⁰ As Shipton (2010, p. 205) notes, Acheulean core tool industries imply imitation and shared intentionality—faculties that “evolved soon after 2 million years ago,” around the same time as Acheulean core technology. Linguistic ability emerging approximately 1.75 million years ago would have not only enhanced cognitive capacity but lead to the coevolution of syntactic language and toolmaking (Uomini and Meyer, 2013; Muller et al., 2017). It has been argued that, compared to Olduvian tool behaviour, these changes in observational learning enhanced fidelity in copying and reinforced cumulative culture and the ratchet effect. Such improvements in observational learning are consistent with the variation and refinements seen in Acheulean technology over millennia (Stout et al., 2014). These refinements include increased symmetry and cross-sectional thinning and may explain why later Acheulean techniques require a superior skill. However, while innovative in its means to facilitate learning, due to its aim to transmit existing knowledge as efficiently and accurately as possible, pedagogy also hinders creativity. Finkel and Barkai’s claim (2018) that Acheulean biface design reflects a *preferred* conservatism supports this proposition.

Given this inherent conservatism, however, learning enhancement is less convincing when used in explaining the innovative technologies appearing from 300 kya. After more than a million years of Acheulean tool industries characterized by the relatively uniform, preconceived, and standardized design of hand axes (Nonaka et al. 2010; French, 2016; Finkel and Barkai, 2018), new technocomplexes emerged marked by increased evidence of symbolic behaviour and non-utilitarian materials in weapons as well as in processing tools. Contrary to Acheulean industries’ relative conformity, the material data appearing in the Middle Paleolithic/MSA feature various new techniques. Distinct tool types include

retouched scrapers, stone points, miniature hand axes, and elongated picks. There is also evidence of jewelry, beads, ornaments, small geometric flakes, compound tools, hafting, and highly sophisticated bone instruments (McBrearty and Brooks, 2000).

Arguably, cultural tradition and functionality governed Acheulean and later non-human hominin tool production (Finkel and Barkai, 2018). For instance, there is increasing evidence of efficiency-enhancing use of organic materials and compound tools by Neanderthals (Daujeard et al., 2014; Degano et al., 2019; Kozowyk and Poulis, 2019). Also, the majority of innovations associated with anatomically modern humans (AMH) during this period undoubtedly improves efficiency. Nonetheless, archaeologists have often struggled to explain post-300 kya cultural material in terms of functional enhancement. As Henshilwood and Marean (2003, p. 363) note, “decoding the meaning of a design engraved on a piece of ochre or understanding why a bone tool is crafted much more carefully than necessary for a utilitarian object is difficult”. The ethnographic data indicate that such difficult-to-explain variants may relate to political dynamics implied in the transmission of prestige skills. These dynamics are evident in Dietrich Stout’s (2002) research in Irian Jaya, suggesting that self-aggrandizing strategies of experts result in features—shape, sizes, and techniques—*independent of the use-value of the produced objects*. Novices’ work on adze heads too small to be useful impeded the learning process. The largest adze heads produced by experts stood out less for their use-value and more for the difficulty of their construction, which boosted experts’ status. Grund’s (2017) study of why in human prehistory bows and arrows replaced atlatls illustrates how similar considerations may prove advantageous in interpreting archaeological data. For the most part, researchers have argued for the efficacy of bow and arrow (Riede, 2009; Lombard and Haidle, 2012; Walls, 2019). Nonetheless, rejecting interpretations linking change in terrestrial hunting weapons to altered subsistence behaviours, Grund (2017) suggests that the bow and arrow might have been preferred over atlatl because the former are more exclusive and more challenging to learn to manufacture. This reasoning not only echoes Stout’s (2002) findings among contemporary adze makers but also Harris et al.’s (2021) research with Hadza bowyers.

In this study, Harris et al. (2021, p. 3) investigated if expert bowmakers have superior causal knowledge about optimal and efficient bow design. The study resulted in several findings relevant to the subject of this article. First, bowyers do not necessarily choose the most efficient design. A considerable percentage of those interviewed allude to cultural preference. More precisely, however, they said that they had selected a round cross-sectional shape, as opposed to the optimal flat cross-sectional limbs because this is how “the elders have instructed” them. Second, Harris et al. (2021) found that causal knowledge does not necessarily increase with age. This finding is consistent with the expectation that in the context of prestige-based transmission, it is sufficient for learners to *believe* that elders possess superior knowledge. Studies as this should further encourage archaeologists to move away from purely adaptive functional explanations of innovative behaviour surrounding technology and toward considering the context of political interactions involved in craft learning.

