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## Abstract

Social learning among hunter-gatherers has been widely discussed in the literature and authors often draw on ethnographic cases to support theoretical models. In this study we report on the cross-cultural occurrence of various modes and processes of social learning in distinct cultural domains from the ethnographic record. To our knowledge this is the first systematic, cross-cultural study of hunter-gatherer social learning. We rely on the sample of hunter-gatherers in the electronic Human Relations Area Files (eHRAF) to generate our source of ethnographic texts. We have coded and analyzed 982 ethnographic texts from 23 diverse societies. Oblique and vertical transmission appear at similar rates. Various forms of teaching are the most common processes of social learning and account for more than half of all coded texts. Vertical and oblique social learning are predominantly characterized by teaching, whereas horizontal social learning is primarily through collaborative learning. Approximations of age reveal a general developmental pattern in which social learning of miscellaneous skills characterizes infancy, subsistence skills dominate early and middle childhood, and the social learning of religious beliefs are most frequent during adolescence. Across development we identify a reduction in the importance of vertical transmission in favor of oblique transmission, for subsistence skills in particular. These results highlight the importance of teaching in the ethnographic record of hunter-gatherer social learning and provide a systematic, cross-cultural, framework for theoretical models to rely on.

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## Keywords

Hunter-gatherers · Human Relations Area Files · Social learning · Cultural transmission · Teaching

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## 2.1 Introduction

The primary goal of this study is to identify and analyze the cross-cultural occurrence of various modes and processes of social learning in distinct cultural domains among hunter-gatherers. Understanding the lifeways of hunter-gatherers

requires a broad, holistic perspective incorporating multiple methodological approaches. Even a cursory ethnographic review reveals immense diversity within (Draper and Cashdan 1988) and between hunter-gatherer societies (Cummings et al. 2014; Kelly 2013; Lee and Daly 1999). Comparative approaches utilizing data on multiple hunting and gathering societies have been informative (Boehm 2008; Ember 1978; Marlowe 2005) and provide important methodological tools to systematically investigate and better understand a wide sample of forager groups (Munroe and Gauvain 2010). We consulted ethnographic materials on

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hunter-gatherers in the electronic Human Relations Area Files (eHRAF) to determine the relationships between cultural domains, modes, and processes of culturally transmitted and acquired information with reference to established evolutionary theoretical models. Despite the limitations of ethnography-based comparative research, the ethnographic record of hunter-gatherers is a resource that should not go overlooked. The specifics of social learning among small kin group-based forager populations are likely to reveal the expression of psychological mechanisms that facilitate adaptive learning in these environments (Tooby and Cosmides 1990). An evolutionary account of social learning must incorporate the descriptive accounts of learning across a wide range of foraging populations (Bock 2010). This approach can provide insights about the universality of the acquisition of culture and also the degree to which the environment and cultural values shape social cues facilitating learning.

Social learning has been a widely discussed topic, and theoretical models have been developed from case studies and ethnographic research across diverse cultural settings (Cavalli-Sforza et al. 1982; Henrich and Broesch 2011; Hewlett and Cavalli-Sforza 1986; Reyes-García et al. 2009). We seek to further validate these models and provide cross-cultural data on the prevalence of the components of social learning. To our knowledge this is the first HRAF investigation of cultural transmission among hunter-gatherer societies. This study utilizes the rich and detailed information ethnographers have produced and is intended to supplement field-based research on hunter-gatherer social learning (Hewlett et al. 2011; Reyes-García et al. 2009).

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## 2.2 The Transmission and Acquisition of Culture

Anthropologists have been interested in understanding the diversity and universality of cultural learning processes since the inception of the discipline (Munroe and Gauvain 2010; Mead 1964; Tylor 1871). Social learning is at the root of culture, and neither social learning nor culture is unique to humans (Box and Gibson 1999; Laland and Galef 2009; Perry 2011). Although a number of cultural behaviors have been identified among other species such as ground-living monkeys, apes, and particularly chimpanzees, human culture is cumulative in nature and clearly an outlier among social animals (Laland and Hoppitt 2003; Whiten 2011). Our capacity for cultural transmission and the complex methods by which we deliver social information is an important feature promoting these distinctions.

Cavalli-Sforza and Feldman define cultural transmission as the acquisition of a cultural trait or the units of culture that

are learned and subject to evolutionary change, by one individual from another, and may involve lengthy processes of social learning (Cavalli-Sforza 1981). However, as the models of Cavalli-Sforza and Feldman have identified, cultural transmission is not restricted to dyadic relationships, but include many-to-one and one-to-many contexts of transmission (Cavalli-Sforza et al. 1982). We use this expanded definition, conceptualizing cultural transmission as the process of communicating socially learned information from one individual or group to another individual or group (Cavalli-Sforza 1981; Cavalli-Sforza et al. 1982). Models of cultural transmission have identified multiple mechanisms by which culture spreads and revealed that patterns are often specific to cultural domains, such as religion or politics (Cavalli-Sforza et al. 1982).

Modes of cultural transmission specify the context of the acquisition of culture, who is transmitting culture, and who is acquiring culture. Theoretical models describing the transmission of culture have used systems of genetic transmission as a foundation and point of comparison (Dawkins 2006). Vertical transmission of culture involves children learning from their parents, a mode more congruent with genetic inheritance (Cavalli-Sforza 1981). Vertical transmission stems from attachment between parents and offspring and is predominant during infancy and early childhood (Bowlby 1973). The altriciality and close proximity of human infants to their parents allows internal working models of cultural traits to develop based on those of their parents (Hewlett et al. 2000). Among the Okiek, parents impart important knowledge during this time, and Huntingford (1951) notes that “up to the age when a child can be of some help to its parents, both boys and girls are mainly with their mother, who teaches them the business of eating and living in a hut. She corrects childish bad habits and makes them familiar with the ordinary customs and precautions of everyday life that have to be observed in Dorobo surroundings. The father corrects improper behaviour towards himself and the mother.” Vertical transmission is a low cost method of acquiring culture for infants and young children and limits innovations while promoting cultural conservation (Cavalli-Sforza et al. 1982). In stable environments vertical transmission is expected to be highly adaptive, especially within reproductively salient dimensions of culture, such as traits promoting fertility, survival, and reproduction (Boyd and Richerson 1985; Richerson and Boyd 2005).

