

# **Interpersonal aggression among Aka hunter-gatherers of the Central African Republic: Assessing the effects of sex, strength, and anger**

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## **Abstract**

This paper explores sex differences in interpersonal aggression among Aka foragers of the Central African Republic (CAR). We tested whether male Aka physically aggressed more than female Aka, and whether female Aka indirectly aggressed more than male Aka, as evolutionary theories of aggression predict. To our knowledge, these are the first tests of these theories among an extant population of hunter-gatherers. We also tested predictions of a recent evolutionary theory of physical strength, anger, and physical aggression. Data include a measure of upper body strength, age, sex, and qualitative views on aggression norms, as well as peer assessments of anger, physical aggression, and indirect aggression. Our results provide mixed support for the predicted sex differences in physical aggression and indirect aggression, and for the predicted relationships among anger, strength, and the use of aggression.

Key words: aggression, indirect aggression, sex differences, hunter-gatherers, anger, Aka

## **Introduction**

Violence causes 9.2 deaths per 100,000 per year globally, warfare an additional 3.9 deaths per 100,000 (WHO 2002). Although annual homicide rates have declined significantly in the US over the past 30 years, 5.6 Americans are still killed per 100,000, with an especially high victimization rate, 20.6 per 100,000, among African Americans (U.S. Department of Justice 2005). These annual mortality rates are comparable to those due to major global health problems such as HIV/AIDS, respiratory infections, and cancers, which are responsible for 5.84, 20.9, and 37.02 deaths per 100,000, respectively (WHO 2002).

There is a growing interest in using evolutionary theory to tackle the problems of aggression and violence. We report tests of three adaptationist theories of interpersonal aggression and violence (described next) in which aggression type (physical vs. indirect), sex, physical strength, and anger play important roles. To our knowledge, these are the first tests of these popular theories among an extant population of hunter-gatherers, the Aka of the Central African Republic.

### ***Sex differences in physical aggression***

The reproductive success of members of the sex that invests more in offspring is limited by access to resources for themselves and their offspring, whereas the reproductive success of members of the sex that invests less in offspring is limited by sexual access to members of the sex that invests more (Trivers 1972). In humans, as in most mammals, the sex that invests more is female, and the sex that invests less is male. Accordingly,

human males are expected to contest over sexual access to females, frequently employing costly forms of physical aggression, as the potential costs of injury or death are outweighed by the potential benefits of increased mating opportunities (e.g., Archer 2004, 2009; Campbell 1999; Daly and Wilson 1988).

Empirically, a male bias in physical aggression (i.e., a greater rate of physical aggression by males than females) is consistently seen across those relatively few cultures in which it has been systematically studied. Archer's 2004 meta-analysis of sex differences in aggression summarized results from over 300 studies. This meta-analysis included self-report studies in 13 nations, with the size of the male bias (Cohen's  $d$ ) ranging from 0.27 in New Zealand to 1.16 in Israel; observational studies in 9 nations, with the male bias ranging from 0.34 in Belize to 1.97 in Kalmyk; and peer-report studies in five nations, with the male bias ranging from 0.69 in Finland to 1.46 in Australia. Across age categories, the largest male biases are found in children, teenagers, and young adults.

So far as we can determine, the hypothesized universal male bias physical aggression within (as opposed to between) groups has not been subject to detailed scrutiny in a population of extant hunter-gatherers. We wanted to determine whether it exists in such a population, the Aka, who are also known for their strong ethics of egalitarianism and non-aggression. Theories of social norms argue that the male bias in aggression stems from gender differences in norms against aggression. If social norms could be measured and statistically controlled for, we could test whether the male bias would persist, as an evolutionary analysis would predict (for discussion of social learning theories of aggression, see Archer 2009; Hess and Hagen 2006).

### ***Strength, anger, and physical aggression***

Variation in physical strength should also predict variation in physical aggression.

According to Sell (2006; Sell, Tooby & Cosmides 2009), humans internally represent a Welfare Tradeoff Ratio (WTR) that indicates the extent to which they will allow costs on themselves in order for a social partner to benefit, and the extent to which they will impose costs on that partner for their own benefit. In other words, individual A will tolerate an action by social partner B that imposes a small cost on A as long as B benefits greatly (more precisely, as long as the ratio of B's benefit to A's cost is higher than the negotiated threshold). But A will not tolerate an action by B that imposes a large cost on A for only small benefit to B.

Sell (2006) argues that the emotion anger is an adaptation to inflict costs or withdraw benefits (or to threaten to do either) in order to recalibrate another's WTR with respect to, and for the benefit of, oneself. That is, if B's actions impose high costs on A yet yield only small benefits to B, A will get angry at B to deter B from acting similarly in the future: B must take A's welfare into account, weighting it more heavily.

Insofar as physical aggression can be used to bring about such recalibration, those possessing a greater ability to physically aggress should engage their anger response more readily, i.e., physically stronger individuals should experience more anger, which then results in more physical aggression. In a population of US undergraduates, Sell, Tooby & Cosmides (2009) found that, among men, physical strength was a positive predictor of both anger and physical aggression. This relationship was not found in

women. Similar results were found among East Indians (Archer & Thanzami, 2007). We wanted to attempt to replicate these results in a non-Western population of married adults.

### ***Sex differences in indirect aggression***

Females do not stand to gain by fighting for additional copulations. Furthermore, injury or death due to fighting is likely to impede a female's ability to secure resources for herself and her offspring, and to provide protection and nurturance to her highly altricial offspring. Consequently, when females do contest over scarce resources—be they material or social resources—they are expected to use methods, such as ostracism and gossiping, that are less likely to result in physical injury (Campbell 1999; see also Archer 2004, 2009). Such nonphysical forms of physical aggression have taken different names including indirect aggression, relational aggression, and social aggression; in accordance with Archer and Coyne (2005), we will refer to them as 'indirect aggression.'

The empirical evidence for a universal female bias in indirect aggression is weak, with different methods of measuring aggression yielding different results. In Archer's meta-analysis, the largest female bias, -0.74, was found in observational studies (all apparently from the US). Self-report studies from North America and Asia found a small female bias (-0.11 and -0.08, respectively), whereas those from Europe found a small male bias (0.11). Peer-report studies from Australia and Finland found a moderate female bias (-0.35), whereas those from the US and Canada found a very small male bias (0.03). Confounds include that in different nations, studies involved different indirect aggression

scales and different ages. Across age categories, the largest female bias occurs in teenagers.

