Teaching and Overimitation Among Aka Hunter-Gatherers

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Abstract

Cognitive psychologists indicate that teaching, language, and accurate imitation are distinct features of human cognition that enable rapid and precise acquisition of cultural beliefs and practices. This chapter examines two of the three proposed cognitive mechanisms that hypothetically enabled pronounced cultural diversity and complexity—teaching and accurate imitation. Both are either rare or do not exist in great apes but are hypothesized by researchers to be part of human nature and therefore universal. A limitation of most existing studies on these topics is that they have been conducted with Western children in laboratory settings. No studies on these topics have been conducted with active hunter-gatherers. This chapter describes two systematic studies with Aka hunter-gatherers of the Central African Republic. Videotapes of Aka 1-year-olds in naturalistic settings are used to evaluate whether or not one type of teaching, called natural pedagogy (NP), exists among foragers. The second study uses a standardized puzzle box with 4- to 7-year-old children to consider whether or not one form of accurate imitation, called overimitation, occurs at this age among the Aka, as it does among 90 % of Western children. Aka data supported the natural pedagogy hypothesis, but found that natural pedagogy was shaped by cultural context and that many other forms of teaching existed in infancy. The overimitation study questioned the age at which it is hypothesized to emerge in human children. Most Aka children used emulation rather than overimitation with the puzzle box, while most Aka adults used overimitation. Again, hunter-gatherer cultural context is suggested to impact the timing of its emergence in human development.

Keywords

Teaching • Overimitation • Hunter-gatherers • Aka • Ngandu • Social learning

3.1 Introduction

Understanding how children learn from others is a fundamental issue in several disciplines, including cultural anthropology, developmental psychology, and evolutionary biology. Tomasello et al. (1993) indicate that teaching, language, and accurate imitation are distinct features of human cognition that enable rapid and high-fidelity social learning. When features of culture are highly conserved, they stay in the population longer which increases the chance of an innovation or modification of a cultural belief or practice,

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H. Terashima, B.S. Hewlett (eds.), *Social Learning and Innovation in Contemporary Hunter-Gatherers*, Replacement of Neanderthals by Modern Humans Series, DOI 10.1007/978-4-431-55997-9_3

which in turn leads to greater cumulative culture (Enquist et al. 2010). Increases in cumulative culture amplify the number of socially transmitted and acquired beliefs and practices, which ultimately leads to an increasing importance of the three features. Simulation models indicate that transmission fidelity (measured by the loss rate of a belief or practice) is far more important than innovation for establishing and maintaining cumulative culture (Lewis and Laland 2012).

This chapter examines two of the three proposed cognitive mechanisms of social learning that hypothetically enabled pronounced cultural diversity and complexity—teaching and accurate imitation. Research by developmental psychologists and evolutionary biologists indicates that both of these cognitive mechanisms do not exist in great apes, our closest living relatives, and hypothesize that they are innate biologically based features of human cognition (Whiten 2011). A limitation of existing research on both cognitive mechanisms is that results are based largely upon studies with children from WEIRD (Western, educated, industrial, rich, democratic) cultures (Henrich et al. 2010), often in child development laboratories. This chapter examines whether or not one form of teaching, called natural pedagogy, and one form of accurate imitation, called overimitation, exist in Aka hunter-gatherers of the Congo Basin. The chapter summarizes, integrates, and expands upon the authors' studies on these topics (Hewlett and Roulette 2016; Berl and Hewlett 2015).

3.1.1 The Aka

The Aka are one of about 15 ethnolinguistic groups of Congo Basin hunter-gatherers (Hewlett 2014). Approximately 40,000 Aka live in northern Republic of the Congo and southern Central African Republic and about 2,000 live in and around the study area. The Aka live in mobile groups of 25–35 people and rely upon a wide variety of hunting and gathering techniques for day-to-day subsistence. The Aka have multidimensional social-economic relationships with Ngandu and other farming ethnic groups. As with several forager groups, three related foundational schemas—ways of thinking that pervade many domains of life—include egalitarian ethos, autonomy, and sharing (see Chap. 1 for more details). An egalitarianism ethos devalues hierarchical ranking, including political, age, or gender ranking. Chiefs have very limited power or influence over others, and men and women as well as young and old are viewed as relatively equal and have similar access to resources. Respect for individual autonomy is also a core value. One does not coerce or tell others what to do, including children. Giving or sharing is also a pervasive way of thinking in Aka life; they share 50–80 % of what is acquired, they share it with everyone in camp, and they share it every day. Sharing of childcare is also extensive; for instance, 90 % of Aka mothers report that other women nurse their young babies (Hewlett and Winn 2014).

3.2 Does Natural Pedagogy Exist in Hunter-Gatherers?

3.2.1 The Problem

Cultural anthropologists and cross-cultural psychologists consistently report that teaching does not exist or is rare in small-scale cultures (Lancy and Grove 2010; Gaskins and Paradise 2010; Rogoff 2011). David Lancy (2010) is particularly forceful in rejecting the notion that teaching occurs in small-scale cultures. A recent review (2010) article "Learning 'From Nobody': The Limited Role of Teaching in Folk Models of Children's Development" concludes that "Teaching—even if defined, minimally, as self-conscious demonstration—is rare in the accounts of anthropologists and historians. . .Teaching has largely been superfluous in the process of cultural transmission throughout human history" (2010, p. 97). Lancy does not define teaching, but uses the term to refer to "student-centered, developmentally appropriate instruction by dedicated adults" (ibid), generally associated with Western schools.