Oblique transmission involves social learning between individuals of distinct generations or age groups typically from an older generation to a younger generation (Cavalli-Sforza 1981). Oblique transmission may occur within an extended kin group or local population. Grandparents or aunts and uncles may pass on cultural variants to grandchildren or nieces and nephews; similarly, adults of a local community may pass on cultural knowledge to

unrelated children. Among the Ojibwa religious knowledge is acquired obliquely, and “older people relate the tribal tales, sing the songs and perform the religious rites, and the children pick them up by association” (Burgesse 1944). Oblique transmission can also occur between age grades of children with adolescents transmitting cultural information to younger children. This mode of learning becomes more common during middle childhood and may occur bidirectionally as younger children and older children participate in each other’s social learning (Harris and Corriveau 2011). Culture change can occur rapidly when transmitted obliquely, and in changing and stochastic environments, oblique transmission is predicted to be highly adaptive as a wider range of cultural variants may be available to adopt if vertically acquired cultural traits may no longer be successful in new ecological contexts (Boyd and Richerson 1985; Richerson and Boyd 2005). In subarctic North America among the Chipewyans, acquiring sufficient subsistence skills and learning the local geography necessitate taking advantage of the experience of several older adults. Informants expressed, “it is generally the rule that a young man will trap with some older relative for at least 4 or 5 years before attempting to go out on his own. This means that by the time a man is in his early or middle twenties, he is thoroughly familiar with at least one and probably more trapping areas and is also skilled at other trapping activities” (Van Stone 1963).

There are multiple types of oblique transmission. Concerted transmission involves a group of older individuals formally or informally gaining consensus on the transmission of particular cultural variants (Cavalli-Sforza 1981; Hewlett and Cavalli-Sforza 1986). Concerted transmission often occurs during initiation rituals and formal aspects of cultural development, such as when Aranda elders pass on the religious dimension of astronomical knowledge during initiation; Maegraith (1932) explains that “when they grow up and have undergone their ceremonial circumcision, they are taught the ‘truth’ about the tribal legends and names handed on to the boys. The old men also instruct the initiated boys in the movements, colour and brightness of the stars. . .the knowledge is handed down by the old men to the boys at their initiation, and is carefully concealed from the women, who know practically nothing about the stars.” Because a community of adults converge in agreement upon the content of cultural transmission, the opportunity for innovation in cultural variants that are concertedly transmitted obliquely is expected to be difficult and infrequent (Hewlett and Cavalli-Sforza 1986). Hence, the content of concerted transmission is generally consistent within a population, often within the context of age and gender, and is predicted to be highly conserved across generations and cultural evolution (Cavalli-Sforza 1981; Hewlett and Cavalli-Sforza 1986).

Several types of model-based oblique transmission involve differential transmission by specific types of individuals with specific qualities (Boyd and Richerson 1985; Richerson and Boyd 2005). Prestige-biased learning is commonly discussed in the literature and involves preferential social learning from models that receive freely conferred deference from other members of the community (Chudek et al. 2011). Prestigious individuals embody conceptions of success within a cultural context, and humans possess a psychological adaptation to prefer modeling the behavior and skills of identified experts within cultural domains (Henrich and Gil-White 2001), such as in the case of Aleut men acquiring the components of hunting skills; Shade (1948) relates that “the training of young men was conducted by recognized experts in their fields: weather forecasting, skin boat handling, marksmanship, and so forth. Out of such a background grew an easily recognizable respect for knowledge and authority.” Prestige-biased learning facilitates more accurate and rapid cultural transmission by streamlining the process of selecting potential models for skill acquisition and differentially spreading the most successful information or skills across the group and to younger generations (Henrich and Gil-White 2001).

Cultural transmission also occurs within an age group. Horizontal transmission involves social learning from individuals of the same generation, age group, or cohort, roughly within 4–5 years of age (Cavalli-Sforza 1981). Horizontal transmission becomes more frequent during middle childhood when children spend a majority of time in mixed-aged playgroups (Konner 2010). Culture change can occur rapidly in domains that are primarily transmitted horizontally, and in changing environments, a reliance on horizontal transmission can be highly adaptive (Boyd and Richerson 1985; Richerson and Boyd 2005).

Multiple processes of social learning have been defined to explain how culture is learned. Teaching is one process of social learning and multiple forms have been identified across diverse taxa. Caro and Hauser (1992) provide three criteria for defining teaching. Teaching involves, first, a knowledgeable individual modifying their behavior in the presence of a naïve individual; second, the knowledgeable individual incurs some cost or derives no immediate benefit by modifying their behavior; third, the naïve individual acquires knowledge or skills more rapidly or efficiently than they would have otherwise, or he or she acquires knowledge or skills it would not have learned at all in the absence of the knowledgeable individual’s modified behavior (Caro and Hauser 1992). The roles of various forms of teaching and their importance in traditional societies have been elaborately discussed. Cultural anthropologists have historically downplayed the importance of teaching in traditional societies (Lancy and Grove 2010; Tomasello et al. 1993); however, cognitive psychologists have

purported that teaching is a universal feature of human psychology (Gergely and Csibra 2006). Evolved psychological mechanisms produce a type of learning described as natural pedagogy, which involves social learning by recognition of explicit cues of generalizable knowledge within a given context (Csibra and Gergely 2011; Gergely and Csibra 2006). These psychological mechanisms facilitate the efficacy of both learning and teaching and increase the capacities for social learning beyond those of observation and imitation alone. Teaching also involves guided demonstration, positive and negative reinforcement, verbal explanation, and scaffolding (see Hewlett et al., Chap. 3 this volume; Konner 2010). One aspect of this contention, concerning the frequency and importance of teaching, stems from the operationalization and classification of teaching. While some authors have conceptualized teaching only in the strict formal sense, others have suggested teaching is multidimensional and methods of informal teaching are in fact classifiable as teaching (Kruger and Tomasello 1996). Recently, significant work has moved this debate forward by resolving discrepancies between approaches to define and study teaching. Klein (2015) provides a taxonomy of teaching and links processes of teaching to cultural adaptation; this framework predicts teaching to be highly frequent cross-culturally. A more comprehensive conception of teaching reveals the importance of the social learning process in traditional cultural settings (Hewlett et al. 2011).

Imitation has been regarded as the dominant process of acquiring cultural information. Observation and imitation is considered a requisite technique to ensure the reproduction and transmission of cultural variants (Gergely and Csibra 2006). Observation and imitation can often occur peripherally around teaching, yet represent a distinct process of social learning. Imitation, verbal instruction, and prosociality have been suggested as the suite of sociocognitive processes responsible for the cumulative nature of human culture (Dean et al. 2012). Observation and imitation involves the learner directly observing some skill or behavior and then attempting to replicate the observed actions or behaviors. Imitation is a widespread process of social learning across many species; however, only human children incorporate a dimension of sociality when imitating actions. For young children, unlike the process of imitation documented among monkeys, imitation is not purely utilitarian and self-serving but is a collaborative process that develops social networks and potentially incorporates horizontal transmission throughout the process (Dean et al. 2012). The ability and propensity to imitate are deeply engrained in children's psychology to the point that children imitate unnecessary actions when attempting to replicate behaviors to achieve a goal (Lyons et al. 2007).