Although our sample sizes would likely be too small to detect such small-to-moderate female biases in indirect aggression, we nevertheless wanted to explore indirect aggression in a population in which physical aggression appears to be heavily discouraged, and which might thereby increase indirect aggression as an alternative. We also wanted to test whether a female bias, if found, would persist after controlling for social norms against indirect aggression. Additionally, if indirect aggression is a safer alternative to physical aggression (Campbell 1999) then, just as we predict that physically stronger individuals should exhibit increased physical aggression, physically weaker individuals might be expected to exhibit increased indirect aggression, controlling for level of provocation, which we operationalized as anger level.

### ***Aggression among foragers***

Early Western observers described hunter-gatherers as territorial and defensive, living “nasty, brutish, and short” existences, frequently suffering from starvation, and thinking little about the future (Kelly, 1995). It was not until mid-twentieth century that this perception began to change. Following the 1966 “Man the Hunter” conference, Sahlin’s (1968) concept of forager culture as the original affluent society took widespread and tenacious hold; hunter-gatherers were now often seen as “noble savages” living in harmony with nature and each other (Kelly 1995). More recently, it has become clear that outside of a shared economic mode, there are extensive cultural and social differences among foragers (Kelly 1995; Kent 1996; Schweitzer et al. 2000).

Research on within-group aggression among foraging populations frequently emphasizes its absence (Montagu, 1978). Most of the numerous studies describing the nonviolence of foragers, however, also make extensive mention of the use of gossip, rough joking, and ridicule as means of maintaining group cohesiveness and social norms by leveling status among individuals (Draper 1978; Hewlett 1991; Levy 1978; Thomas 1958; Turnbull 1965, 1978). These behaviors could easily be categorized as indirect aggression, as they are in Western populations.

According to Turnbull (1978), for example, violence among the African Mbuti foragers is virtually impossible until adulthood, when it then becomes an expected aspect of life. Because the Mbuti recognize violence as a potential problem they actively discourage it through teaching and rituals that occur over the course of development. Very young children are only punished by their parents in response to self-endangerment, perhaps with a light slap, but older children can be punished for being a nuisance. As children get older and begin to play together, they use ridicule and nicknames to promote equality of status, a pattern that continues into adulthood. Violence is manifested primarily by adult men. Turnbull sees aggression as a consequence of the inherent conflict between the individual and social self that Mbuti will face throughout adulthood. This conflict is symbolized, for instance, by the premarital *elima* initiation festival marking the transition to adulthood, in which adolescent boys are whipped by the girls they are attempting to court.

In contrast to within-group aggression, warfare is fairly well-studied among hunter-gatherers and small-scale societies, both past and present. Ember (1978) notes that 64%

of hunter-gatherer societies experienced warfare at least once every two years, and for only 12% of the foragers in her study was warfare rare. It is unclear if the same was also true for prehistoric hunter-gatherers (Ember and Ember, 1997); indeed it appears likely that the recent past, at least, was characterized by greater violence (Gat 1999; McCall and Shields 2008; Walker 2001). Additionally, the low levels of warfare found in contemporary hunter-gatherer societies certainly do not preclude interpersonal conflict; while certain societies may be warless, this does not qualify them as “peaceful” (Kelly 2000).

Wrangham et al. (2006) found that the median annual mortality rate from intergroup aggression among 12 hunter-gatherer societies was 164 deaths per 100,000 (with a mean of 249). Bowles (2009) similarly estimated the fraction of adult mortality due to warfare among the 15 archaeological and 8 ethnographic populations of foragers for which sufficient evidence exists. For the archaeological populations, dated between 16,000 BP and 238 BP, the fraction ranges from 0 to 0.46, with a mean of 0.14. For the ethnographic populations, the fraction ranges from 0.04 to 0.30, with a mean of 0.14.

Some assert that warfare (and resultant homicide) is distinct from “normal” aggression (McCall and Shields 2008). Ember and Ember (1994), however, demonstrated a close relationship between warfare and other forms of aggression, and they suggest that the presence of warfare may have the effect of lowering norms against other forms of violence (as parents may socialize their children for warriorhood, thereby legitimizing aggressive behavior). Kelly (2000) warns, though, that clear causality between socialization practices and aggression has yet to be established.

# **Study population: Aka foragers of the Central African Republic**

The estimated size of our study population, the Aka "pygmies," is between 15,000 and 30,000 (Bahuchet 1985), although accurate census is challenging due to frequent camp changes (the term *pygmy* is now viewed as derogatory, but no suitable replacement has yet emerged). The Aka are culturally and linguistically unique, but share several traits with many other foragers across the Central African rainforest, such as a strong identity with (and preference for) forest life, high mobility, ritualization of elephant hunting, and an association with farmer populations (Hewlett 1996a).

The Aka subsist primarily on 63 plant species, 20 insect types, honey from eight species of bees, and 28 species of game (Hewlett 1991). The Aka obtain a large proportion of vegetable foods, and hence calories, by trading forest products, such as meat, to the farmers with whom they are associated. Unlike other hunter-gatherers in the area who practice bow hunting, the Aka practice net-hunting, in which men, women, and children participate. There is a widespread ethic of food sharing maintained primarily through reputational effects, but it is clear that not all foods are shared equally. Many desirable foods are eaten on the spot or hidden and eaten later (Meehan 2005; Shannon 1996).

Five significant social units can be identified among the Aka: the family, the camp, the clan, the band, and the regional community (Hewlett 1991). In regards to the family, many men and women form lasting relationships resulting in several children (but marriage can be dissolved with relative ease). Monogamy is prevalent, but polygyny is

acceptable. The Aka are indulgent and affectionate parents, instilling autonomy and independence at a very early age, and evidence uniquely high levels of paternal investment (Hewlett 1991).

An Aka camp averages between 20 and 35 individuals, or about 6 to 8 households, though the composition of these camps is subject to frequent change (Bahuchet 1990; Hewlett et al. 2000). Camp size tends to increase during the dry season (Hewlett 1991). Camps are distributed along trails that radiate out from a farming village into the forest.

The clan is identified patrilineally, but this is relatively superficial and rarely remembered more than two generations back. Additionally, while descent is patrilineal, it is also possible to access to one's mother's trail, so married Aka can freely make use of four distinct territories (Hewlett 1996b). The band is composed of several clans that hunt and gather together in the same area over an extended period of time. The regional community is the exploration range of an individual and includes the areas where socialization occurs, social contacts are established, and where one meets his or her spouse (Hewlett et al. 1982).