In addition to aiding the analysis of craft production’s social context, prestige skills also pertain to human life history discussions. Among the distinctive life history patterns, adolescence, the period between puberty and adulthood lasting 5–10 years, has received increasing attention in recent years. How we conceptualize the relationship of social learning, and cultural products may be consequential not only for the theory of adolescence but also for disputes as to which hominin species other than

modern humans, and perhaps archaic sapiens, possessed adolescence (Locke and Bogin, 2006; Machin, 2009; Nowell and White, 2010). In considering the function and significance of adolescence, Bogin (2003) noted that apart from reproductive advantage and integration into the adult social, economic, and political world, adolescence affords young humans “extra time” to learn the complex human culture. In contrast, the ethnographic research considered above suggests that far from being a given, experts often generate cultural complexity to uphold their position vis-à-vis learners. This alternative model implies that rather than resulting from passive cultural “accumulation,” agency—the political dynamics of experts and learners—could have played a greater role than currently acknowledged in processes generating human adolescence.

Apart from prolonged childhood, the ethnographic material considered in this article also raises questions about a related issue at the forefront of recent discussions; the similarities and differences between the social learning and capacity for the culture of anatomically modern humans and Neanderthals (Terashima, 2016). Ethnographic studies suggest that the shared political space of experts and juveniles engenders prestige skills. However, similar political integration of social learning in non-human hominins cannot be taken for granted (Pettitt, 2000; Kuhn and Stiner, 2006). For instance, despite prestige copying, dominant chimpanzee models, while scaffolding infants, chase away juveniles (Stout, 2005).¹¹ The extent to which expert Neanderthal (and other non-human hominin) models tolerated or avoided politically threatening juveniles is uncertain. Granted, compared to chimpanzees, in hand-axe-producing hominins such as *Homo ergaster/erectus*, *heidelbergensis* and Neanderthals, enhanced learning facilitation, possibly augmented with linguistic cues, would indicate increased proximity and involvement of skilled individuals and learners. However, it has been suggested that teaching of toolmaking in Neanderthals occurred in childhood rather than in the juvenile period, as often is the case in modern humans (Eren et al., 2011). In our species, institutions such as kinship, family, and marriage establish the shared learning space for dominant models and adolescent learners. If Neanderthals and other hominins did not develop social and political institutions similar to modern humans, despite language, symbolic behaviour, and evidence of behavioural complexity, they would likely have been deprived of prestige skills and associated innovations, thus, of a significant source of cultural elaboration.

Conclusions

The ethnographic cases discussed make it apparent that cultural complexity resulting from political interactions between expert models and novices complicates human cultural processes. Incorporating these dynamics into existing approaches represents a challenge as well as an opportunity to shift paradigms. Compared to the robust effects of pedagogy on cultural accumulation and enrichment, prolonging learning and its impact on cultural complexity may seem less significant. Nonetheless, the ethnographic examples suggest that producing complex human culture is more multifaceted than acknowledged in dominant theories. Apart from faithfully copied information from one generation to the next, cumulative cultural processes also act on innovations derivative of mechanisms intended to extend learning. In addition, these mechanisms influence conceptions of tradition and innovation and the transmission of adaptive vs. maladaptive traits.

This conceptual paper is limited in that it fails to present a systematic review of evidence. This is in large part because, in the absence of theoretically oriented studies, such evidence is lacking. While the ethnographic literature of apprenticeship contains untheorized thematically relevant descriptive data, social

learning studies of hunter-gatherers have not yet focused on political relations of social learning. Therefore, relevant observations are buried in general ethnographic monographs. Due to this absence of focused analytically coded data, except for the study of gender differences in the length of learning periods, it is doubtful that cross-cultural surveys would produce helpful conclusions. Similarly, experimental and brief field studies are unlikely to yield valuable information. While these approaches have been prevalent in studies of social learning, they often lack contextual information concerning the political embeddedness of knowledge and skill transmission. Relationships forming the sociopolitical context of social learning tend to develop and unfold in kinship structures (Bird-David, 2019) over several years. Such context is problematic to reproduce in laboratory conditions. Similarly, brief interview-based field studies are disadvantaged when it comes to exploring intricate relationships and patterns of which participants may be unaware. Therefore, the most immediate task is conceptual enrichment, requiring focused, theoretically informed, longitudinal observation-based research, including ethnoarchaeological studies. Such research, as Lew-Levy et al. suggest (2017a, p. 388), should particularly involve “a narrative approach in which foragers themselves explain how they learn”.