Cultural anthropologists indicate that teaching is rare because children in small-scale cultures acquire a wide variety of knowledge and skills easily, almost automatically and without effort, and nobody fails. They use the term "osmosis" to characterize social learning in small-scale cultures (Spindler 1974; Gaskins and Paradise 2010). Extensive learning occurs without teaching and most cultural learning occurs through observation and imitation (Gaskins and Paradise 2010) and participation in adult activities (Paradise and Rogoff 2009).

The view that teaching is rare in small-scale cultures is dramatically different from the research of cognitive psychologists. They hypothesize that one form of teaching, called natural pedagogy (NP), is an innate and relatively unique feature of human cognition (Gergeley and Csibra 2006, Csibra and Gergeley 2006, 2011). Natural pedagogy is when an individual (the teacher) provides explicit signals (e.g., pointing, motherese, child-directed speech, infant's name, or eye gaze) of generalizable (to other situations or individuals) knowledge to another individual (the learner) that can read and interpret the content of the signals (Csibra and Gergely 2006, p. 5). They hypothesize that NP evolved to solve the recurring problem of faithfully transmitting opaque knowledge (e.g., functions) about tools to the learner. Learners evolved to pay attention to these

"ostensive" cues, and teachers evolved the skills to convey important information to learners by using these cues. The researchers indicate that other learning processes such as observation, imitation, emulation, and participation were not sufficient for learning tasks and behaviors that were opaque to the learner.

Part of the problem between the two perspectives is how teaching is conceptualized and defined. Cultural anthropologists and cross-cultural psychologists associate teaching with Western formal education systems; it is student centered, takes place in a specific place, and is primarily verbal. Cognitive psychologists on the other hand define teaching as "an intentional activity that is pursued in order to increase the knowledge (or understanding) of another who lacks knowledge, has partial knowledge or possesses a false belief" (Strauss and Ziv 2012, p. 187). Theory of mind (i.e., attribution of false beliefs) is a key component to many definitions of teaching in education and developmental psychology (Tomasello et al. 1993; Strauss and Ziv 2012), but Gergely and Csibra (2006) indicate it is not necessary to have theory of mind for NP to occur. This chapter uses a minimal definition of teaching: an individual modifies her/his behavior to enhance learning in another (see Skerry 2013; Kline 2014, and Chap. 1 of this volume for similar definitions). We focus on one type of teaching, natural pedagogy, but also discuss other types observed in our study.

3.2.2 Methods

Gergely and Csibra's research on NP was conducted with older infants in laboratory settings. Likewise, this study focused on older infants but in a naturalistic setting. Ten (five male, five female) Aka 12–14-month-old infants were videotaped for 1 h in a naturalistic setting (usually in or near the camp). Infants came from nine different Aka camps within 3 km of the village. Caregivers and others in camp were asked to maintain normal activities as best as possible, but infants had to be awake, and parents were asked to keep infants in public (not in a hut) as a condition of Institutional Review Board approval, which was not difficult because families spend most of the day outside of their homes. Researchers have conducted infant focal follow observations for several years with Aka in the study area (Hewlett et al. 1998) so filming was not that unusual for parents and community members. The video camera was set up in camp for about 30 min before filming started to help diminish attention paid to the camera by the infant and camp members. We wanted to return to the field to increase the sample size of the study but a civil war in the Central African Republic made it impossible.

The first author made the videos and watched two of the videos carefully to establish a tentative coding scheme. Videos were sent to Gyorgy Gergely to verify whether the observations and coding of natural pedagogy were consistent with how it was defined in their laboratory studies. Hewlett and Roulette independently coded all tapes. They discussed discrepancies in coding and easily resolved differences. Finally, an individual unfamiliar with the hypotheses was trained with the codes and then coded two randomly selected videotapes (see Hewlett and Roulette, in review, for more details about methods). The outsider and researchers agreed on the coding of natural pedagogy and other forms of teaching to a satisfactory degree (Cohen's $k = 0.734$).

3.2.3 Results

Natural pedagogy (NP) regularly occurs in the lives of Aka infants. Eight of the ten videotapes had at least one instance of NP and it took place an average of 4.1 times per hour (3.5 SD). Teaching episodes that included NP were relatively short with 47 % of the episodes lasting less than 3 s. Considerable variability existed; two infants did not experience NP during the 1 h of videotaping, while one infant had ten exposures to this type of teaching during the hour videotape. NP was associated with the transmission of a broad range of skills and knowledge including how to use a knife to cut, how to dig for roots/yams, how to prepare food, how to build a fire, how to cook on a fire, and how to hold a baby. It is important to point out that various skills, knowledge, and information were transmitted via NP, but we did not systematically evaluate the effects of the transmission.

While results were consistent with the NP hypothesis, the cognitive mechanism takes place within a cultural context. Aka caregiver and infant interactions relied more on touch, physical proximity, and pointing, and less on verbal exchange, which is common in Western laboratory-based samples. Infants were often held during NP and verbal explanations and interactions were rare and no instances of motherese were observed.

Natural pedagogy was not the only type of teaching observed in the videotapes. Table 3.1 summarizes the different types of teaching, as defined above, observed in the videotapes. The data indicate that the Aka infants experienced 16.9 instances of teaching per hour on average. Natural pedagogy was the most common but infants received various forms of teaching from others.