This overimitation has been found to be unique to humans and is the result of a highly developed sense of attributing causality to a series of actions involved in task completion (Lyons et al. 2007; however, see Berl and Hewlett 2015 for exceptions). Overimitation can be beneficial in allowing the child to calibrate a specific action over time to more efficiently complete a given task; however, overimitation is initially costly in that redundant unnecessary actions are weighted equally with essential actions (Lyons et al. 2007). Investigating the nature of overimitation among children in diverse cultural settings remains an important aspect of research on social learning. Field studies among hunter-gatherers (Hewlett et al. 2011) and reviews of ethnographic materials (MacDonald 2007) suggest that observation and imitation is the primary process of human social learning in traditional cultural settings.

The nature of child development and demography in hunter-gatherer society indicates that over the course of human evolutionary history, much of the social interaction that occurs during childhood takes place in the context of mixed-aged groups (Konner 2010). The community of children in small kin-based societies provides ample opportunity for collaborative learning experiences involving children of all ages. Collaborative learning consists of two learners of approximately equal skill, knowledge, and cognitive ability responding to a problem and co-constructing a solution (Konner 2010; Tomasello et al. 1993). For example, among the Mbuti, "the children played house, learning the patterns of cooperation that would be necessary for them later in life. They also learned the prime lesson of equality, other than for purposes of division of labor making no distinction between male and female, this nuclear family or that" (Turnbull 1983). Collaborative learning often involves acquiring sociocultural skills or information through play, practice, or adopting social roles among a group of children and requires children to consider the perspective of others (Hewlett and Boyette 2012; Hewlett et al. 2011). In this study collaborative learning was identified in the form of children's play, and we developed a distinction between play, role-playing, and rule-based play from ethnographic accounts.

The local environment provides opportunities and limitations for social learning, and both learners and teachers exploit the local ecology and materials to facilitate cultural transmission. Local enhancement involves a learner gaining knowledge or skills by being exposed to particular areas of the local environment by others. Often this occurs unintentionally as a byproduct of daily life as young children are encouraged to accompany their parents or adults while attending to various tasks (Konner 2010). Local enhancement requires direction, initiative, or intention on the part of

the transmitter or facilitator, but at the proximate level, local enhancement may resemble individual learning as the child is given the opportunity to learn directly from environmental conditions (Heyes et al. 2000; Konner 2010). Local enhancement may be unintentional; however, stimulus enhancement involves the learner being directly given an object to facilitate learning about the use and manipulation of that object or as a model for other objects. Among the San stimulus enhancement is used to instill practices of social exchange, and Wiessner (1978) describes, “symbolic training to do hxaro begins between the age of 6 months and a year when the maternal or paternal grandmother cuts off a child’s beads, washes him, puts the beads in the child’s hand, has him give them to some older relative and replaces them with new ones.” This process of learning also seems to be especially salient in the acquisition of subsistence skills as parents and other adults often give children miniature versions of important subsistence tools, such as bows and arrows or traps (MacDonald 2007).

These mechanisms of cultural transmission have been proposed as features of the process of acquiring culture and constitute aspects of an evolved culture acquisition device (Brown 1991; Konner 2010; Tomasello et al. 1993). By systematically examining the modes and processes of cultural transmission, a more fine-grained view of the process of culture acquisition emerges and allows us to inquire about specific aspects of social learning in hunter-gatherers.

Field studies among hunter-gatherers provide opportunities for systematic observational research on social learning. Egalitarian hunter-gatherers are populations without strict social hierarchy, hereditary classes, or significant wealth differences and live in ways socially more congruent with the vast majority of human evolutionary history (Boehm 1999). Investigating cultural transmission among hunter-gatherers is one approach to infer ancestral patterns of human social learning and also allows us to better understand how groups of contemporary foragers pass on their cultural knowledge. Hewlett et al. (2011) report on social learning from behavioral observation data among Congo basin egalitarian foragers and offer specific findings and predictions concerning modes and developmental parameters of cultural transmission. Generally, social learning occurs early in life, vertical transmission characterizes early childhood, and horizontal and oblique transmission become more dominant during middle childhood (Hewlett et al. 2011). However, studies such as this among hunter-gatherers are rare, despite a vast ethnographic literature on hunter-gatherer lifeways.

Other researchers have utilized the rich and detailed ethnography of hunter-gatherers, which spans over 150 years, to investigate social learning and cultural transmission. MacDonald (2007) uses a comparative approach to analyze the development of hunting skill in traditional

societies and identifies cross-cultural patterns that characterize the transmission of hunting techniques with reference to the parameters and predictions of life-history theory. MacDonald’s study provides a highly informative review of the ethnographic descriptions of learning to hunt; however, the process of selecting ethnographic sources and the sample of societies she reviews are not specified, and her study includes societies that utilize farming and other subsistence strategies.

As MacDonald explains, models of human evolution and of our species’ unique life-history strategy have emphasized the importance of large, difficult-to-acquire, packages of high-quality animal protein (Kaplan et al. 2000; MacDonald 2007). Therefore, understanding the process of learning to hunt may be generalizable to other domains of learning as well. MacDonald’s review suggests learning to hunt begins very young through vertical or oblique modes of transmission and often involves stimulus enhancement, where older individuals provide children with miniature versions of tools for play and experimentation (MacDonald 2007). Adults teach and guide children on the use of hunting tools in some contexts. MacDonald (2007, p. 390) notes that in several cases, “adults or older children provide hunting tools for the children to play with...and adults also offer advice on the peculiarities of the weapons and how to use them.” Providing hunting weapons to children allows for the development of important skills through play and also gives parents the opportunity to influence and direct children’s use of these tools and hence the acquisition of subsistence-based knowledge and skills through teaching (MacDonald 2007). Additionally, hunters may target easier prey when accompanied by children to facilitate the demonstration of proper technique (MacDonald 2007). However, MacDonald suggests teaching and observation are infrequent processes of acquiring hunting skill and learning to manufacture hunting tools. MacDonald suggests collaborative learning, group play, and stimulus enhancement are the dominant processes of the development of hunting skill. MacDonald emphasizes the importance of the social context and kin relations among males and the transmission of hunting skills. Clearly a number of modes and processes are important in acquiring subsistence skills.

Kruger and Tomasello (1996) provide a review of the ethnography on social learning and identify three types of cultural learning: imitative learning, instructed learning, and collaborative learning. These distinct processes of social learning are situated in a developmental context and are dependent upon degrees of comprehension and intentional states of the learner. Imitative learning emerges early in development, followed by instructed and collaborative learning (Kruger and Tomasello 1996). Through their review of ethnographic materials, Kruger and Tomasello further define three types of intentional instruction. They

conclude that expected learning, which involves a *laissez faire* approach where children learn information or skills on their own accord, occurs throughout development and is employed for simple or relatively unimportant tasks; guided learning occurs when adults believe children need assistance to acquire knowledge or skills and is used when tasks are moderately complex and often involves adults scaffolding children's learning; designed learning is a more formal process of instruction and occurs when children are perceived to need insistent and direct instruction and is reserved for complex or highly valued cultural tasks, such as sitting or walking early on and subsistence skills across development (Kruger and Tomasello 1996). Kruger and Tomasello predicted that all human societies demonstrate intentional teaching of children and surveyed ethnographic materials of a range of cultures including foragers, chiefdoms, and state-level societies. Their review provides important evidence that many diverse cultures engage in intentional instruction at least to some degree; however, their study is limited in that the ethnographic materials reviewed and the process of selecting their sample of cultures are not specified and not developed in a systematic manner (Kruger and Tomasello 1996).