The Aka have a mutually dependent relationship with the Bantu farmers of the region (in this study area, the Ngandu), yet retain their cultural independence. This relationship can be somewhat contentious, however, and Bahuchet and Guillame (1982:194) note that the villagers' opinion of the Aka is that they are devoid of culture and therefore "bound to be dominated." The farmers see themselves as essentially "agents of rural development," providing the Aka with an introduction to western clothes, medicines, and goods (Hewlett 1996b).

Despite perceiving themselves as superior, the farmers see the Aka as powerful hunters and connected to the spirits of the forest. They consider them to be great sharers, loving parents, and skilled in the supernatural (Hewlett 1996b). The Aka, however, view the villagers as lazy, arrogant, brutal and coarse, comparable to forest animals in noise and aggressiveness (Hewlett 1996b; Meehan 2005:42). The Aka even have a gesture to indicate their opinion of the Ngandu as chimp-like (Hewlett 1996b). Foragers and farmers nevertheless have a fictive kin relationship of sorts, sharing clan names, which indicates a tie between an individual Aka and a farmer (Shannon 1996:44-45). This bond can be broken, however, and an Aka can become a “free agent” or retreat to the forest. Reasons for breaking away include the feeling that one can get more money or products from new villagers; moving to a new area for new opportunities or services; or that one’s village patron treats him or her poorly (Hewlett 1996b). But independence has the potential to push an Aka individual into an unfamiliar cash economy which can be exploitative (Bahuchet 1999; Hewlett 1996b).

### ***Aka aggression***

The Aka, like many foraging populations, tend to be more egalitarian and less aggressive than non-foraging populations. The Aka lack gender and intergenerational inequality, and maintain this ethic through prestige avoidance, rough joking, and demand sharing (Hewlett 1991). Demand sharing among foragers might also be a form of aggressive behavior, in that when sharing is a strong social norm, there are opportunities for some to take advantage of the majority. Demand sharing has been hypothesized to be one of the primary reasons the Aka have not adopted agriculture (although some do maintain small

gardens), as relatives would come and request food at harvest time (K. Lupo, personal communication).

Domestic violence is frequently observed among the neighboring Ngandu, yet it has rarely been observed among the Aka. When it does occur, it is often when one spouse fears losing their husband or wife to someone else. Both sexes hit, with women initiating 7 of 10 incidents reported by women, and 9 of 17 incidents reported by men. Unlike Ngandu women, when an Aka women is hit by a man she is likely to hit him back (Hewlett and Hewlett 2008).

The leading causes of death for the Aka at all ages are infectious and parasitic diseases, with children under age 15 at greatest risk. In a study involving 669 cases, violence and accidents accounted for about 5% of deaths, with males twice as prone to violent and accidental deaths as females, and only males experiencing murder (Hewlett 1986).

## **Methods**

We recruited Aka participants residing along the Bombalango trail, which is associated with the Bokoka cartier of the village of Bangandou, Central African Republic. In order to ensure their familiarity with other Aka involved in the study, participants were solicited along a single trail. Our observations along the Bombalango trail were made during the middle of the rainy season. Camp sizes ranged from 11 to 55 people, with a mean size of 26.

## *Participants*

We recorded SEX and AGE of all participants. As with many small-scale, traditional societies, Aka do not record birthdates; it is therefore difficult, and often impossible, to determine ages with accuracy. To estimate ages, we used two methods. First, we recorded participants' indigenous age category, roughly 'child, 'adolescent,' and 'adult.' By definition, 'adolescents' are unmarried whereas 'adults' are married. After entering the study as unmarried adolescents, a small number of participants claimed to have recently gotten married. Among the Aka, marriages of young people typically entail bride service (a practice in which the young man moves to live with, and work for, his wife's family for a few years); in none of these cases was the putative husband performing bride service, so we interpreted these 'marriages' as more akin to serious dating relationships. Because 'adults' participated in another study restricted to reproductive-aged individuals, this category excluded the elderly. For our second estimate of age, one of us (BH), based on 30 years of experience working with this population, approximated within-category ages to the nearest year, usually with input from the participant or one of the participant's parents, and/or other camp members (Table 1).

All participants agreed to have their photo taken, and to be rated by fellow Aka on the following variables: a measure of physical aggression, one or two measures of indirect aggression, and a measure of anger. We refer to all those so rated as "targets." In addition, the physical strength of all targets was measured. Most of our participants also acted as "raters," i.e., provided ratings of target participants on the aforementioned measures of aggression and anger.

Raters only rated Aka belonging to the same age category (i.e., children rated only children, adolescents rated only adolescents, and adults rated only adults). We chose to limit rater-target dyads to peer groups for several reasons. First, we wanted to limit potential confounds involving age-related differences and physical size and social status. For example, a child might have a different threshold for what constitutes “hitting” in an adult vs. “hitting” in a child, as a light tap by an adult might feel quite strong and thus like a “hit” to a child. Or, it could be the case that, due to age-related status differences or social norms of respect to one’s elders, an adolescent might not want to report whether an adult commonly hits others. Second, presumably most individuals are spending significant time with similarly aged peers, and so peers ought to have ample access to information about the social interactions of their peers. Third, members of different age groups might perceive aggression levels differently. For example, young children might not yet have the verbal skills to recognize subtle gossip (one form of indirect aggression) among adults. Similarly, adults might interpret hitting among children as playing rather than aggression.

Our ability to recruit study participants was limited by the length of our field season and the dispersed nature of Aka camps. There were 98 targets in our study (see Table 1 for a breakdown of targets by age and sex). Raters included 78 of these 98 Aka: 20 children (10 male), 20 adolescents (10 male), and 38 adults (19 male). Ours is one of the few studies of adults that employs peer-reports of anger and aggression: of the 109 studies of adult aggression summarized in the meta-analysis of Archer (2004), all employed self-reports (studies of children and adolescents, on the other hand, commonly employ peer-reports).

	<b>N (targets)</b>	<b>Male, Female</b>	<b>Age range</b>	<b>Mean age</b>	<b>SD (age)</b>
Children	32	15, 17	5.5 -- 12	32.6	1.92
Adolescents	26	12, 14	12.5 -- 18	16.3	1.48
Adults	40	20, 20	25 -- 45	8.9	5.66

Table 1: Basic demographic characteristics of the targets. Ages are approximate.

***Procedures: Quantitative data***

The Aka are not literate, so all questions were presented verbally by one of two Ngandu research assistants who translated questions from either French or English into the Aka language, DiAka. All raters were interviewed in private, with the exception of some younger children, who were interviewed with their parents present. Parents were asked not to speak for their children, and typically followed this instruction.