Table 3.1 Definitions and mean frequencies per hour of different types of teaching (as defined in chapter) observed with Aka infants

Type of teaching	Definition	Mean frequency per hour
Natural pedagogy	Caregiver points, uses eye contact, child-directed speech, infant name, or other cues to draw the infant's attention and provide information about a skill (how to use knife, machete, how to dig stick, and how to climb a tree) or knowledge (e.g., how to share, where to find roots)	4.1
Positive feedback	Caregiver smiles, makes positive sounds (*eee*), or dances in response to infant's good performance of a skill	1.2
Negative feedback	Caregiver makes displeasing comments or sounds or moves infant's body when the infant slaps, threatens, hits another, or starts to do something that may be dangerous (pointing knife at person, climbing a tree)	2.7
Redirect	Caregiver redirects infant to another location or activity because he/she does something dangerous (going into fire, tipping hot pot on fire) or inappropriate (tries to step into the mortar)	1.3
Opportunity scaffolding	Caregiver provides infant with an object (e.g., knife, machete, digging stick) and learning opportunity. Caregiver may watch/monitor after providing the object, but does not provide cues about how to use	0.9
Demonstration	Caregiver demonstrates how to use an object or tool (e.g., machete, knife, etc.). Object may be given to infant after demonstration; includes demonstration by moving infant's body	3.0
Task assignment	Caregiver gives infant a task (e.g., to bring something across the camp)	1.4
Move body	Caregiver moves infant's body to show her/him how to dance or what not to do (the movement must convey information)	1.7
Verbal instruction	Caregiver provides some verbal explanation (making sounds not enough) about a task or knowledge to the infant	0.6

Natural pedagogy often occurred with other forms of teaching, such as demonstration or positive feedback; NP took place with other types of teaching in 34 out of the 41 times it occurred. Only seven times did it happen on its own. NP co-occurred with demonstration in 59 % of cases, verbal explanation in 12 % of cases, and positive feedback in 15 % of cases.

Mothers were holding their infants most of the time during videotaping, so it was not surprising that mothers provided 70 % of the NP cases, while fathers, other adults, older children, and younger children provided NP in 12 %, 10 %, 5 %, and 2 % of the cases, respectively.

Correlational analysis found that a significant relationship existed between the frequency an infant experienced natural pedagogy and the frequency he/she imitated the teacher ($r^2 = 0.47, p = 0.029$). A relationship did not exist between the frequency of imitation and the frequency of demonstration or between the frequency of imitation and the total number of teaching episodes that an infant experienced. This suggests that natural pedagogy plays an important role in imitation. Infants did observe and imitate without NP, e.g., observing adults or children make a fire or use a knife and then imitating the actions, but the majority (about 70 %) of the cases of imitation occurred in the context of NP. One has to be extremely cautious in interpreting correlational analyses because the sample size and the number of observation hours are relatively small and correlation does not mean causation.

3.3 Does Overimitation Exist in Hunter-Gatherers?

3.3.1 The Problem

Recent interdisciplinary research on social learning has focused on by what means and under which conditions humans and other animal species utilize social learning (Laland 2004; Rendell et al. 2010,2011), the most basic of these being imitation and emulation. Following Whiten et al. (2009), imitation is defined as a focus by the observer on the reproduction of the form of modeled actions rather

than the result or goal of those actions, and conversely, emulation is defined as a focus on reaching the modeled outcome rather than the details of the actions that accomplish that outcome. The phenomenon of "overimitation," a term coined by Lyons et al. (2007), was first observed by Horner and Whiten (2005) in a study investigating whether children from two nursery schools in the United Kingdom and captive chimpanzees could switch between imitative and emulative strategies given the availability of visual information about the causal relationships of a series of demonstrated actions. Some of the actions shown were causally relevant and necessary to obtain the end reward, but others were irrelevant and could be omitted by using emulation, thereby increasing the efficiency of the procedure and reaching the reward more quickly. They found that the chimpanzees did so but that the children—even in the presence of visual information about the causality of their actions—continued to imitate the irrelevant demonstrated actions rather than switching to an emulative strategy. Overimitation is thus defined as the copying of causally irrelevant actions in the presence of clear causal information.

Subsequent studies have observed overimitation in Western children under a variety of experimental conditions. It appears to develop between the ages of 18 months and 3 years (Nielsen 2006; McGuigan and Whiten 2009; Gardiner et al. 2011), increases through ages 3–5 (Horner and Whiten 2005; Lyons et al. 2007; McGuigan et al. 2007; Nielsen and Tomaselli 2010), and is observed at even higher rates in adults (McGuigan et al. 2011; Flynn and Smith 2012). Many of these studies have attempted to tie overimitation into current theory on the cultural and biological evolution of our species, as a nonselective copying strategy that facilitates rapid adoption of the vast amount of causally opaque cultural knowledge available during childhood (Nielsen and Susianto 2010; Nielsen and Tomaselli 2010; Lyons et al. 2011). Nielsen and colleagues have made the assertion that overimitation is a "universal human trait" (Nielsen and Susianto 2010, p. 156).

To date, there have been only two studies of overimitation conducted with non-Western groups. Nielsen and Tomaselli (2010) investigated overimitation in the !Xóõ, ǂKhomani, !Xun, and Khwe San peoples of Botswana (!Xóõ) and South Africa (ǂKhomani, !Xun, and Khwe), while Nielsen et al. (2014) extended this research to two groups of Aboriginal Australians, the Yanyuwa and the Garrwa in the Northern Territory, and performed additional work with the San groups from the previous study. Both studies found little difference between the indigenous populations and a group of Western children in Brisbane, Australia, in the frequency or manner with which children overimitate.