Our study is distinct from the previous comparative research on cultural transmission in that we draw on a specific sample of the ethnographic record by relying exclusively on the eHRAF. In doing so we avoid researcher-introduced biases from nonsystematic sampling of cultures. Additionally, we restrict our analyses to hunter-gatherers to best characterize social learning among populations that subsist in ways more congruent with the majority of human evolutionary history. The eHRAF does not provide a complete or perfect sample of hunter-gatherers, but by limiting our searches to this data set, we avoid suppressing evidence or selecting ethnographic cases that would tend to support one theoretical perspective over another. Furthermore, the eHRAF has subject-coded ethnographic texts providing additional safeguards against biases in the collection of our target ethnographic data. By relying on the eHRAF, we are able to be confident that all ethnographic materials derive from valid and reliable sources with the vast majority produced by trained social anthropologists or ethnographers. This study is the first systematic analysis of social learning among hunter-gatherers designed to provide results useful in the mainstream approach to social learning in evolutionary anthropological studies today.

### 2.3 Cross-Cultural Methodology

Currently the eHRAF database contains ethnographic information on over 280 cultures. The content of the eHRAF is subject coded at the paragraph level using the Outline of

Cultural Materials (OCM) coding scheme. Our search was limited to 46 cultures with the eHRAF subsistence designation of hunter-gatherers. Three OCM codes were used in an advanced search to extract ethnographic information on cultural transmission: 867 Transmission of Cultural Norms, 868 Transmission of Skills, and 869 Transmission of Beliefs. We focus on egalitarian social structures. Equestrian hunter-gatherers of the North American plains and complex hunter-gatherers of the North American Pacific Northwest were excluded from data collection. This allows for more valid comparisons among hunter-gatherers between cultures and regions. Our search (after exclusions) generated 982 paragraphs in 153 documents from our final sample of 23 hunter-gatherer populations.<sup>1</sup>

Ethnographic information was only extracted and recorded if the ethnographer explicitly provided either context or content of social learning. All extracted texts contained information suitable for classification into a cultural domain and a specific process of cultural transmission (e.g., teaching, observation and imitation); however, in many cases, the mode of transmission (e.g., vertical, oblique) was not clear. Ethnographic texts can be classified as cases or cultural models. Cases are instances where the ethnographer describes an observed action or event involving specific individuals at a specific time. Cultural models are ethnographic descriptions of social values, norms, or standards that the ethnographer may infer based on their expertise or may be related from one or more local informants. Cases and cultural models provide valuable and viable ethnographic material and both types of textual information are used in this analysis. Overly general statements regarding cultural acquisition or learning were disregarded. Cultural models that were purely based on myths or fables were not included. Extracted texts were required to have at least a brief statement concerning what cultural information was transmitted. Data collection procedures produced 146 ethnographic texts (14.8 % of total texts generated by search) suitable for coding and analysis.

Ethnographic texts were coded for each instance of cultural transmission. An individual text may yield multiple codes. Codes were first classified by cultural domain and then coded for both mode of transmission and process of transmission. Table 2.1 lists operational definitions used in coding ethnographic texts. Cultural domains were determined post hoc from collected ethnographic texts. Additionally, each code includes a measure of the age of the learner coded as infancy, early childhood, middle childhood, adolescence, childhood (general), and nonspecific. The sex of

<sup>1</sup> Our sample includes the Okiek, San, and Mbuti from Africa; the Ainu, Andaman, Vedda, and Semang from Asia; the Aleut, Chipewyan, Copper Inuit, Innu, Kaska, Ojibwa, Mi'qmaq, and Northern Paiute from North America; and the Aranda, Tiwi, Abipón, Sirionó, Warao, Bororo, Ona, and Yaghan from South America.

the learner was also coded as male; female; both, for cases that mention each sex; and general, for statements that apply to children generally without specific mention of either sex. Two coauthors (ZG, MG) independently coded the 146 texts, and a third coauthor (BH) coded a sample of half of the texts and easily resolved the few coding discrepancies to reach unanimous consensus. Collaborative learning rule-based play was not used in the final coding results because it rarely occurred.

We have employed two methods of evaluating these data. One approach is to simply look at the frequency of unique domain mode process combinations for each culture, rather than the full set of generated codes. This allowed us to characterize and compare cultures more so than the ethnography of those cultures. Given the amount of ethnographic materials available for each culture varies, this process partially avoids biases in the quantity of ethnographic materials. For example, Lorna Marshall (1957) describes

Table 2.1 Operational definitions of coding scheme

Domains	
Subsistence skills and knowledge	Knowledge or skills related to food acquisition, includes hunting, gathering, food processing, production and use of subsistence-related tools, knowledge of edible plants and animals
Religious beliefs and practices	Knowledge or skills related to the spiritual, religious, or supernatural domain, includes folk mythology, ritual training, and initiation dealing with the supernatural
Language	Speaking skills, vocabulary, grammar, and other features of language acquisition
Ecology	Knowledge or skills concerning the physical environment, including nonedible plants, ethnobotany, medicinal plants, astronomy (non-spiritual, e.g., navigation, naming constellations), weather patterns, geographical knowledge
Miscellaneous skills	Knowledge or skills related to general locomotion, basic operation of crafts (e.g., canoes), swimming, basic climbing, dancing, singing, basic tool use (not directly tied to subsistence, or manufacture), alloparenting, toilet training, and some domestic skills (not directly related to subsistence, e.g., sewing)
Manufacture (non-subsistence)	Knowledge or skills involving production of useful items, including watercrafts, other transportation crafts, craft manufacture such as basketry, textile manufacture, tool manufacture, and building dwellings
Cultural values and kinship	Knowledge or skills concerning culturally preferred social behavior, including gender roles, morality, social norms (e.g., sharing, generosity), proper behavior between kin, kin terms, age-graded social distinctions, emotional behavior, and culturally preferred conduct
Modes	
Horizontal	Learning from individuals of the same generation, age group, or cohort within approximately 5 years of age (e.g., children–children, adult–adult)
Oblique	Social learning between individuals of distinct generations or age groups (e.g., uncle to nephew, adult to child, adolescents to young children)
Oblique–prestige bias	Social learning from a culturally identified expert to member(s) of a different generation or age group
Oblique concerted	Several adults agree upon what should be transmitted to an individual (usually in initiation context)
Vertical	Children learning from their parents
Unknown	The context was not specific enough to justify coding, but some information of a domain and a process was mentioned
Processes	
Collaborative learning	Individuals of approximately equal age, skill, knowledge, and cognitive ability collectively contribute to the learning of a specific skill or knowledge
Collaborative learning play	Type of collaborative learning that involves the transmission, acquisition, or practice of cultural knowledge or skills through informal play or miscellaneous games
Collaborative learning, role-playing	Type of collaborative learning that involves individuals of similar age collectively playing social roles (e.g., play house, husband-wife)
Local enhancement	The learner gains knowledge or skills by interacting with the local environment because other individuals expose the learner to the setting or environment (e.g., parents take children gathering or walk through forest)
Stimulus enhancement	The learner is given an object to facilitate learning how to use the object
Observation and imitation	The learner directly observes some skill or behavior and attempts to replicate the observed actions or behaviors
Teaching	An individual modifies his or her behavior specifically to impart knowledge, skills, or behaviors, to a learner, but there is insufficient information to code as demonstration or storytelling
Teaching–demonstration	Type of teaching where an individual demonstrates knowledge, skills, or behaviors, to a learner, and may offer feedback and examples during the process
Teaching–storytelling	Type of teaching where an individual actively imparts specific (within one of the defined domains) knowledge, skills, or behaviors to a learner by verbal communication of stories or metaphors
Individual learning	Individual exhibits repeated attempts to learn a skill or develop new skills or knowledge on his or her own. Includes trial and error and individual practice