The Aka are almost completely unfamiliar with questionnaires, and translating and explaining a single question to an Aka individual could frequently take a minute or two. We therefore decided to employ a pile sort technique, in which raters would place photos of fellow Aka into one of two piles. Specifically, photos of targets of the rater’s same age category were presented to raters, one at a time. The raters were asked if the person in the photo committed the specific aggressive act more or less frequently than most Aka (e.g., hitting, gossiping, and/or excluding others), and/or whether the person in the photo became more or less angry than most Aka.[1] Thus, all ratings were on a two-level scale (1, 0). Raters rated their own photo, and members of both sexes. Ratings were summed for each target and then divided by the number of raters, resulting in a score between zero and one. The stack of photos was shuffled prior to each rating task.

## **Variables**

As stated above, we recorded SEX and AGE for all participants. For each photo raters were asked whether the target HIT more or less than most Aka (physical aggression), whether the target engaged in GOSSIP more or less than most Aka (one measure of indirect aggression), and (for children and adolescents only) whether the target tended to EXCLUDE others more or less than most Aka (another measure of indirect aggression). EXCLUDE was described as “not allowing him/her to join a playgroup.” We did not measure EXCLUDE among adults because it did not map clearly to an identifiable social phenomenon in Aka culture. We also asked adults to rate whether the target became angry (ANGER) more or less than most Aka.

To assess Aka stereotypes, if any, about sex biases in aggression, after a rater had finished rating all photos we asked him or her who is more likely to hit and gossip – males, females, or both equally?

To determine if putative sex biases in aggression could be explained by sex biases in social norms against aggression, we asked all raters to indicate, on a 5-point scale, how wrong it was to hit (HITNORM), gossip (GOSSIPNORM), or, for children and adolescent raters, exclude (EXCLUDENORM). This was done by asking them to place 1 to 5 red plastic straws on a table (1 = not bad; 5 = very bad). Finally, we obtained measures of upper body STRENGTH from all 40 adult targets using a modified hand press (a JAMAR Hand Dynamometer) shown by Sell et al. (2008) to be an accurate indicator of overall strength.

## **Predictions**

For all age categories we predicted a male bias in mean HIT ratings (prediction 1) and female biases in mean GOSSIP and EXCLUDE ratings (prediction 2). We predicted these biases would persist after controlling for HITNORM, GOSSIPNORM, and EXCLUDENORM, respectively. Because aggression norms should deter aggression, we nevertheless predicted that our norm variables would correlate negatively with the corresponding aggression type (e.g., HITNORM would correlate negatively with HIT, and so forth). We could only evaluate the norm hypotheses for our sample of raters, and not targets, as only raters provided norm self-reports. In adults, we also measured ANGER, which we predicted would positively correlate with both types of aggression, HIT and GOSSIP (prediction 3). We predicted that STRENGTH would positively correlate with ANGER (prediction 4), at least in males. As a test of the hypothesis that indirect aggression is a safer alternative to physical aggression, possibly explaining why it is used more by females than males, we predicted that, controlling for ANGER, STRENGTH would correlate negatively with GOSSIP (prediction 5), at least in females, and that HIT would correlate negatively with GOSSIP (prediction 6) at least in females.

## ***Power analysis***

Archer (2004) summarized the numerous studies of sex differences in physical and indirect aggression in a meta-analysis, providing mean effect sizes ( $d$ ), broken down by type of aggression, by type of study (e.g., observational, self-report, peer-report), and by age categories. We computed the sample sizes required to detect these effects, as well as the effects we could detect, given our actual sample sizes (table 2). As can be seen in the

table, our sample sizes were only adequate to detect the large male biases usually seen in physical aggression (especially among adolescents), but not the relatively small female biases often found in indirect aggression among adolescents. Nevertheless, we did check for sex differences in both types of aggression.

	Mean effect size (d)	N required (f/m)	N recruited (f/m)	d
<b>Physical</b>				
Children	0.69	27/27	17/15	0.90
Adolescents (younger/older)	0.82 / 0.97	19/19, 14/14	14/12	1.01
Adults (younger/older)	0.60 / 0.25	35/35, 199/199	20/20	0.80
<b>Indirect</b>				
Children	0.00	na	17/15	-0.90
Adolescents (younger/older)	-0.13 / -0.35	732/732, 102/102	14/12	-1.01
Adults	-0.01		20/20	-0.80

Table 2: Power analysis. The mean effect sizes for sex differences in aggression are from the meta-analysis of Archer (2004). Mean effect sizes for children and adolescents are from peer-reports; those for adults are from self-reports. We computed the ‘N’ required to detect these effects in one-tailed t-tests with power 0.8 and alpha = 0.05. Given the ‘N’ we actually recruited, the effect sizes we were able to detect with the same power and alpha are listed in the final column (d).

### ***Procedures: Qualitative data: semistructured interviews***

To better understand the reasons for aggressive behavior, we then asked who had victimized the rater, and who they themselves had victimized (e.g., Who hits you, and why? Who have you hit, and why?). Finally, to see where aggressive acts fell along a continuum of adverse behaviors, we asked what was the worst thing one Aka could do to another.

## **Results**

### ***Qualitative data***

Although Aka participants had little trouble recalling incidents of hitting, these were not daily occurrences. In fact, because it can lead to divisions within a camp, many Aka cited physical or verbal fighting as one of the worst things one individual can do to another, along with not sharing, stealing food or husbands/wives, and especially sorcery. The latter are frequently cited as the causes of hitting or gossiping.

Among children, causes of hitting include: no reason; fun; being 'provoked'; because someone hit you; refusing to work; and dominance relationships. For instance, one child reported that his older brother hit him because he played with his brother's spear after being forbidden to touch it. Another girl reported being hit because she refused to be a particular boy's 'girlfriend.' The most frequently cited cause of gossiping was food-related, e.g., someone eating another's food without asking. Other reasons for gossip included hitting, not sharing, and generally being selfish. Typically, children are aggressing against their friends and siblings.

Adolescents often mentioned the same causes of aggression as children did, in addition to those tied to budding sexual relationships. Like children, hitting sometimes occurs out of fun. One girl recounted how a certain boy would often try to knock the water she was carrying off her head. Another stated that she hit her younger sister because the younger girl ate her family's food and then blamed her. Both hitting and gossiping are sometimes tied to conflicts between two cliques of friends. Gossip leaned towards increasingly adult issues, such as sexual relationships, although not sharing remained an important cause. One girl reported being victimized by gossip because she refused a marriage proposal; another cited an accusation that she was trying to steal her friend's husband. Sometimes these early relationships caused rifts among friends, with former allies gossiping about an individual due to their jealousy of her new boyfriend. These more adult concerns also manifested themselves in the adolescents' perceptions of the worst things one Aka could do to another, with not working and not resolving conflict being cited as significant problems.