However, there is a good reason to believe that the San and Aboriginal Australians involved in these studies are no longer actively engaged in a way of life typical of hunter-gatherers or other small-scale cultures. Robins (2003) describes the present-day ǂKhomani San as "a group of superexploited and hypermarginalized ex-farm workers." The San people are a loose affiliation of indigenous groups that have had continuous exposure to Western ideas, values, and technology for many decades, and this life beside and within Western society has fundamentally altered their respective cultures (Robins 2001, 2003; Robins et al. 2001). In all cases, the San have been made to adapt to political, social, economic, and religious pressures exerted by Western influences. Aboriginal Australian groups have been subject to similarly intense pressures throughout their history of contact and conflict with Western cultures (Robins et al. 2001).

3.3.2 Methods

Previous studies indicated that almost all Western children overimitate by 4 years of age (McGuigan et al. 2007). Consequently, our sample included 28 Aka children and 29 Ngandu children from 4 to 7 years of age (Aka, $M = 5.41$, $SD = 1.15$; Ngandu, $M = 5.31$, $SD = 0.94$). We also recruited 14 Aka adults from 20 to 38 years of age ($M = 28.43$, $SD = 6.00$) to compare children and adults; studies in Western contexts indicate adults also overimitate (McGuigan et al. 2011). We wanted to extend the study to a sample of Ngandu adults but a civil war in the Central African Republic made this impossible. Sex representation was equal or approximately equal in all groups (Aka children: 14M, 14F; Ngandu children: 14M, 15F; Aka adults: 7M, 7F).

The Aka were described previously. The Ngandu, farming neighbors of the Aka, were included in this study to evaluate the impact of farming and regular formal schooling on the frequency of overimitation. The Ngandu are a group of Bantu-speaking farmers that live in villages of 50–200 individuals and cultivate manioc, corn, plantains, and peanuts. They exchange some of their domesticated crops for meat and other forest products from the Aka. Women

plant, maintain, and harvest the fields and provide the majority of dietary calories, while men fish, hunt, and trade. Unlike the Aka, political, age, and gender hierarchy pervade Ngandu life. They have strong chiefs, women are expected to defer to the requests of men, and the young are expected to show deference and respect to elders, be they parents or older brothers or sisters. Most Ngandu children attend elementary schools in the village, and a small percentage of older children go to high schools outside of the village.

The puzzle box used in this study was a transparent polycarbonate box similar to those used by previous researchers, e.g., Horner and Whiten (2005) and McGuigan et al. (2007), differing only in the top door mechanism. Two holes (each 2 × 2 cm) allowed entry into the box, one on the top-facing side and one on the front-facing side. The front hole was covered by a door with a small knob and allowed entry by sliding the door to either side or by lifting it upward and outward. The top hole was covered by a sliding door with an open notch and could be slid to either side. A 22 cm long aluminum tool with two short knobs protruding from one end was used to interact with the box and retrieve the reward, which was stored in an opaque black rectangular prism connected to the inside of the front hole. The top hole led to a chamber with a transparent barrier separating it from the rest of the box and the reward. Thus, any actions performed on the top of the box or on any external surface aside from the front door were causally irrelevant to obtaining the reward. Accordingly, opening the front door and obtaining the reward were judged to be causally relevant (see Berl and Hewlett 2015 for a photo of the device and more details on methods).

Participants in each group were randomly assigned to receive a demonstration or to receive no demonstration, such that roughly one third of the participants in each group were assigned to the no-demonstration condition (Aka children, $N = 9$; Ngandu children, $N = 9$; Aka adults, $N = 4$). In the demonstration condition, participants observed a 30- to 35-year-old adult married male model from their ethnic group performs a sequence of actions on the box that resulted in the retrieval of the reward. Participants in the no-demonstration condition had the box and tool placed in front of them without any actions demonstrated by the model.

Tests were conducted in locations familiar to the participants. Aka children and adults were tested in a camp house or on a nearby forest trail and Ngandu children were tested in a village home. The participant sat next to the model, with the apparatus and tool placed in front of and midway between the model and participant. In the demonstration condition, the model said "Watch me" and demonstrated the complete sequence three times, reloading the box out of view of the participant after each demonstration. He then placed the box and tool in front of the participant, said "Your turn," and did not interact with the participant for the remainder of the test.

The demonstrated sequence consisted of six actions, with the first four being causally irrelevant and the final two being causally relevant to the goal of obtaining the reward: tap the right side of the box ("TR," *irrelevant*), tap the left side of the box ("TL," *irrelevant*), slide the top door ("ST," *irrelevant*), tap the barrier inside the top door ("TT," *irrelevant*), slide the front door ("SF," *relevant*), and retrieve the reward ("RR," *relevant*). Thus, the complete demonstrated sequence in order was TR, TL, ST, TT, SF, and RR. Participants were given up to 1 min to interact with the apparatus and, if they did so, 2 min to retrieve the reward.

In the no-demonstration condition, after the box and tool were placed in front of and between the model and participant, the model said, "Can you find the treat?" and did not interact with the box while feigning disinterest for the rest of the test. Circumstances were otherwise identical to the demonstration condition.

All tests were recorded on video for coding and review. Trials were coded in randomized order. Coding of tests included only the six demonstrated actions; other actions were noted for the purpose of determining copying fidelity but were not coded as relevant or irrelevant due to their inherent ambiguity of purpose.

Four different scores were calculated: (a) the number of irrelevant actions performed, (b) an irrelevant imitation score (the number of tool or hand insertions into the top irrelevant hole divided by the total number of insertions into both the top irrelevant and front relevant holes), (c) an irrelevancy quotient (total number of irrelevant actions divided by the total number of irrelevant and relevant actions), and (d) a fidelity quotient (a fidelity score, defined as the longest string of actions performed in the same order as the demonstration, divided by the maximum possible fidelity score [6 for this study]).