Above all, the evidence cited in this article implies that if we are to understand unique human culture, we need to shift our focus from social learning to the sociopolitical restructuring that facilitates the integration of prestigious models and juveniles. This is not only because sociopolitical structure constitutes the likely framework in which both human pedagogy and prestige skills developed, but, even more importantly, because a research program centred on age-politics and linked institutions has the potential to unite diverse themes and interests in human evolutionary studies. Resolving some of the most pressing questions of prehistoric archaeology concerning human life history, normativity, or extended regional networks and traditions requires linking individual and group level analysis. A focus on sociopolitical structure and institutions, an approach Alan Barnard (2011, p. 144) calls a “social anthropology of human origins”, will undoubtedly constitute an essential component of the Extended Evolutionary Synthesis (EES) advocated by Kissel and Fuentes (2021, p. 95), with the potential to “place paleoanthropological inquiry in more intensive dialogue with... a broader anthropological practice”.

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Notes

- 1 In the case of Tukulor weavers, these “skilled tasks” surrounding the trade include “laying of warps, the design of clothes and the ordering of a sufficient number of pieces of cloth” (Dillely, 1989, p. 187).
- 2 Complexifying crafts via verbal embellishment and other means is congruent with Jiménez and Mesoudi’s (2019) suggestion that variation in knowledge/skill enhances the likelihood that individuals are copied. Since knowledgeable individuals often compete, it is in their interest to secure learners’ attention by embellishing crafts via innovation.
- 3 Restricting learners to reproducing traditional lore applies to virtually all contexts of institutional learning, from medieval European guilds (Renard, 1968) to the training of graduate students who, as Rudolph (1994, p. 206) notes, must move skillfully and carefully between dependence/deference” and “aggressiveness/initiative”. The link of insistence on “tradition” and experts’ status is evident in the following observation by trainee doctors: “A lot of types of guys (doctors), like certain obstetricians, like their thing done a certain way. They like their episiotomies done this way, you know. I mean they like them (women) sewn up in a particular way. You know, there is a certain way to do it, and this is the right way, my way. If you’re going to deliver one of my babies, then you’ve got to do it my way or else you don’t do it” (Haas, 1989, p. 96, emphasis added).