Aka adults most often stated that they hit their wife or husband as a result of sexual jealousy. Several individuals noted that this frequently occurred at dances, where Aka from several trails come together at a single camp. Dances provide opportunities to meet new social partners, but can also lead to conflict in existing relationships. Other reasons for hitting were kin-related (e.g., one individual hit his brother-in-law when he was observed to hit his wife, the individual's sister, during bride service) or because someone had spread gossip. The most frequent cause of gossip was a failure to share enough with other camp members; sharing is an extremely important social norm among the Aka.

Making too much money, stealing, hitting others, retaliatory gossip, and acting too much like a villager are other significant sources of gossip.

### *Aka gender stereotypes*

We asked Aka whether, in general, males or females were more likely to engage in each aggression type (HIT, GOSSIP, and EXCLUDE). By and large, males, as a class, were stereotyped as hitting more than females, and females were stereotyped as gossiping more than males. Children, though, saw boys and girls hitting equally. There were no significant perceived sex stereotypes in EXCLUDE. See table 3.

Aggression type	Females more	Males more	Both equally	Chi-sq	df	p	
<b>Children</b>							
HIT	8	7	5	0.7	2	.70	
GOSSIP	13	4	3	9.1	2	.01	**
EXCLUDE	11	4	5	4.3	2	.12	
<b>Adolescents</b>							
HIT	3	13	4	9.1	2	.01	**
GOSSIP	15	2	3	15.7	2	< .001	***
EXCLUDE	9	5	6	1.3	2	.52	
<b>Adults</b>							
HIT	3	20	14	12.1	2	.002	**
GOSSIP	20	2	16	14.1	2	< .001	***

Table 3. Aka sexual stereotypes for each type of aggression. Values represent the number of Aka peer-raters who claimed a female bias, a male bias, or no sex bias in each aggression type.

### ***Inter-rater reliability for peer-ratings of hitting, gossiping, exclusion, and anger***

We measured inter-rater reliability of peer-ratings using intraclass correlations (ICC, type 2k), equivalent to Cronbach's alpha or, for our dichotomous ratings, Kuder-Richardson Formula 20. Inter-rater reliability was acceptable-to-high for all measures among adults, but was poor-to-moderate for children and adolescents (see table 4). For children and adolescents, we therefore examined the correlations between individual ratings and the overall ratings, removing raters with negative or near-zero correlation values. This raised ICC values to greater than 0.4, values which were now significantly greater than zero (table 4).

When used to evaluate the internal consistency of a scale, the “rule of thumb” cutoff for Cronbach’s alpha is usually taken to be 0.6 or 0.7, rather than 0.4. We are assessing inter-rater reliability, however, not the internal consistency of a scale. Moreover, our raters had lifelong personal relationships with most targets. Hence, their ratings no doubt reflected both the general tendency of targets to hit or gossip, which is the focus of our study, as well as raters’ unique personal interactions with targets. For this study the latter represents unavoidable “noise.”

Our results were not sensitive to the inclusion or exclusion of raters. We ran all analyses using mean ratings of all raters, as well as mean ratings of only the relatively consistent subsets of raters, as just described. All computed statistics and parameters were virtually identical in both analyses, with no statistically significant differences. We report values computed with mean ratings of the subset of consistent raters.

	ICC (all raters)	Raters removed	ICC (subset)	95% CI
<b>Children</b>				
Hits	0.48	1 of 20	0.53	0.26 – 0.74
Gossips	0.06	5 of 20	0.48	0.17 – 0.71
Excludes	-0.22	6 of 20	0.42	0.08 – 0.68
<b>Adolescents</b>				
Hits	0.28	3 of 21	0.53	0.22 – 0.76
Gossips	0.04	5 of 21	0.50	0.17 – 0.74
Excludes	0.00	5 of 20	0.42	0.04 – 0.70
<b>Adults</b>				
Anger	0.71	0 of 37	na	0.57 – 0.83
Hits	0.88	0 of 37	na	0.82 – 0.93
Gossips	0.63	0 of 37	na	0.45 – 0.78

Table 4: Inter-rater reliability before and after removing raters whose ratings had negative or near-zero correlations with other raters. For children and adolescents, the 95% CI refers to ICC (subset), whereas for adults it is for ICC (all raters).

***Predictions 1 and 2: Sex differences in aggression types by age category***

We used t-tests to determine whether there were sex biases in peer-ratings of aggression. Results of these tests among children, adolescents, and adults are summarized in table 5.

Variable	Female mean	Male mean	t	df	d	p	
<b>Children</b>							
HIT	0.39	0.54	-3.06	29.5	1.12	.005	**
GOSSIP	0.47	0.52	-0.69	29.7	0.25	.49	
EXCLUDE	0.41	0.48	-1.16	28.6	0.43	.26	
<b>Adolescents</b>							
HIT	0.40	0.61	-4.23	23.6	1.73	.0003	***
GOSSIP	0.48	0.50	-0.33	22.5	0.13	.74	
EXCLUDE	0.45	0.51	-0.93	17.5	0.40	.36	
<b>Adults</b>							
HIT	0.54	0.58	-0.67	37.8	0.22	.51	
GOSSIP	0.53	0.50	0.87	37.5	-0.28	.39	

Table 5: Tests for sex-differences in peer-ratings of aggression (two-tailed).

### Children and adolescents

Supporting prediction 1, boys were rated as HITting significantly more than girls among both children and adolescents, with very large effect sizes (table 5). To test whether this sex difference could be a consequence of a sex difference in social norms against hitting, we first compared HITNORM in boys vs. girls. In children, the mean HITNORM was identical ( $M = 3.60$ ) in both sexes. In adolescents, the mean female HITNORM (3.27) was not significantly different from the mean male HITNORM (3.30),  $t = -0.05$ ,  $df = 18.6$ ,  $p = .96$  (two-tailed). We then tested for an effect of SEX on HIT, controlling for HITNORM. The male bias was still significant in children and adolescents (table 6, models 1 and 2). Contrary to predictions, HITNORM was not significantly negatively correlated with HIT in children ( $r = -.06$ ,  $p = .40$ ), or in adolescents ( $r = -.12$ ,  $p = .30$ ).