3.3.3 Results

First, comparisons between participants that received the demonstrations and those who did not found that participants in all groups who observed the demonstrations were much more likely to exhibit irrelevant actions than those who did not ($t = 3.23$, $p = 0.004$).

Second, Fig. 3.1a–d summarizes the results from the three groups of participants that observed the demonstrations: the reproduction of irrelevant actions (1a), irrelevant imitation

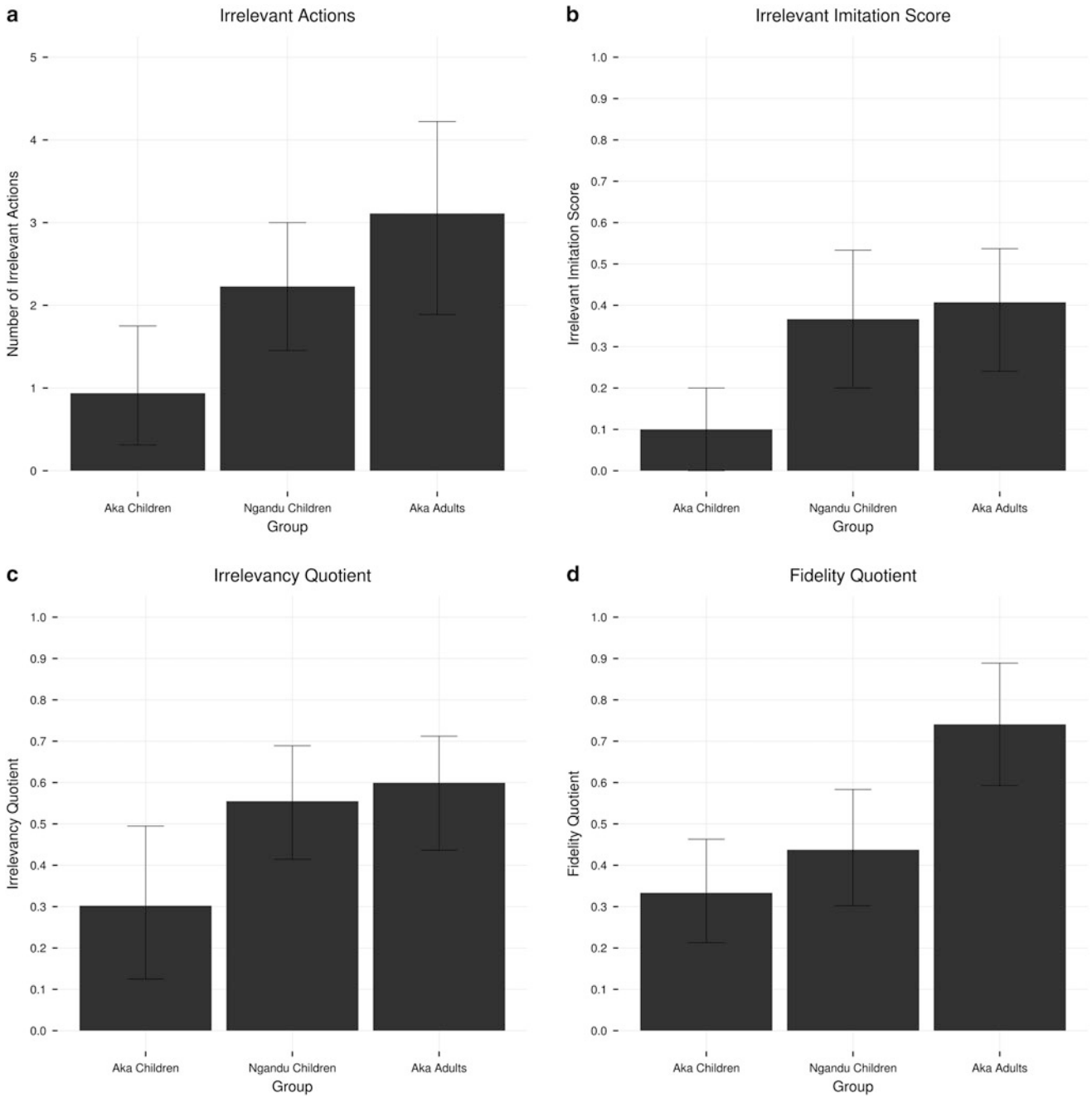

Fig. 3.1 (**a**) Number of irrelevant actions. (**b**) Irrelevant imitation score. (**c**) Irrelevancy quotient. (**d**) Fidelity quotient

scores (1b), irrelevancy quotients (1c), and fidelity quotients (1d). Finally, Table 3.2 provides an overview of the statistical analyses of each of the four above measures. The figures and statistical analysis indicate that Aka children were the least likely to overimitate and had the lowest fidelity in copying the demonstrator. Conversely, Aka adults were the most likely to overimitate and scored especially high on the fidelity score. The statistically significant differences were primarily between Aka children and adults. Ngandu children were intermediate and were not statistically different from Aka children or adults in three of the four measures. No statistically significant sex differences were found on any of the measures.

Table 3.3 is particularly informative because it shows that 60 % of the Aka children that found the treat used emulation rather than overimitation. This means that the majority of Aka children watched the demonstration but ignored all of the irrelevant actions and went directly to the opening with the treat. By comparison, Ngandu children used emulation 15 % of the time and Aka adults used it 11 % of the time. The percentage of Aka children that used emulation rather than overimitation is the highest percentage of children at this age of any population that has been studied thus far. As mentioned above, previous studies indicate most children (90+ percent) used overimitation by this age.