- 4 Dalidowicz (2015) reports a similar dynamic for North Indian kathak dancers.
- 5 Although in small-scale societies age regulates the relations of both genders, there is evidence that men's declining age trajectory contrasts with that of women. While, as Henrich and Gil-White (2001) also observe, the status of older men deteriorates women's status tends to continually increase over the lifetime (Gutmann, 1977, cited in Keith and Kertzner, 1984; Foner, 1984).
- 6 It has been repeatedly observed that even though proficiency in collecting skills peak in middle age, after that it starts to decline. Kelly (1995, p. 179) notes that "for male hunters, hunting success decreases over the age of forty due to eye problems and arthritis. While women's foraging abilities appear less affected, Bock (2006) nonetheless reports that mongongo nut processing skill and ability also begins to decline in the mid-forties.
- 7 For a longer account of fluid, but nonetheless age-graded, acquisition of healing and surrounding lore among hunter-gatherers, see Richard Katz' *Boiling Energy* (1982). This work depicts healing among! Kung as a "career," a life-long development, which men typically begin to pursue in the earnest in their twenties.
- 8 For an excellent discussion of age-graded acquisition of tool making (bows and arrows) and the role of complexity, and diversification of shape, decoration, and the difficulty to manufacture in politically structuring relationships according to age, see Nishiaki's (2013) analysis of Watanabe's New Guinean 1970s data.
- 9 There is some evidence of a generational exchange of tools for subsistence. Mcbrearty and Brooks (2000, p. 459) note, for instance, that "ethnographically, individuals have been observed to continue to manufacture projectiles long after their declining eyesight, reflexes, and endurance have diminished their own success as hunters. Among the! Kung and other people, projectiles are provided to successful hunters in exchange for a claim on the meat".
- 10 This does not mean an absence of dissenting views. Several authors have offered interpretations of Acheulean technology other than learning enhancement (e.g., Tennie et al., 2017; Corbey et al., 2016; Herzlinger et al., 2017).
- 11 Referring to work by Inoue-Nakamura and Matsuzawa (1997), Stout (2005, p. 337) notes that "in chimpanzees, learning is facilitated by a combination of adults' affective response to infants (tolerance) and infants' emotionally-motivated tendency to attend to, interact with and generally stay close to adults. These mechanisms of facilitation tend to break down with maturation... Juveniles ... are actively denied opportunities for participation and are often chased away if they try 'to get stones and/or nuts at the sides of the adults'". Distinguishing Neanderthals and AMH based on differences in social structure is preferable to differentiation based on behaviour. This latter basis has been criticized by Zilhão (2006), who pointed out that Neanderthals exhibited all settlement-subsistence strategies known from ethnographic cases. Thus, while behavior may show significant flexibility, species maybe characterized by distinct social structures as humans, for instance, are characterized by the structure of categorical and complementary age.
- ## References
- Argenti N (2002) People of the chisel: apprenticeship, youth, and elites in Oku. *Am Ethnol* 29(3):497–533
- Aronson L (1989) To weave or not to weave: apprenticeship rules among the Akwete Igbo of Nigeria and the Baule of the Ivory Coast. In: Coy MW (ed.) *Apprenticeship: from theory to method and back again*. SUNY, Albany, pp. 189–162
- Bamforth DB, Finlay N (2008) Introduction: archaeological approaches to lithic production skill and craft learning. *J Archaeol Method Theory* 15:1–27
- Barnard A (2011) *Social anthropology and human origins*. Cambridge University Press, Cambridge
- Bird-David N (2006) Studying children in "hunter-gatherer" societies: Reflections from a Nayaka perspective. In: Hewlett BS, Lamb ME (eds) *Hunter-gatherer childhoods: evolutionary, developmental and cultural perspectives*. Transaction Publishers, New Brunswick, pp. 92–105
- Bird-David N (2019) Kinship and Scale: on paradoxes in hunter-gatherer studies and how to overcome them. *Hunter Gatherer Res* 4(2):177–192
- Bliege Bird R, Bird DW (2008) Why women hunt: risk and contemporary foraging in a western desert aboriginal community. *Curr Anthropol* 49(4):655–693
- Blurton Jones N, Marlowe FW (2002) Selection for delayed maturity: does it take 20 years to learn to hunt and gather? *Hum Nat* 13(2):199–238
- Bock J (2002) Learning, life history, and productivity: children's lives in the Okavango Delta of Botswana. *Hum Nat* 13(2):161–198
- Bock J (2006) What makes a competent adult forager? In: Hewlett BS, Lamb ME (eds) *Hunter-gatherer childhoods: evolutionary, developmental and cultural perspectives*. Transaction Publishers, New Brunswick, pp. 109–129
- Bogin, B (2003) The Human Pattern of Growth and Development in Paleontological Perspective. In: Thompson, JL, Krovitz, JE, Nelson AJ (eds) *Patterns of Growth and Development in the Genus Homo*. Cambridge University Press, Cambridge, pp 15–44