the processes of learning subsistence skills among the San noting that “the adults do not let their children out of their sight. . . the adults pause to show them how to hold a digging stick, or a toy bow or drill, so that play and learning merge.” The following statements yield a code of subsistence skills and knowledge—teaching—demonstration—oblique. A similar code is generated from Richard Lee’s (1979) description noting that “around age 12 a boy starts accompanying his father, uncles, or older brothers on hunts. . . the boy becomes more active in shooting, with mongeese, genets, hares, and game birds as the main targets; during the winter months the young adolescent boy also builds snarelines, often under the guidance of his father or grandfather.” These two ethnographic texts would only contribute to one count of the subsistence skills and knowledge—teaching—demonstration—oblique permutation; however, other codes may stem from each of these texts. All reported frequency data was produced from this version of the data, which used only unique domain mode process combinations for each culture, ignoring age or sex distinctions. Results concerning developmental patterns or sex biases rely on the full set of generated codes.

## 2.4 Results

An important dimension of the eHRAF is the classification and evaluation of source ethnographies. This sample of ethnographic texts stems from 77 unique documents covering 23 hunting and gathering cultures. These documents were primarily authored by ethnographers or social anthropologists (62, constituting 80 %), with the remaining authored by other social scientists or professionals.

Frequency data can be evaluated across the entire sample or within each cultural domain. Due to variation in the ethnographic materials of each culture in the eHRAF, certain cultures or regions are overrepresented in this sample. In the frequency data, 30 % of the codes stemmed from eight North American societies, 26 % of codes came from three African societies, 13.3 % of codes came from two societies from Oceania, and 10 % of codes were from four Asian societies. Results in Table 2.2 reveal certain domains were more commonly discussed than others. The subsistence skills and knowledge domain was the most common and accounted for 37.6 % of all frequency codes. The cultural values and kinship domain accounted for 16.5 % of the distribution followed by the religious beliefs and practices domain which accounted for 13.8 %. The manufacturing and miscellaneous skills domains accounted for 12.8 % and 11.5 % of the frequency data, respectively. The ecology domain accounted for 6.4 % and the language domain for 1 %.

Across the entire sample, the frequencies of vertical and oblique transmission were the most common and appear at similar rates (37 % and 34 %, see Table 2.1 column totals). If the subcategories of oblique (prestige bias, concerted) are added to the more general oblique classification, oblique becomes the most frequent mode of transmission (43 %). Only three instances (3.2 %) of oblique codes described young children learning socially from adolescents, and two cultural models (2.1 %) mentioned young children learned from adolescents or elders. Therefore, the vast majority (95 %) of oblique codes concern children’s social learning from adults. Horizontal transmission accounted for 10 % of the frequency data.

The frequency data of processes of cultural transmission in Table 2.3 highlight the importance of teaching in the

Table 2.2 Prevalence of modes of transmission (with number of cases in parentheses) by cultural domain

Domains	Modes						Domain totals
	Vertical	Horizontal	Oblique			Unknown	
			General	Concerted	Prestige bias		
Subsistence skills and knowledge	39 % (32)	14.6 % (12)	32.9 % (27)	3.7 % (3)	01.2 % (1)	8.5 % (7)	82 cases
Religious beliefs and practices	23.3 % (7)	6.7 % (2)	36.7 % (11)	23.3 % (7)	0	10 % (3)	30 cases
Language	33.3 % (1)	0 %	66.7 % (2)	0 %	0 %	0 %	3 cases
Ecology	50 % (7)	0 %	21.4 % (3)	7.1 % (1)	7.1 % (1)	14.3 % (2)	14 cases
Miscellaneous skills	16 % (4)	12 % (3)	36 % (9)	8 % (2)	4 % (1)	24 % (6)	25 cases
Manufacture (non-subsistence)	57.1 % (16)	7.1 % (2)	28.6 % (8)	0 %	3.6 % (1)	3.6 % (1)	28 cases
Cultural values and kinship	36.1 % (13)	8.3 % (3)	41.7 % (15)	5.6 % (2)	0 %	8.3 % (3)	36 cases
Mode totals	37 % (80)	10 % (22)	34 % (75)	7 % (15)	2 % (4)	10 % (22)	

Table 2.3 Prevalence of processes of transmission (with number of cases in parentheses) by cultural domain

Domains	Processes										Domains totals
	Observation and imitation	Stimulus enhancement	Local enhancement	Collaborative learning			Teaching			Individual learning	
				General	Play	Role-playing	General	Demonstration	Storytelling		
Subsistence skills and knowledge	23.2 % (19)	6.1 % (5)	7.3 % (6)	3.7 % (3)	6.1 % (5)	3.7 % (3)	28 % (23)	15.9 % (13)	2.4 % (2)	3.7 % (3)	82 cases
Religious beliefs and practices	10 % (3)	3.3 % (1)	0 %	3.3 % (1)	0 %	3.3 % (1)	43.3 % (13)	10 % (3)	20 % (6)	6.7 % (2)	30 cases
Language	33.3 % (1)	0 %	0 %	0 %	0 %	0 %	66.7 % (2)	0 %	0 %	0 %	3 cases
Ecology	7.1 % (1)	0 %	21.4 % (3)	0 %	0 %	0 %	21.4 % (3)	21.4 % (3)	28.6 % (4)	0 %	14 cases
Miscellaneous skills	24 % (6)	8 % (2)	0 %	4 % (1)	4 % (1)	0 %	24 % (6)	28 % (7)	0 %	8 % (2)	25 cases
Manufacture	42.9 % (12)	0 %	0 %	0 %	0 %	0 %	46.4 % (13)	7.1 % (2)	0 %	3.6 % (1)	28 cases
Cultural values and kinship	16.7 % (6)	2.8 % (1)	0 %	2.8 % (1)	0 %	2.8 % (1)	58.3 % (21)	0 %	16.7 % (6)	0 %	36 cases
Processes totals	22 % (48)	4 % (9)	4 % (9)	2.8 % (6)	2.8 % (6)	2.3 % (5)	37.2 % (81)	12.8 % (28)	8.3 % (18)	3.7 % (8)	