Contrary to prediction 2, girls did not GOSSIP or EXCLUDE more than boys, and results actually trended slightly in the opposite direction (however, we had little power to detect sex differences of the relatively small magnitudes usually seen in indirect aggression). In children, there was no significant difference in the mean GOSSIPNORM in girls ( $M = 2.7$ ) vs. boys ( $M = 2.6$ ),  $t = 0.25$ ,  $df = 17.6$ ,  $p = .81$  (two-tailed). In adolescents, there was also no significant difference in the mean GOSSIPNORM in girls (2.8) vs. boys (3.2),  $t = -1.04$ ,  $df = 17.5$ ,  $p = .31$  (two-tailed). Controlling for GOSSIPNORM did not reveal a significant sex bias in GOSSIP in children or adolescents (tests not reported). Contrary to predictions, GOSSIPNORM was not negatively correlated with GOSSIP in children ( $r = .22$ ,  $p = .36$ ), or in adolescents ( $r = -.07$ ,  $p = .39$ ).

<b>Model 1: Children</b>	<b>Estimate</b>	<b>Std. Error</b>	<b>t value</b>	<b>Pr(&gt;  t )</b>	
(Intercept)	0.37	0.10	3.79	< 0.001	***
SEX (m)	0.19	0.07	2.86	0.01	**
HITNORM	-0.01	0.02	-0.29	0.77	
<b>Model 2: Adolescents</b>					
(Intercept)	0.45	0.10	4.68	< 0.001	***
SEX (m)	0.22	0.06	3.61	< 0.001	***
HITNORM	-0.02	0.03	-0.74	0.47	

Table 6: Male biases in physical aggression in children and adolescents after controlling for physical aggression social norms. **Model 1:** Residual standard error: 0.15 on 17 degrees of freedom, multiple R-squared: 0.33, Adj. R-squared: 0.25; F-statistic: 4.15 on 2 and 17 DF, p-value: 0.034. **Model 2:** Residual standard error: 0.14 on 18 degrees of freedom, multiple R-squared: 0.43, adjusted R-squared: 0.37, F-statistic: 6.75 on 2 and 18 DF, p-value: 0.006.

## **Adults**

Contrary to prediction 1, men were not rated as HITting significantly more than women, although the effect trended in the predicted direction and was of a magnitude comparable to other studies of middle-aged adults (table 2). There was no significant difference in the mean HITNORM in women ( $M = 4.11$ ) vs. men ( $M = 3.89$ ),  $t = 0.51$ ,  $df = 35.6$ ,  $p = .61$  (two-tailed). Controlling for HITNORM did not reveal any significant sex bias in HIT, but, as predicted, HIT was significantly negatively correlated with HITNORM,  $r = -.38$ ,  $p = .01$ .

Contrary to prediction 2, women did not GOSSIP more than men, although the effect trended in the predicted direction and was of a magnitude similar to those seen in self-report studies of community samples (Archer 2004). (We did not measure EXCLUDE in adults.) There was no significant difference in the mean GOSSIPNORM in women ( $M = 3.74$ ) vs. men ( $M = 3.32$ ),  $t = 0.99$ ,  $df = 35.9$ ,  $p = .33$  (two-tailed). Controlling for GOSSIPNORM did not reveal any significant sex bias in GOSSIP, nor was GOSSIP significantly correlated with GOSSIPNORM, although the trend was in the predicted negative direction,  $r = -.21$ ,  $p = .10$ .

### ***Prediction 3: Anger and aggression among adults***

In adults, we also measured ANGER, which correlated positively with both HIT ( $r = .70$ ,  $p < .001$ ) and GOSSIP ( $r = .71$ ,  $p < .001$ ), supporting prediction 3. These results confirm that both behaviors are viewed as aggressive. These results also suggest ANGER might be an important control variable when exploring sex differences in aggression. We therefore computed models of HIT and GOSSIP as a function of SEX, controlling for

ANGER. The model of HIT still showed no significant effect of SEX (test not reported), but the model of GOSSIP now revealed a significant female bias (table 7).

	<b>Estimate</b>	<b>Std. Error</b>	<b>t value</b>	<b>Pr(&gt;  t )</b>	
(Intercept)	0.21	0.05	4.49	< 0.001	***
SEX (male)	-0.08	0.03	-2.80	0.01	**
ANGER	0.69	0.10	7.25	< 0.001	***

Table 7: Adult GOSSIP as a function of SEX and ANGER. Residual standard error: 0.086 on 37 degrees of freedom, multiple R-squared: 0.60, adjusted R-squared: 0.57, F-statistic: 27.21 on 2 and 37 DF, p-value < .001.

#### ***Prediction 4: Strength and anger among adults***

Prediction 4 was that, in adults, upper body STRENGTH would positively correlate with ANGER, at least for males. For the entire sample (men and women), there was a positive, albeit non-significant, correlation ( $r = .21$ ,  $p = .10$ ). Inspection of the scatterplot (figure 1a) revealed three male outliers on STRENGTH. All three were traditional Aka healers. The mean healer strength, 41.1 kg, was 1.6 standard deviations (SDs) above the mean male strength, 25.5 kg. Despite being outliers on strength, the healers' mean ANGER ( $M = 0.37$ ) was 1.1 SDs below the mean ANGER score for men ( $M = 0.54$ ), and 0.81 SDs below the population mean ( $M = 0.50$ ). Both differences were statistically significant,  $t = 3.4$ ,  $df = 7.4$ ,  $p = .01$ ;  $t = 2.9$ ,  $df = 4.2$ ,  $p = .04$ , respectively.

If healers are removed from the analysis (see discussion), the positive correlation between upper body STRENGTH and ANGER was significant ( $r = 0.45$ ,  $p = .0025$ ).

There was no significant main effect of, or interaction with, sex (tests not reported). Separately, the correlations between STRENGTH and ANGER for men (excluding healers) and women were almost identical ( $r = 0.38$  vs.  $0.37$ , respectively).

### **Does ANGER mediate the effect of STRENGTH on HIT?**

In adults, STRENGTH positively correlated with physical aggression (HIT),  $r = .37$ ,  $p = .01$ . However, given that STRENGTH positively correlated with ANGER (prediction 4), and ANGER positively correlated with HIT (prediction 3), it was possible that this effect was entirely mediated by the effect of STRENGTH on ANGER. To determine whether STRENGTH had an effect on HIT independent of its effect on ANGER, we computed two path models, one with healers excluded, and one with them included. As can be seen in figure 2, when healers are excluded the effect of STRENGTH on HIT is entirely mediated by the effect of STRENGTH on ANGER. With healers included, STRENGTH has an effect on HIT independent of its (non-) effect on ANGER. Interestingly, despite having low ANGER for their STRENGTH, healers' HIT scores are consistent with their STRENGTH (figure 1b) – healers are strong, are perceived to hit more than most Aka, but are not perceived as angry.