- Boyd R, Richerson PJ, Henrich J (2011) The cultural niche: why social learning is essential for human adaptation. *PNAS* 108(suppl. 2):10918–10925
- Boyette AH, Hewlett BS (2018) Teaching in hunter-gatherers. *Rev Philos Psychol* 9(4):771–797
- Buechler, H (1989) *Apprenticeship and Transmission of Knowledge in La Paz, Bolivia*. In: Coy MW (ed) *Apprenticeship: From theory to method and back again*. SUNY, Albany, NY, pp 31–51
- Castro L, Toro MA (2014) Cumulative cultural evolution: the role of teaching. *J Theor Biol* 347:74–83
- Corbey R, Jagich A, Vaesen K, Collard M (2016) The Acheulean handaxe: More like a bird's song than a Beatles tune? *Evol Anthropol Issues News Rev* 25(1):6–19
- Coy M (1989) Introduction. In: Coy MW (ed.) *Apprenticeship: from theory to method and back again*. SUNY, Albany, pp. 1–11
- Creanza N, Fogarty L, Feldman MW (2013) Exploring cultural niche construction from the Paleolithic to modern Hunter-Gatherers. In: Akazawa T, Nishiaki Y, Aoki K (eds.) *Dynamics of learning in Neanderthals and modern humans, vol 1: cultural perspectives*. Springer Japan, Tokyo, pp. 211–29
- Dalidowicz M (2015) Crafting fidelity: pedagogical creativity in kathak dance. *J R Anthropol Inst* 21:838–854
- Dallos C (2011) *From equality to inequality: social change among newly sedentary Lanoh hunter-gatherer traders of Peninsular Malaysia*. University of Toronto Press, Toronto
- Daujeard C, Moncel M, Fiore I, Tagliacozzo A, Bindon P, Raynal J (2014) Middle Paleolithic bone retouchers in Southeastern France: variability and functionality. *Quat Int* 326:492–518
- Deafenbaugh L (1989) Hausa weaving: surviving amid the paradoxes. In: Coy MW (ed.) *Apprenticeship: from theory to method and back again*. SUNY, Albany, pp. 163–179
- Degano I, Soriano S, Villa P, Pollarolo L, Lucejko JJ, Jacobs Z, Douka K, Vitagliano, Tozzi C (2019) Hafting of Middle Paleolithic tools in Latium (Central Italy): new data from Fossellone and Sant'Agostino Caves. *PLoS ONE* 14(6): e0213473
- Dilley RM (1989) Secrets and skills: apprenticeship among Tukolor weavers. In: Coy MW (ed.) *Apprenticeship: from theory to method and back again*. SUNY, Albany, pp. 181–198
- Dow J (1989) Apprentice shaman. In: Coy MW (ed.) *Apprenticeship: from theory to method and back again*. SUNY, Albany, pp. 199–211
- Endicott K (2017) Cooperative autonomy: social solidarity among the Batek of Malaysia. In: Gibson T, Sillander K (eds.) *Anarchic solidarity: autonomy, equality, and fellowship in Southeast Asia*. Yale University Southeast Asia Studies, New Haven, pp. 62–88
- Epstein R (1998) Craft guilds, apprenticeship, and technological change in pre-industrial Europe. *J Econ Hist* 58(3):684–713
- Eren MI, Bradley BA, Sampson CG (2011) Middle Paleolithic skill level and the individual knapper: an experiment. *Am Antiq* 76(2):229–251
- Finkel M, Barkai R (2018) The Acheulean Handaxe technological persistence: a case of preferred cultural conservatism? *Proc Prehist Soc* 84:1–19
- Fogarty L, Strimling P, Laland KN (2011) The evolution of teaching. *Evol* 65(10):2760–70
- Foner N (1984) *Ages in conflict: a cross-cultural perspective on inequality between old and young*. Columbia University Press, New York
- French JC (2016) Demography and the Palaeolithic archaeological record. *J Archaeol Method Theory* 23(1):150–199
- Gamst FC (1989) The railroad apprentice and the "rules": historic roots and contemporary practices. In: Coy MW (ed.) *Apprenticeship: from theory to method and back again*. SUNY, Albany, pp. 65–86
- Gärdenfors P, Höögberg A (2017) The archaeology of teaching and the evolution of *Homo docens*. *Curr Anthropol* 58(2):188–208
- Gardner PM (1966) Symmetric respect and memorate knowledge: the structure and ecology of individualistic culture. *SJ Anthropol* 22(4):389–415
- Garfield ZH, Garfield MJ, Hewlett BS (2016) A cross-cultural analysis of hunter-gatherer social learning. In: Terashima H, Hewlett BS (ed) *Social learning and innovation in contemporary hunter-gatherers: evolutionary and ethnographic perspectives*. Springer, Japan, pp. 19–35
- Goody EN (1989) Learning, apprenticeship and the division of labor. In: Coy MW (ed.) *Apprenticeship: from theory to method and back again*. SUNY, Albany, p 233–256
- Graves B (1989) Informal aspects of apprenticeship in selected American occupations. In: Coy MW (ed.) *Apprenticeship: from theory to method and back again*. SUNY, Albany
- Grund BS(2017) Behavioral ecology, technology, and the organization of labor: how a shift from spear thrower to self bow exacerbates social disparities. *Am Anthropol*. 119(1):104–119
- Gutmann D (1977) The cross-cultural perspective: notes toward a comparative psychology of aging. In: Birren JE, Schaie KW (eds) *Handbook of the psychology of aging*. Academic Press, New York, pp. 209–34
- Haas J (1989) The process of apprenticeship: ritual ordeal and the adoption of a cloak of competence. In: Coy MW (ed.) *Apprenticeship: from theory to method and back again*. SUNY, Albany