ethnographic record of hunter-gatherers. We have identified three distinct types of teaching, teaching–demonstration, teaching–storytelling, and a more general teaching classification. These three processes accounted for 58 % of the data; the general teaching process was the most frequent process accounting for 37 %, while teaching–demonstration and teaching–storytelling accounted for 12.8 % and 8.3 % of the data, respectively. Observation and imitation was the second most frequent process (22 %), followed by stimulus enhancement and local enhancement, which both accounted for 4 %. Collaborative learning and collaborative learning play each accounted for 2.8 %. Collaborative learning, role-playing, was noted in 2.3 % of cases. Individual learning was noted in 3.7 % of frequency data texts.

The mosaic plot depicted in Fig. 2.1 displays the relationship of mode of transmission by the process of social learning for the frequency data. Note that the proportions along the x-axis represent the number of observations of each level of mode of transmission. The y-axis represents the overall proportions of each process of social learning. In this plot the subcategories associated with teaching, collaborative learning, and oblique transmission have been collapsed into their respective single category. Figure 2.1 illustrates the high frequency of oblique and vertical transmission; teaching dominates vertical and oblique transmission, while collaborative learning is most common in horizontal transmission.

The second approach to data analyses involves the full set of generated codes, including age and sex classifications, rather than unique combinations of domain mode process. In this data set, each domain mode process code also contains an evaluation of the age and sex of the learner. This version of the data allowed us to investigate wider patterns of social learning with the goal of characterizing the content and context of transmission across the complete sample of all codes.

The ethnographic record is not ideal for identifying the age of the learner in the context of cultural transmission. However, in many cases the ethnographer does specify rough estimates of the developmental stage of social learners. Our data collection procedure did not target any particular age range but relied on texts coded by the mentioned OCM codes. We used this information to code a measure of age to each domain mode process code generated. In half of the coded texts (141, 50.2 %), the ethnographer provides a general evaluation mentioning that transmission of culture occurs during “childhood.” However, the remaining texts (140, 49.8 %) do provide sufficient detail warranting a rough, but more specific evaluation of the age of the social learner. Besides the more general coding of childhood, we have coded age as infancy (10 instances), early childhood (44), middle childhood (27), adolescence (37), all ages (7), and nonspecific (15).

### Mosaic plot of Mode by Process (frequency data)

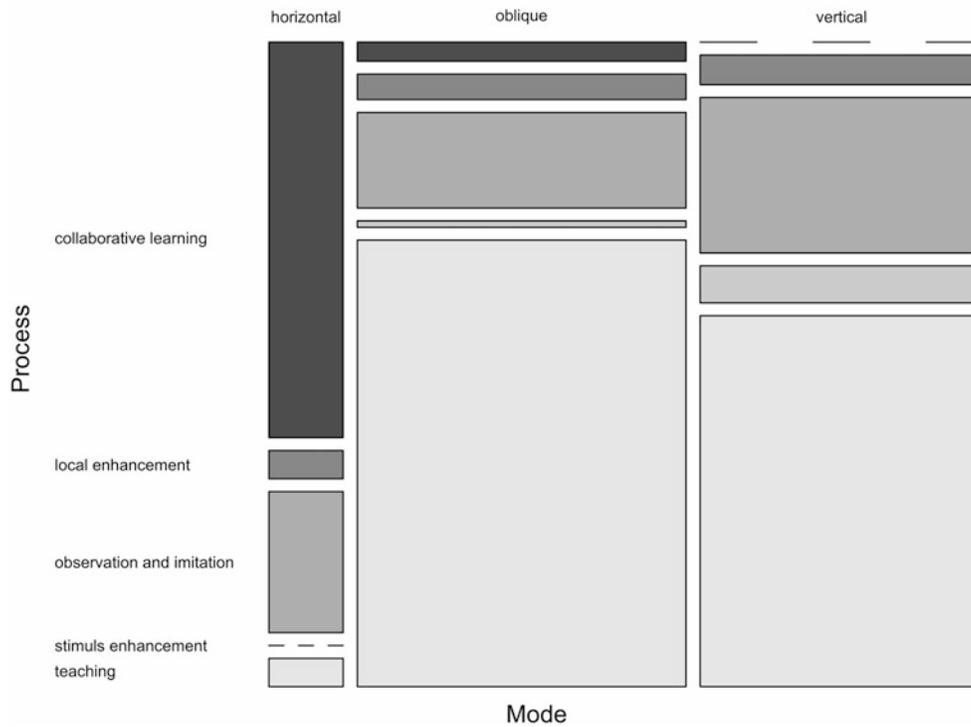


Fig. 2.1 Distribution of mode of social learning by process of social learning

We investigated the relationship between the age of the learner and the domain of cultural transmission across all domains (Table 2.4). Here we excluded the general evaluations of childhood and all ages as well as instances where the age of the learner was not specified. In infancy miscellaneous skills were the primary domain of culturally acquired content; early childhood was associated with learning in the subsistence skills and knowledge domain; the subsistence skills and knowledge domain also dominated middle childhood although to a lesser degree; adolescence was associated with cultural transmission in the religious skills and beliefs domain more so than others.

Table 2.5 displays the relationship between the age of the learner and the mode of cultural transmission within each domain. To examine developmental relationships, Tables 2.5 and 2.6 omit data with age coded as childhood, all ages, and unknown. In many cases frequencies were low and do not warrant reporting; however, a few interesting results emerge. In the subsistence skills and knowledge domain, oblique and vertical transmissions were approximately equivalent (20 and 21 instances, respectively) during childhood generally. During early childhood subsistence skills and knowledge-related cultural transmission were predominantly vertical (15 instances), whereas horizontal transmission (3) and oblique transmission (1) were relatively infrequent.