Separately, the correlations for STRENGTH and HIT for men and women were somewhat different ( $r = .43$  vs.  $.28$ , respectively), being significant for men ( $p = .03$ ) but not for women ( $p = .11$ ). However, because there were no significant main effects of, or interactions with, sex (tests not reported), we cannot reject the null hypothesis that the effect of STRENGTH on HIT is the same for men and women. Controlling for both

STRENGTH and ANGER, there was still no significant sex-bias in HIT (test not reported).

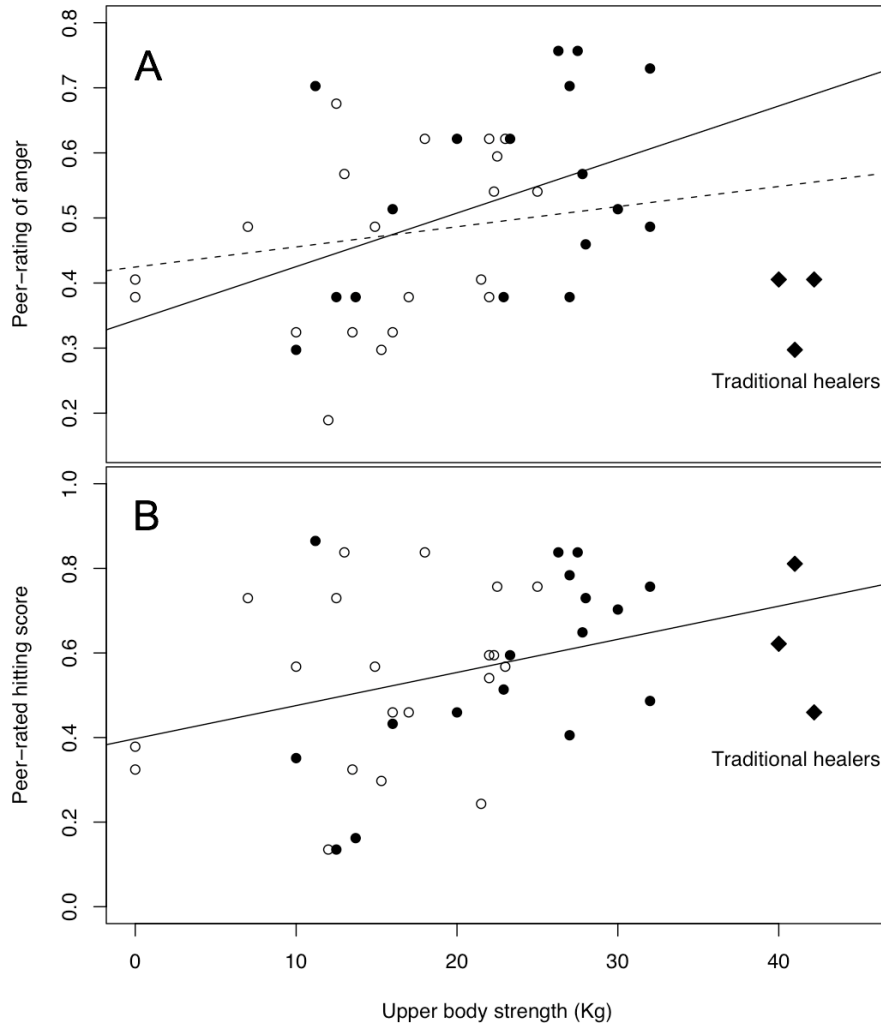


Figure 1. STRENGTH vs. ANGER and HIT. a: Peer-rating of ANGER vs. upper body STRENGTH for adult Aka men (solid symbols) and women (open symbols). Dotted line fit by linear regression including traditional healers (diamonds). Solid line fit by linear regression excluding traditional healers. b: Peer-rated HIT vs. upper body STRENGTH, including healers. The two women with zero upper body STRENGTH scores appeared physically unable to compress the dynamometer, despite multiple attempts.

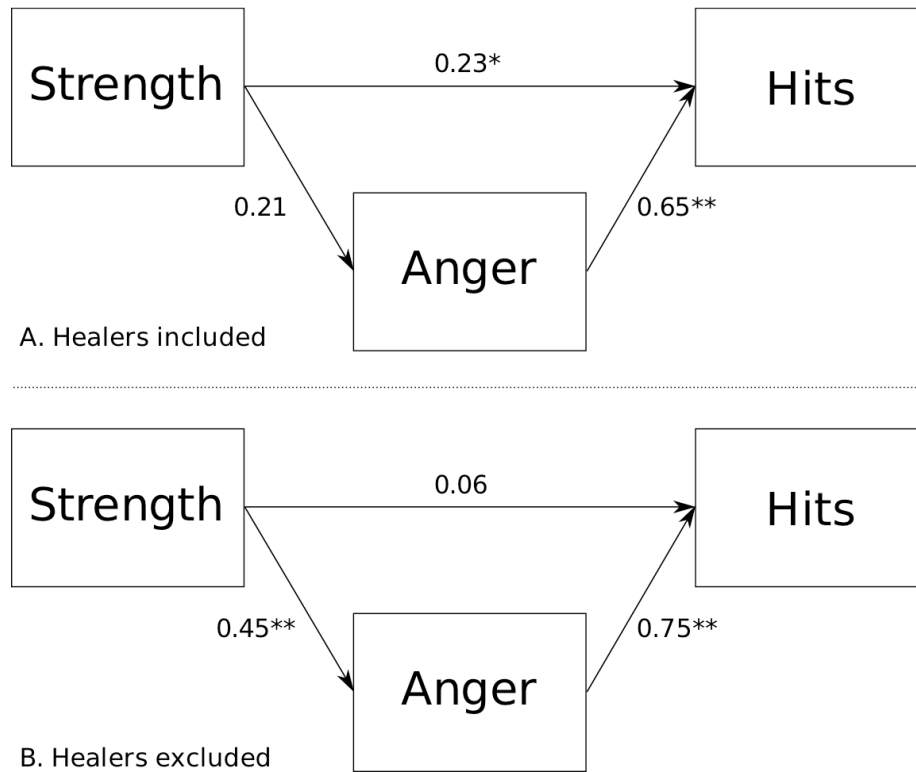


Figure 2: Path models of hitting as a function of strength and anger among adults. A: Healers included. B: Healers excluded. \*  $p < .05$ ; \*\*  $p < .01$ .