Table 3.2 Statistical analysis of data in Fig. 3.1a–d

Number of irrelevant actions						
	ANOVA			Tukey's HSD		
	d.f.	F	Sig.	AC-NC	AC-AA	NC-AA
Group	2	3.71	*	n.s.	**	n.s.
Sex	1	1.25	n.s.			
Irrelevancy quotient						
	ANOVA			Tukey's HSD		
	d.f.	F	Sig.	AC-NC	AC-AA	NC-AA
Group	2	4.52	*	n.s.	n.s.	n.s.
Sex	1	0.2	n.s.			
Irrelevant imitation score						
	ANOVA			Tukey's HSD		
	d.f.	F	Sig.	AC-NC	AC-AA	NC-AA
Group	2	4.50	*	*	*	n.s.
Sex	1	0.62	n.s.			
Fidelity quotient						
	ANOVA			Tukey's HSD		
	d.f.	F	Sig.	AC-NC	AC-AA	NC-AA
Group	2	6.27	**	n.s.	**	*
Sex	1	0.07	n.s.			

n.s. not significant, *AC* Aka children, *NC* Ngandu children, *AA* Aka adults
** = $p < 0.01$, * = $p < 0.05$

Table 3.3 Percentage of successful (obtained treat) individuals that utilized overimitation or emulation strategy

	Overimitation		Emulation		Fisher's Exact		
	n	%	*n*	%	AC-NC	AC-AA	NC-AA
Aka children	6	40.00	9	60.00	*	*	n.s.
Ngandu children	11	84.62	2	15.38			
Aka adults	8	88.89	1	11.11			
Total	25	67.57	12	32.43			

n.s. not significant, *AC* Aka children, *NC* Ngandu children, *AA* Aka adults
* = $p < 0.05$

3.4 Discussion and Conclusions

3.4.1 Teaching

This is the first study to test the natural pedagogy hypothesis (Gergely and Csibra 2006) in a hunter-gatherer culture. Natural pedagogy regularly occurred during Aka hunter-gatherer infancy and was associated with the transmission of a broad range of skills and knowledge. Natural pedagogy takes place within a cultural context, and Aka caregiver and infant sensitivity and interactions relied on touch, physical proximity, and pointing and less on verbal exchange or motherese, which are common in Western laboratory-based studies.

Aka infants observed and imitated skills and behaviors they observed in the community, but they were more likely to imitate in the context of NP where caregivers briefly drew the infant's attention to particular objects or events. This questions generalizations from cultural anthropologists that observation, imitation, and participation, without any type of teaching, are the primary processes of learning.

This chapter did not discuss the general contexts of social learning among the Aka (see Chap. 1 in the book and Hewlett et al. 2011 for details), but the Aka forager way of life can impact the types, frequencies, and the nature of teaching. The culturally constructed niches of Aka hunter-gatherers could amplify the effectiveness of NP and other forms of teaching. Intimate living, multiple care, extensive giving, egalitarian ethos, and the value of autonomy can potentially contribute to: high levels of trust between the "teacher" and "student," playful NP episodes, infant-initiated NP episodes, and intimate knowledge and sensitivity between teacher and student. The combination of these features could contribute to highly efficient teaching and rapid learning. The impact and effects of the cultural niche were not directly evaluated in this study. It will be important to do this in future studies.

NP and other forms of teaching exist in Aka infancy, but the frequency, nature, and types of teaching observed in infancy appear to decline dramatically by middle childhood. Boyette and Hewlett (2015) indicate that 4- to 16-year-old

Aka children receive two to four teaching events per day and that there is a general decline in the frequency of teaching with age. BL Hewlett (2012) documented several forms of teaching in adolescence, and Hewlett et al. (2011) observed several instances of teaching during decades of fieldwork with foragers, but neither of these studies examined the frequency of teaching at various ages.

NP and other forms of teaching can enhance efficient high-fidelity learning, but it can have a downside. Research by Bonawitz et al. (2011) shows that teaching can limit what is learned. Their laboratory studies examined children's learning and exploration of toys with opaque functions. When a teacher provided a demonstration of one function of a toy with multiple functions, the children focused almost exclusively on that function and did not explore other functions. Children that did not receive a demonstration were more likely to explore and discover multiple functions of the toy. This may be instructive, in particular, in a hunter-gatherer context, where flexibility and autonomy are central to adapting rapidly to resource availability and social conflicts, and may help to explain why teaching is relatively rare after infancy.

3.4.2 Overimitation

This was also the first study to examine overimitation in an active hunter-gatherer group. Contrary to all results in previous studies with children in WEIRD cultures, the majority of 4- to 7-year-old Aka forager children were more likely to use emulation rather than overimitation. On the other hand, results with Aka adults as well as the farming neighbors of the Aka, the Ngandu, were more consistent with previous studies. Overimitation does not universally emerge in early childhood, and our data suggest it may emerge later in life in hunter-gatherer cultures.

Why did Aka children emulate rather than overimitate? Several factors may have influenced the results. First, egalitarianism and respect for autonomy of individuals are foundational schema among the Aka and most foraging cultures (Lee and Daly 2004). One aspect of egalitarianism means that relatively equal status exists between individuals of different ages. Deference and respect of elders (parents, older adults, or siblings) are minimal. Respect for autonomy means that individuals seldom try to impose their ways onto others. This includes parents telling children what to do. These core values mean that the Aka children may not have viewed the adult demonstrator of the puzzle box as a person with authority/status and that their strong sense of autonomy led them to disregard irrelevant actions to obtain the treat. Consistent with this interpretation are studies in WEIRD cultures that indicate children are less likely to overimitate if the demonstrator is the same age or younger than the child (McGuigan et al. 2007).