Table 2.4 Prevalence of domain frequencies by age of learner

Domains	Age evaluations			
	Infancy	Early childhood	Middle childhood	Adolescence
Subsistence skills and knowledge	2	22	12	9
Religious beliefs and practices	0	3	4	14
Language	1	1	0	0
Ecology	0	3	1	2
Miscellaneous skills	6	5	2	1
Manufacture	0	6	4	4
Cultural values and kinship	1	4	4	7
Age totals	10	44	27	37

During middle childhood there was a reduction in the relative importance of vertical transmission (7) with a slight increase in the importance of oblique transmission (4). This trend continues into adolescence where oblique transmission was the most frequent mode of subsistence-related cultural transmission, with oblique noted in five instances and oblique concerted noted twice. Vertical transmission was identified twice in adolescence. In the cultural values

Table 2.5 Relationship between age of learner and mode by cultural domain

Age-mode	Domains						
	Subsistence skills and knowledge	Religious beliefs and practices	Language	Ecology	Miscellaneous skills	Manufacture	Cultural values and kinship
Infancy, horizontal	0	0	0	0	0	0	0
Infancy, vertical	1	0	0	0	0	0	0
Infancy, oblique	1	0	1	0	4	0	1
Early childhood, horizontal	3	1	0	0	0	2	0
Early childhood, vertical	15	0	0	2	2	4	2
Early childhood, oblique	1	0	1	0	1	0	2
Middle childhood, horizontal	1	0	0	0	0	0	0
Middle childhood, vertical	7	2	0	0	1	2	3
Middle childhood, oblique	4	2	0	1	1	2	1
Adolescence, horizontal	0	0	0	0	0	0	0
Adolescence, vertical	2	1	0	1	0	3	2
Adolescence, oblique	7	13	0	1	1	1	5

and kinship domain, vertical transmission is the most frequent in the more general coding of childhood (17), with oblique (9) and horizontal (5) transmission following.

Table 2.6 depicts the relationship between the age of the learner and the associated processes of cultural transmission across all domains. Concerning the teaching process of cultural transmission, 48 % of codes were associated with the more general age classification of childhood. The next most frequent association with teaching was adolescence, which accounted for 16 % of all teaching codes. Teaching in middle childhood accounted for 12.9 % and in early childhood accounted for 8 % of all teaching codes. Observation and imitation was predominately linked to childhood generally (75 % of all observation and imitation codes); however, early childhood also stands being associated with 52 % of all observation and imitation codes.

Evaluations of social learning patterns in reference to sex were coded as male, female, or both, as well as general statements without specific reference to sex. The following results concerning sex differences exclude the both and general evaluation and exclusively evaluate instances of male-specific and female-specific social learning. Investigating relationships between male- and female-specific social learning carries implications for sex differences and sex-patterned aspects of culture among hunter-gatherers. Across the domains, a few were biased toward males. The religious beliefs and practices domain included 24 (86 %) instances of male-based social learning and 4 (14 %)

instances of female-based social learning. The subsistence skills and knowledge domain included 36 (58 %) references to male-specific social learning and 26 (42 %) references to female-specific social learning. The miscellaneous skills domain included 11 (73 %) instances of male-based social learning and 4 (27 %) instance of female-based social learning. The ecology domain was also male biased with five of seven (71 %) total occurrences specific to males. The manufacturing domain was relatively equally distributed between the sexes with 14 (52 %) concerning males and 13 (48 %) concerning females. Female social learning constitutes the majority within the cultural values and kinship domain with 12 instances (60 %) compared to 8 (40 %) for male-specific social learning.

Concerning modes of social learning, males were more likely to acquire cultural information horizontally, noted in 12 instances (75 %), and obliquely, noted in 49 instances (73 %). Vertical transmission was relatively equal between the sexes with 39 (53 %) instances of female-specific and 34 (47 %) instances of male-specific vertical transmission.

Across processes of social learning, collaborative learning (all types) was in favor of males with ten instances (83 %) compared to only two mentions of female-specific collaborative learning. Teaching also demonstrates a slight male bias across all subcategories. The sample included 65 (62 %) instances of male-specific teaching and 40 (38 %) instances of female-specific teaching. Observation and imitation was recorded equally

Table 2.6 Relationship between age of learner and process by cultural domain

Age, process	Domains						
	Subsistence skills and knowledge	Religious beliefs and practices	Language	Ecology	Miscellaneous skills	Manufacture	Cultural values and kinship
Infancy, observation and imitation	2	0	0	0	1	0	0
Infancy, collaborative learning	0	0	0	0	0	0	0
Infancy, teaching	0	0	1	0	4	0	0
Infancy, stimulus enhancement	0	0	0	0	1	0	1
Infancy, local enhancement	0	0	0	0	0	0	0
Infancy, individual learning	0	0	0	0	0	0	0
Early childhood, observation and imitation	10	1	0	1	2	5	0
Early childhood, collaborative learning	2	0	0	0	0	0	0
Early childhood, teaching	4	0	1	2	1	1	4
Early childhood, stimulus enhancement	4	0	0	0	1	0	0
Early childhood, local enhancement	2	0	0	0	0	0	0
Early childhood, individual learning	0	1	0	0	1	0	0
Middle childhood, observation and imitation	2	0	0	0	0	1	0
Middle childhood, collaborative learning	0	0	0	0	0	0	0
Middle childhood, teaching	9	4	0	1	2	3	4
Middle childhood, stimulus enhancement	0	0	0	0	0	0	0
Middle childhood, local enhancement	1	0	0	0	0	0	0
Middle childhood, individual learning	0	0	0	0	0	0	0
Adolescence, observation and imitation	0	0	0	0	0	2	0
Adolescence, collaborative learning	1	0	0	0	0	0	0
Adolescence, teaching	7	13	0	2	1	2	7
Adolescence, stimulus enhancement	0	0	0	0	0	0	0
Adolescence, local enhancement	1	0	0	0	0	0	0
Adolescence, individual learning	0	1	0	0	0	0	0

between males and females with 14 occurrences each. Local enhancement was also approximately equal with four instances of female-specific and three instance of male-specific local enhancement. Stimulus enhancement exhibits a male bias although there are few occurrences; of five occurrences of stimulus enhancement, four were specific to males.

## 2.5 Discussion

The most interesting finding from this study is the importance of teaching across a wide range of cultural domains among hunter-gatherers. Teaching is the most common process of social learning in each domain. In the context of

social learning, teaching has been defined as “as modification of one’s behaviour to facilitate learning of information, knowledge or skills in another” (Hewlett et al. 2011, p. 1169). Our operationalization of teaching is consistent with this definition. As previously discussed, cultural anthropologists have long downplayed the importance of teaching among hunter-gatherers (Lancy and Grove 2010; Mead 1930; Rogoff 1990; Rogoff et al. 2007). Western styles of formal education and concerted efforts by parents to teach their children in industrial settings are contrasted with a *laissez faire* approach toward development and instruction in traditional foraging populations (Lancy 2010). However, some authors have begun to deconstruct this long-standing distinction and have provided evidence against perspectives that promote the absence of teaching in small-scale societies (Hewlett et al. 2011; Klein 2015). Ultimately, teaching as defined in the social learning literature is likely a uniquely human trait and occurs only rarely among nonhuman animals if at all (Konner 2010). Teaching complex skills and ideas requires symbolic communication (Hauser et al. 2002; Pagel 2009; Pinker and Jackendoff 2005). Language and teaching are hallmarks of humanity and the idea that teaching is absent or lacking among hunter-gatherers is logically unsound and not supported by the ethnographic record (Kruger and Tomasello 1996; Tomasello 2009); this holds for our systematic study as well as other reviews of classic ethnographies and ethnographic settings (Hewlett et al. 2011; Konner 2010; Kruger and Tomasello 1996). Given the intimate nature of hunter-gatherer social life, it is not surprising teaching dominates social learning. Cooperative breeding necessitates teaching young children by both kin and non-kin (Burkart et al. 2009). Our results indicate a high cross-cultural prevalence and importance of teaching supporting many researchers in the field (e.g., Kruger and Tomasello 1996; Klein 2015; Hewlett et al. Chap. 3, this volume).