- Harris JA, Boyd R, Wood BM (2021) The role of causal knowledge in the evolution of traditional technology. *Curr Biol* 31:1–6
- Hawkes K, O’Connell JF, Blurton Jones NG (1997) Hadza women’s time allocation, offspring provisioning and the evolution of long postmenopausal life spans. *Curr Anthropol* 38(4):551–77
- Henrich J, Gil-White FJ (2001) The evolution of prestige: freely conferred deference as a mechanism for enhancing the benefits of cultural transmission. *Evol Hum Behav* 22:165–196
- Henshilwood CS, Marean CW (2003) The origin of modern human behavior: critique of the models and their test implications. *Curr Anthropol* 44(5):627–650
- Herzlinger G, Wynn T, Goren-Inbar N, Petraglia MD (2017) Expert cognition in the production sequence of Acheulian cleavers at Gesher Benot Ya’aqov. *PLoS ONE* 12(11):e0188337
- Hewlett BL (2013) “Ekeloko” the spirit to create: Innovation and social learning among Aka adolescents of the Central African Rainforest. In: Akazawa T, Nishiaki Y, Aoki K (eds) *Dynamics of learning in Neanderthals and modern humans, vol 1: cultural perspectives*. Springer, Japan, pp. 1187–1195
- Hewlett BL (2016) Innovation, processes of social learning, and modes of cultural transmission among the Chabu adolescent forager-farmers of Ethiopia. In: Terashima H, Hewlett BS (ed) *Social learning and innovation in contemporary hunter-gatherers: evolutionary and ethnographic perspectives*. Springer, Japan, pp. 203–217
- Hewlett BS (2016) Social learning and innovation in hunter-gatherers. In: Terashima H, Hewlett BS (ed) *Social learning and innovation in contemporary hunter-gatherers: evolutionary and ethnographic perspectives*. Springer, Japan, p 1–19
- Hewlett BS, Cavalli-Sforza LL (1986) Cultural transmission among Aka Pygmies. *Am Anthropol* 88(4):922–934
- Hewlett BS, Lamb ME (2006) Emerging issues in the study of hunter-gatherer children. In: Hewlett BS, Lamb ME (eds) *Hunter-gatherer childhoods: evolutionary, developmental and cultural perspectives*. Transaction Publishers, New Brunswick, pp. 3–19
- Hewlett BS, Fouts HN, Boyette AH, Hewlett BL (2011) Social learning among Congo Basin hunter-gatherers. *Philos Trans R Soc Lond B366* (1567):1168–1178
- Inoue-Nakamura N, Matsuzawa T (1997) Development of stone tool use by wild chimpanzees (*Pan troglodytes*). *J Comp Psychol* 111(2):159
- Jiménez ÁV, Mesoudi A (2019) Prestige-biased social learning: current evidence and outstanding questions. *Palgrave Commun* 5(1):1–12
- Katz R (1982) *Boiling energy: community healing among the Kalahari Kung*. Harvard University Press, Cambridge
- Keith J, Kertzer DI (1984) Introduction. In: Kertzer DI, Keith J (eds) *Age and anthropological theory*. Cornell, Ithaca, pp. 19–65
- Kelly RL (1995) *The foraging spectrum: diversity in hunter-gatherer lifeways*. Smithsonian Institution Press, Washington
- Kissel M, Fuentes A (2021) The ripples of modernity: how we can extend Paleanthropology with the extended evolutionary synthesis. *Evol Anthropol* 30(1):84–98
- Konner M (2006) Hunter-gatherer infancy and childhood: The!Kung and others. In: Hewlett BS, Lamb ME (eds) *Hunter-gatherer childhoods: evolutionary, developmental and cultural perspectives*. Transaction Publishers, New Brunswick, pp. 19–65
- Kozowyk PRB, Poulis JA (2019) A new experimental methodology for assessing adhesive properties shows that Neandertals used the most suitable material available. *J Hum Evol* 137:102664
- Kubota S (2016) Innovation of paintings and its transmission: case studies from Aboriginal art in Australia. In: Terashima H, Hewlett BS (ed) *Social learning and innovation in contemporary hunter-gatherers: evolutionary and ethnographic perspectives*. Springer, Japan, pp. 229–237
- Kuhn SL, Stiner MC (2006) What’s a mother to do? The division of labor among Neandertals and modern humans in Eurasia. *Curr Anthropol* 47(6):953–81
- Layton R (2008) What can ethnography tell us about human social evolution. In: Allen NJ (ed) *Early human kinship: from sex to social reproduction*. Blackwell, London, p 113–127
- Lee RB (1979) *The!Kung San: men, Women, and Work in a Foraging Society*. Cambridge University Press, Cambridge
- Lewis J (2016) Play, music, and taboo in the reproduction of an egalitarian society. In: Terashima H, Hewlett BS (ed) *Social learning and innovation in contemporary hunter-gatherers: evolutionary and ethnographic perspectives*. Springer, Japan, pp. 229–237
- Lew-Levy S, Lavi N, Reckin R, Cristobal-Azkarate J, Ellis-Davies K (2017b) How do hunter-gatherer children learn social and gender norms? A meta-ethnographic review. *Cross Cult Res* 1:1–43
- Lew-Levy S, Rachel R, Noa L, Jurgi C-A, Kate E-D (2017a) How do hunter-gatherer children learn subsistence skills? *Hum Nat* 28(4):367–94