Second, the culturally constructed living environments of the Aka and Western children are dramatically different. Young Aka children are given knives, machetes, baskets, axes, and other implements that are used on a daily basis by many people around them and where function is easy to observe. Western children, on the other hand, are given a wide variety of toys, sometimes with multiple functions, that are not used by adults in the environment, where it is often difficult to understand how to use without some instruction. Western children may be more inclined to overimitate early in life due to these different learning environments.

Why did Ngandu children overimitate? The Aka and Ngandu are both small-scale cultures, but substantial differences existed in children's overimitation rates. Some of the differences may be due to foundational schema mentioned above. In contrast to the Aka, age hierarchy is strongly enforced among the Ngandu. A child is expected to show deference and respect to anyone older than him or her. For instance, if a child does not listen to or respond to a parent's request, he or she will be yelled at or hit. The Ngandu also have formal schools. Most Ngandu parents attended school for at least a few years, and most of the Ngandu children in this study had either started to attend or had regularly been around a formal school environment. Ngandu children may have overimitated at higher rates than Aka children because they viewed the demonstrator as someone with authority and status, like a parent or school teacher, and that they should copy the irrelevant actions.

Why did Aka adults overimitate? One might predict more emulation with the puzzle box with Aka adults because of the strong autonomy of individuals and the adults in the study were similar in age to the demonstrator, but this was not the case: Aka adults overimitated and copied the sequence of irrelevant actions more precisely than both groups of children. We hypothesize that adults overimitated because the complexity of skills and knowledge that men and women need to learn for adult survival increases with age. For instance, females do not begin to weave baskets and men do not start to make and hunt with crossbows and spears until adolescence. Initiation ceremonies and other ritual activities also occur and increase during adolescence. Several of the skills and knowledge acquired in adolescence are more complex and their functions are often opaque to the learner. Further study is needed, but based upon what we know about what skills and knowledge are acquired at what ages in foraging cultures (see Dira and Hewlett, Chap. 6, this volume, for discussion of spear hunting), overimitation and high-fidelity imitation are likely to be particularly pronounced in early adolescence.

3.4.3 Final Comments

Both natural pedagogy and overimitation exist among hunter-gatherers, but they are expressed in substantially different times and ways than in WEIRD cultures. The study of natural pedagogy was consistent with the timing and general predictions of Csibra and Gergely (2011), while the study of overimitation questioned studies that suggested it is a human universal in early childhood. Both studies had several limitations, e.g., the teaching study was limited to infants and did not measure precisely what the infant learned, the overimitation study did not include children of other ages or Ngandu adults, and sample sizes in both studies were small, but both studies indicate that it is essential to conduct more research with foraging and other small-scale cultures in order to comprehend the development and diversity of human cognition and cultural learning.

Acknowledgments We want to sincerely thank the Aka families for allowing us into their lives and home. They tolerated our strange studies and provided extensive hospitality. We also appreciate the financial support of the Japanese Society for the Promotion of Science (H. Terashima, P.I.) and the Leverhulme Trust (U. K. K. Bard, P.I.).

References

Berl REW, Hewlett BS (2015) Cultural variation in the use of overimitation in the Aka and Ngandu of the Congo Basin. PLoS ONE 10, e0120180. doi:10.1371/journal.pone.0120180

Bonawitz E, Shafto P, Gweon H, Goodman ND, Spelke E, Schultz L (2011) The double-edged sword of pedagogy: instruction limits spontaneous exploration and discovery. Cognition 120:322–330

Boyette AH, Hewlett BS (2015) Teaching in daily life across childhood (4 to 16 years) among central African foragers and farmers. Paper presented at the annual meeting of the Society for Research in Child Development, Philadelphia, Pennsylvania, USA

Csibra G, Gergely G (2006) Social learning and social cognition: the case for pedagogy. In: Munakata Y, Johnson MH (eds) Processes of change in brain and cognitive development: attention and performance. Oxford University Press, Oxford, pp 249–274

Csibra G, Gergely G (2011) Natural pedagogy as evolutionary adaptation. Philos Trans R Soc B Biol Sci 366:1149–1157

Enquist M, Strimling P, Eriksson K, Laland K, Sjostrand J (2010) One cultural parent makes no culture. Anim Behav 79(6):1353–1362

Flynn E, Smith K (2012) Investigating the mechanisms of cultural acquisition: how pervasive is overimitation in adults? Soc Psychol 43:185–195

Gardiner AK, Greif ML, Bjorklund DF (2011) Guided by intention: preschoolers' imitation reflects inferences of causation. J Cogn Dev 12:355–373

Gaskins S, Paradise R (2010) Learning through observation in daily life. In: Lancy DF, Bock J, Gaskins S (eds) The anthropology of learning in childhood. Alta Mira Press, Lanham, pp 85–118

Gergely G, Csibra G (2006) Sylvia's recipe: the role of imitation and pedagogy in the transmission of human culture. In: Enfield NJ, Levinson SC (eds) Roots of human sociality: culture, cognition, and human interaction. Berg, Oxford, pp 229–255

Henrich J, Heine SJ, Norenzayan A (2010) The weirdest people in the world. Behav Brain Sci 33:61–83

Hewlett BL (2012) Listen, here is a story: ethnographic life narratives of Aka and Ngandu women of the Congo Basin. Oxford University Press, New York

Hewlett BS (2014) Hunter-gatherers of the Congo Basin: cultures, histories and biology. Transaction, New Brunswick

Hewlett BS, Roulette CJ (2016) Teaching in hunter-gather infancy. Royal Society Open Science 3: 150403.