Observation and imitation remains critical, and several ethnographers noted parents encourage observational learning, demonstrating tasks with limited verbal instruction. Condon (1983) explains among the Copper Inuit, “Young boys... are more likely to be taken out hunting and trapping with their fathers, at which time they are instructed in the finer details of hunting, trapping, cold-weather camping, snowmobile repair, etc. Instruction in these areas... tends to be a nonverbal process. Parents do not verbally instruct their children at various tasks, but expect them to learn through observation. In fact, the persistent asking of questions is regarded as ‘childish’.” However, this history of downplaying the importance of teaching among foragers may reflect a shortsighted conception of teaching overlooking the role of various forms of teaching, such as natural pedagogy, which is hypothesized to be a psychological adaptation that has evolved across hominid

evolution (Csibra and Gergely 2011). The finding that teaching is more dominant in social learning among hunter-gatherers relative to observation and imitation could in part stem from the focus and attention of ethnographers. Teaching is an easily observable process that can garner the attention of the group. There are multiple forms of teaching that generally involve a process of interaction. Learning by observation may be less obvious. Despite the numerous accounts of observational learning in the ethnographic record, it may be that ethnographers simply documented teaching more frequently than observational learning. Additionally, ethnographers may have a cultural bias in favor of the importance of teaching given the emphasis of this process of learning in Western culture. Regardless, these results reveal uniformity in ethnographic accounts; teaching is important and frequent among hunter-gatherers and has likely been a common process of social learning cross-culturally and throughout human evolution (Csibra and Gergely 2011; Kruger and Tomasello 1996; Thornton and Raihani 2008).

Consistent with Hewlett et al. (2011), vertical transmission appears to be an important mode of cultural transmission among hunter-gatherers, especially in early childhood. However, oblique transmission is nearly as common as vertical transmission, and the aggregate of oblique transmission and the two subcategories, concerted and prestige bias, outranks vertical transmission by 6.4 %. This suggests across childhood and the life span oblique transmission dominates cultural learning. As cooperative breeders, we can expect oblique transmission to be important among hunter-gatherer groups (Hewlett et al. 2011). Ethnographic descriptions often mentioned a wide range of adults taking care to transmit cultural information. As soon as the child begins spending significant time outside the home and beyond the reach of parents, the frequency of oblique transmission increases. Concomitantly, collaborative horizontal transmission increases, primarily in the form of children’s play.

Surprisingly, prestige bias was infrequently mentioned and only in the subsistence skills and knowledge, miscellaneous skills, ecology, and manufacturing domains. Prestige-biased learning has been widely discussed and documented in observational research and is expected to be an important aspect of children’s social learning specifically and cultural adaptation generally (Chudek et al. 2011). Identifying and rewarding prestigious individuals, in a given cultural context, is an evolved psychological adaptation (Henrich and Gil-White 2001), and prestige is associated with greater reproductive success across many different populations (Hill 1984; Reyes-García et al. 2008). Perhaps the overarching and vestigial conception of egalitarian hunter-gatherers lacking prestige systems has contributed to ethnographers overlooking the importance of skill performance-directed learning. The ethnographic record does not highlight the

importance of prestige-biased social learning to the degree that observational research and the theoretical literature suggest.

Comparing the relative frequency of data in different cultural domains partially reveals the priority of ethnographers and the general content of the ethnographic record of social learning. The process of learning subsistence skills has been widely discussed in the ethnographic record. The foraging lifestyle has been of great interest and especially among cultural ecologists. The degree to which contemporary hunter-gatherers can inform us of evolutionary history has also promoted a focus on subsistence (Lee and DeVore 1968; Slocum 1975). Religious beliefs, manufacturing technology, and cultural values and kinship typically receive a section or chapter in the standard ethnographic format, and these domains are relatively equally discussed. It is surprising that the process of learning language is so rarely mentioned. Linguistics has long been a component of anthropology, and cognitive psychologists and symbolic anthropologists have focused heavily on the diversity and role of language; however, this is not reflected in this sample of ethnographies.

Subsistence skills and practices are highly vertically transmitted. Parents are the primary agents in the cultural transmission of subsistence skills during early childhood with other adults in the community participating in the cultural education of subsistence-based knowledge later in childhood and adolescence. This supports and helps to explain the perspective that subsistence skills remain stable across several generations (Hewlett and Cavalli-Sforza 1986). Additionally, transmitting knowledge about the local ecology and various manufacturing practices is predominantly the responsibility of the parents. Along with the subsistence domain, these are the only cultural domains in which vertical transmission is the most common. This suggests transmission of these skills and information occurs early and is highly conserved across generations, which is consistent with Zarger's findings on the nature of learning about the environment (Zarger 2010), but inconsistent with other research suggesting the acquisition of ethnobotanical knowledge is predominantly oblique (Reyes-García et al. 2009). This may be due to the wide geographic range of societies in this sample and variation in the importance of ecological and ethnobotanical knowledge.

The transmission of religious beliefs and practices is primarily from the community of adults to a younger generation and is often concerted in that many adults deliver a consensus cultural message; many initiation rituals fall into this category. Teaching, including teaching in the form of storytelling and demonstration, is the primary process by which children and adolescents acquire religious-based knowledge. Similarly, cultural values and knowledge concerning kinship systems and kin-specific behavior are most commonly transmitted obliquely. As children become

older and begin to spend more time away from their nuclear family, they begin to acquire ideological cultural information from a wide range of adults and older children. Learning religious beliefs may be distinct from subsistence-based and ecological knowledge, but is likely equally important to be a successful member of society and integrate with the wider community.

These results examine several theories of cultural transmission (Boyd and Richerson 1985; Cavalli-Sforza et al. 1982; Hewlett and Cavalli-Sforza 1986; Richerson and Boyd 2005) and provide a foundational reference for further research investigating specific domains and processes in specific cultural contexts. Despite the low frequency of particular modes or processes in this sample, our results speak to the suite of mechanisms of social learning. We emphasize that various modes and processes are not mutually exclusive and all are likely to be present in any human population. This study could be expanded to include more stratified traditional societies, in order to highlight the unique nature (or lack thereof) of hunter-gatherer social learning. We provide greater external validity to observational research and theoretical literature highlighting the importance of teaching across a wide range of cultures and cultural domains while also supporting the finding that vertical transmission is dominant early in life with various forms of oblique transmission being more important throughout life in hunting and gathering societies (Reyes-García et al. Chap. 4, this volume).

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