- Lew-Levy S, Milks A, Lavi N, Pope SM, Friesem DE (2020b) Where innovations flourish: an ethnographic and archaeological overview of hunter-gatherer learning contexts. *Evol Hum* 2(31):1–23
- Lew-Levy S, Kissler SM, Boyette AH, Crittenden AN, Mabulla IA, Hewlett BS (2020a) Who teaches children to forage? Exploring the primacy of child-to-child teaching among Hadza and Bayaka hunter-gatherers of Tanzania and Congo. *Evol Hum Behav* 41(1):12–22
- Little CAJ, Lancy DF (2016) How do children become workers? Making sense of conflicting accounts of cultural transmission in anthropology and psychology. *Ethos* 44(4):269–288
- Locke JL, Bogin B (2006) Language and life history: a new perspective on the development and evolution of human language. *Behav Brain Sci* 29(3):259–280
- Lombard M, Haidle MN (2012) Thinking a bow-and-arrow set: cognitive implications of middle stone age bow and stone-tipped arrow technology. *Camb Archaeol J* 22(2):237
- Machin A (2009) The role of the individual agent in Acheulean biface variability: a multi-factorial model. *J Soc Archaeol* 9(1):35–58
- Marchand THJ (2008) Muscles, morals, and mind: craft apprenticeship and the formation of person. *Br J Educ* 56(3):245–271
- Maybury-Lewis D (1984) Age and kinship: a structural view. In: Kertzer DI, Keith J (eds) *Age and anthropological theory*. Cornell, Ithaca, pp. 123–40
- McBrearty S, Brooks AS (2000) The revolution that wasn’t: a new interpretation of the origin of modern human behavior. *J Hum Evol* 39(5):453–563
- McIntosh J (2009) Elders and “frauds”: commodified expertise and politicized authenticity among Mijikenda. *Africa* 79(1):35–52
- Mesoudi A, Whiten A, Laland KN (2006) Towards a unified science of cultural evolution. *Behav Brain Sci* 29(4):329–47
- Milne B (2005) Paleo-Eskimo novice flintknapping in the Eastern Canadian Arctic. *J Field Archaeol* 30(3):329–345
- Minar CJ, Crown PL (2001) *Learning and Craft Production: An Introduction*. *J Anthropol Res* 57(4):369–380
- Muller A, Clarkson C, Shipton C (2017) Measuring behavioural and cognitive complexity in lithic technology throughout human evolution. *J Anthropol Archaeol* 48:166–180
- Nielsen M (2018) The social glue of cumulative culture and ritual behavior. *Child Dev Perspect* 12(4):264–68
- Nishiaki Y (2013) Gifting’ as a means of cultural transmission: the archaeological implications of bow-and-arrow technology in Papua New Guinea. In: Akazawa T, Nishiaki Y, Aoki K (eds) *Dynamics of learning in Neanderthals and modern humans, vol 1: cultural perspectives*. Springer, Japan, pp. 173–89
- Nonaka T, Bril B, Rein R (2010) How do stone knappers predict and control the outcome of flaking? Implications for understanding early stone tool technology. *J Hum Evol* 59(2):155–167
- Nowell A, White M (2010) Growing up in the Middle Pleistocene: life history strategies and their relationship to Acheulean industries. In: Nowell A, Davidson I (eds) *Stone tools and the evolution of human cognition*. University Press of Colorado, Boulder, pp. 67–83
- O’Donnell, M, McNeill, P (1985) *Age and Generation*. Routledge, London
- Palecek M (2020) The evolution of ‘Culture’: juggling a concept. *Anthropol. Theory* 20(1):53–76
- Pandaya V (2005) Deforesting among Adamanese children. In: Hewlett BS, Lamb ME (eds) *Hunter-gatherer childhoods: evolutionary, developmental and cultural perspectives*. Transaction Publishers, New Brunswick, pp. 385–406
- Pettitt PB (2000) Neanderthal lifecycles: developmental and social phases in the lives of the last Archaics. *World Archeol* 31(3):351–66
- Pradhan GR, Tennie C, van Schaik CP (2012) Social organization and the evolution of cumulative technology in Apes and Hominins. *J Hum Evol* 63:180–90
- Renard G (1968) *Guilds in the middle ages*. Sentry Press, New York
- Riede F (2009) The loss and re-introduction of bow-and-arrow technology: a Case Study from the Northern European Late Paleolithic. *Lithic Technology* 34(1):27–45
- Rudolph DE (1994) Constructing an apprenticeship with discourse strategies: professor-graduate student interactions. *Lang Soc* 23:199–230
- Shipton C (2010) Imitation and shared intentionality in the Acheulean. *Camb Archaeol J* 20(2):197–210
- Simpson E (2006) Apprenticeship in western India. *J R Anthropol Inst* 12:151–171
- Singleton J (1989) Japanese folkcraft pottery apprenticeship: Cultural patterns of an educational institution. In: Coy MW (ed.) *Apprenticeship: from theory to method and back again*. SUNY, Albany, pp. 163–179
- Sterelny K (2011) From hominins to humans: how sapiens became behaviourally modern. *Philos Trans R Soc Lond B* 366(1566):809–22
- Stock JPJ (2002) Learning “Huju” in Shanghai, 1900–1950: apprenticeship and the acquisition of expertise in a Chinese local opera tradition. *Asian Music* 33(2):1–42
- Stout D (2002) Skill and cognition in stone tool production: an ethnographic case study from Irian Jaya. *Curr Anthropol* 43(5):693–722