Hewlett BS, Winn S (2014) Allomaternal nursing in humans. Curr Anthropol 55:200–229

Hewlett BS, Lamb ME, Shannon D, Leyendecker B, Schölmerich A (1998) Culture and early infancy among central African foragers and farmers. Dev Psychol 34:653–661

Hewlett BS, Fouts HN, Boyette AH, Hewlett BL (2011) Social learning among Congo Basin hunter-gatherers. Philos Trans R Soc B Biol Sci 366:1168–1178

Horner V, Whiten A (2005) Causal knowledge and imitation/emulation switching in chimpanzees (Pan troglodytes) and children (Homo sapiens). Anim Cogn 8:164–181

Kline MA (2014) How to learn about teaching: an evolutionary framework for the study of teaching behavior in humans and other animals. Behav Brain Sci. doi:a0.1017/S0140525X14000090

Laland KN (2004) Social learning strategies. Learn Behav 32:4–14

Lancy DF (2010) Learning 'from nobody': the limited role of teaching in folk models of children's development. Child Past 3:79–106

Lancy DF, Grove MA (2010) The role of adults in children's learning. In: Lancy DF, Bock J, Gaskins S (eds) The anthropology of learning in childhood. AltaMira Press, Lanham, pp 145–180

Lee RB, Daly R (2004) Cambridge encyclopedia of hunters and gatherers. Cambridge University Press, Cambridge UK

Lewis HM, Laland KN (2012) Transmission fidelity is the key to the build-up of cumulative culture. Philos Trans R Soc B Biol Sci 367 (1599):2171–2180

Lyons DE, Young AG, Keil FC (2007) The hidden structure of overimitation. Proc Natl Acad Sci 104:19751–1975

Lyons DE, Damrosch DH, Lin JK, Macris DM, Keil FC (2011) The scope and limits of overimitation in the transmission of artefact culture. Philos Trans R Soc B Biol Sci 366:1158–1167

McGuigan N, Whiten A (2009) Emulation and "overemulation" in the social learning of causally opaque versus causally transparent tool use by 23- and 30-month-olds. J Exp Child Psychol 104:367–381

McGuigan N, Whiten A, Flynn E, Horner V (2007) Imitation of causally opaque versus causally transparent tool use by 3- and 5-year-old children. Cogn Dev 22:353–364

McGuigan N, Makinson J, Whiten A (2011) From over-imitation to super-copying: adults imitate causally irrelevant aspects of tool use with higher fidelity than young children. Br J Psychol 102:1–18

Nielsen M (2006) Copying actions and copying outcomes: social learning through the second year. Dev Psychol 42:555–565

Nielsen M, Susianto EW (2010) Failure to find over-imitation in captive orangutans (Pongo pygmaeus): implications for our understanding of cross-generation information transfer. In: Håkansson J (ed) Dev Psychol. Nova, New Yok

Nielsen M, Tomaselli K (2010) Overimitation in Kalahari Bushman children and the origins of human cultural cognition. Psychol Sci 21:729–736

Nielsen M, Mushin I, Tomaselli K, Whiten A (2014) Where culture takes hold: 'overimitation' and its flexible deployment in Western, Aboriginal and Bushmen children. Child Dev: In press

Paradise R, Rogoff B (2009) Side by side: learning by observing and pitching in. Ethos 37:102–138

Rendell L, Boyd R, Cownden D, Enquist M, Eriksson K, Feldman MW, Fogarty L, Ghirlanda S, Lillicrap T, Laland KN (2010) Why copy others? Insights from the social learning strategies tournament. Science 328:208–213

Rendell L, Fogarty L, Hoppitt WJE, Morgan TJH, Webster MM, Laland KN (2011) Cognitive culture: theoretical and empirical insights into social learning strategies. Trends Cogn Sci 15(2):68–76

Robins S (2001) NGOs, 'Bushmen' and double vision: The ≠khomani San land claim and the cultural politics of 'community' and 'development' in the Kalahari. J S Afr Stud 27:833–853

Robins S (2003) Comment on 'The return of the native'. Curr Anthropol 44:398–399

Robins S, Madzudzo E, Brenzinger M (2001) An assessment of the status of the San in South Africa, Angola, Zambia and Zimbabwe. Legal Assistance Centre, Windhoek

Rogoff B (2011) Childhood and learning: how do children learn without being taught? One way is by observing and pitching in. Anthropol Child Youth Interest Group Newsl 8 October

Skerry AE (2013) The origins of pedagogy: developmental and evolutionary perspectives. Evol Psychol 11:550–572

Spindler G (1974) The transmission of culture. In: Spindler GD (ed) Education and cultural process. Holt,Rinehart and Winston, New York, pp 279–310

Strauss S, Ziv M (2012) Teaching is a natural cognitive ability in humans. Mind Brain Educ 6:186–196

Tomasello M, Kruger AC, Ratner HH (1993) Cultural learning. Behav Brain Sci 16(3):495–511

Whiten A (2011) The scope of culture in chimpanzees, humans and ancestral apes. Philos Trans R Soc B Biol Sci 366 (1567):997–1007

Whiten A, McGuigan N, Marshall-Pescini S, Hopper LM (2009) Emulation, imitation, over-imitation and the scope of culture for child and chimpanzee. Philos Trans R Soc B Biol Sci 364:2417–2428