- Stout D (2005) The social and cultural context of stone-knapping skill acquisition. In: Roux V, Brill B (eds) *Stone knapping: the necessary conditions for a uniquely hominin behaviour*. Cambridge University Press, Cambridge, pp. 331–341
- Stout D (2011) Stone toolmaking and the evolution of human culture and cognition. *Philos Trans R Soc B: Biol Sci* 366(1567):1050–1059
- Stout D, Apel J, Commander J, Roberts M (2014) Late Acheulean technology and cognition at Boxgrove, UK. *J Archaeol Sci* 41:576–590
- Tehrani JJ, Riede F (2008) Towards an archaeology of pedagogy: learning, teaching, and the generation of material culture traditions. *World Archaeol* 40(3):316–31
- Tennie C, Call J, Tomasello M (2009) Ratcheting up the ratchet: on the evolution of cumulative culture. *Philos Trans R Soc B: Biol Sci* 364(1528):2405–2415
- Tennie C, Premo LS, Braun DR, McPherron SP (2017) Early stone tools and cultural transmission: resetting the null hypothesis. *Curr Anthropol* 58(5):652–672
- Terashima H (2016) Reflections on hunter-gatherer social learning and innovation. In: Terashima H, Hewlett BS (eds) *Social learning and innovation in contemporary hunter-gatherers: evolutionary and ethnographic perspectives*. Springer, Japan, pp. 311–318
- Terashima H, Hewlett BS (Eds) (2016) *Social learning and innovation in contemporary hunter-gatherers: evolutionary and ethnographic perspectives*. Springer, Japan
- Thornton A, McAuliffe K (2012) Teaching can teach us a lot. *Anim Behav* 83(4):E6–9
- Tucker B, Young AG (2006) Growing up Mikea: children's time allocation and tuber foraging in Southwestern Madagascar. In: Hewlett BS, Lamb ME (eds) *Hunter-gatherer childhoods: evolutionary, developmental and cultural perspectives*. Transaction Publishers, New Brunswick, pp. 147–175
- Uomini NT, Meyer GF (2013) Shared brain lateralization patterns in language and Acheulean stone tool production: a functional transcranial Doppler ultrasound study. *PLoS ONE* 8(8):e72693
- van Schaik CP, Pradhan GR, Tennie C (2019) Teaching and curiosity: sequential drivers of cumulative cultural evolution in the Hominin lineage. *Behav Ecol Sociobiol* 73(1):2
- Wallaert-Pêtre H (2001) Learning how to make the right pots: apprenticeship strategies and material culture, a case study in handmade pottery from Cameroon. *J Anthropol Res* 57(4):471–493
- Walls M (2019) The bow and arrow and early human sociality: an enactive perspective on communities and technical practice in the Middle Stone Age. *Philos Technol* 32(2):265–81
- Welch J (2015) Learning to hunt by tending the fire: Xavante youth, ethnoecology, and ceremony in Central Brazil. *J Ethnobiol* 35:183. <https://doi.org/10.2993/0278-0771-35.1.183>
- Woodburn J (1982) Egalitarian societies. *Man (NS)* 17(3):431–451
- Zilhão J (2006) Neandertals and moderns mixed, and it matters. *Evol Anthropol Issues News Rev* 15(5):183–95

Competing interests

The author declares no competing interests.

Additional information

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