***Predictions 5 and 6: Gossiping, strength, and hitting among adults***

Contrary to prediction 5, there was no significant negative correlation between STRENGTH and GOSSIP, and the effect trended in the opposite direction: among all adults,  $r = .02$ ,  $p = .92$ ; excluding healers,  $r = .21$ ,  $p = .22$ ; and for women only,  $r = .37$ ,  $p = .11$ . Controlling for ANGER, there was also no significant relationship between STRENGTH and GOSSIP for all adults, or when considering the sexes separately (tests not reported).

Contrary to prediction 6, there was a significant positive, rather than negative, correlation between HIT and GOSSIP for all adults,  $r = .56$ ,  $p = .002$ ; and for women only,  $r = .60$ ,  $p = .005$ . However, as shown above, HIT and GOSSIP were confounded with ANGER. After controlling for ANGER, there was still no significant relationship between HIT and GOSSIP, although the effect still trended in the positive direction, again contrary to our hypothesis (table 8). Adding sex to the model did not change this (test not reported).

	<b>Estimate</b>	<b>Std. Error</b>	<b>t value</b>	<b>Pr(&gt;  t )</b>	
(Intercept)	0.20	0.05	3.75	< 0.001	***
HITS	0.08	0.10	0.76	0.45	
ANGER	0.56	0.14	3.95	< 0.001	***

Table 8: GOSSIP as a function of HITS, controlling for ANGER. Residual standard error: 0.094 on 37 degrees of freedom, multiple R-squared: 0.52, adjusted R-squared: 0.49, F-statistic: 19.8 on 2 and 37 DF, p-value < .001.

## **Discussion**

We found a large male bias in hitting among children and adolescents, even after controlling for social norms against hitting. These results support the view that a male bias in physical aggression is probably a human universal, at least in children and adolescents, and one that is not well explained by a sex bias in social norms. In fact, there were no significant sex differences in any aggression norms in any age category. One caveat is that Aka children themselves did not stereotype boys as hitting more than girls (but adolescents did stereotype boys as hitting more than girls).

Although we found an adult male bias in physical aggression of a magnitude similar to that found in other studies of middle-aged adults, it was not significant, perhaps due to the insufficient power of our study to detect such small-to-moderate effect sizes. Aka adults did stereotype men as hitting more than women.

Alternatively, there might be no sex bias in physical aggression among Aka adults. Aka men have the highest known levels of paternal investment (Hewlett 1991). As there is a tradeoff between mating and parenting (Trivers 1972), increased paternal investment should reduce male investment in mating, which should reduce intrasexual competition and hence male physical aggression, a hypothesis that we hope to explore in future research (cf. Campbell 1999).

Despite the fact that Aka of all age categories stereotyped females as gossiping more, there was no significant sex-bias in peer-reported gossiping or exclusion among children and adolescents. After controlling for anger, however, there was a significant female bias in gossiping among adults (we did not measure anger in children or adolescents). Again, our study had insufficient power to detect sex biases of a magnitude typically found in other studies of indirect aggression. In this regard, the significant adult female bias in gossiping we found (after controlling for anger) is somewhat surprising. This result suggests that controlling for anger could be important in future studies of sex and indirect aggression.

As predicted, physical strength significantly positively correlated with physical aggression ( $r = .37$ ). In males alone, the effect was somewhat larger ( $r = .43$ ) and still significant, but in females alone, it was smaller and no longer significant ( $r = .28$ ).

However, a multiple regression model of hitting as a function of strength, sex, and their interaction, did not find a significant main effect of, or interaction with, sex. This means that although the zero-order correlation for males was significantly greater than zero, and the zero-order correlation for females was not significantly greater than zero, we cannot conclude that the male effect was significantly greater than the female effect. In other words, we cannot reject the null hypothesis that the effect of strength on physical aggression was the same for males and females.

Contrary to predictions, strength was not a significant positive predictor of anger. The failure of this hypothesis was due to the inclusion in the study of three traditional Aka healers, all men, who differed from other men in two important ways: first, they were extreme outliers on physical strength; second, despite high peer-ratings on physical aggression, they had exceptionally low peer ratings on anger (figures 1a, b). Healers are a distinct Aka population. By catering to local villagers and even clients from distant cities, they can earn several dollars per healing, whereas most Aka can only earn about \$0.50 per day working for villagers. Healers also use their frequent contacts with clients from cities, including the Capital, Bangui, to obtain Western medicines. These factors, in combination with their own formidable knowledge of local medicinal plants, could mean that healers are healthier, better nourished, and hence stronger than most other Aka.

As for their low anger levels, healers, to effectively treat sorcery, must control their emotions. Their clients are often extremely emotional and upset, and healers must remain calm in order to see the sorcery and cure it. Another possibility is that healers fill an important social role requiring physical aggression but not anger. Among the !Kung,

social norms are enforced by the "strong" (an emic category), which includes good hunters, musicians, and healers (Wiessner 2005). Perhaps Aka healers play a similar role, which would require them to use physical aggression to punish norm violations when necessary (explaining healers' relatively high levels of peer-rated physical aggression), but would not spark anger as the healers are not attempting to adjust others' WTRs with respect to themselves but instead WTRs with respect to other group members.

If we removed healers from the analysis, then strength was significantly positively correlated with anger ( $r=.45$ ), as predicted. Separately, the correlations between strength and anger for men (sans healers) and women were almost identical ( $r = 0.38$  vs.  $0.37$ , respectively), and a multiple regression analysis found no significant main effect of, or interaction with, sex. Anger, in turn, was a positive predictor of both physical and indirect aggression, as predicted.

The positive association between strength and anger provisionally supports Sell's (2006) model of anger, with two caveats: first, it does not apply to traditional healers, who might play a special role in Aka society. Second, it also seems to apply to Aka females, contrary to findings among a population of US undergraduate students (Sell, Tooby & Cosmides 2009).

Contrary to predictions that indirect aggression might be favored by individuals of low physical strength, or that there might be an inverse relationship between physical and indirect aggression (controlling for anger, our proxy for level of provocation), we found a significant *positive* correlation between hitting and gossiping (that disappeared after controlling for anger) and no significant correlation between strength and gossiping.

These results do not support the view that indirect aggression is a safer alternative to physical aggression, but much more research is needed to fully evaluate this hypothesis.

Our study had several limitations. Most importantly, although our results illuminate Aka perceptions of aggression, we did not conduct actual observations of Aka aggression. We therefore cannot compare Aka levels of aggression with those of other populations, nor can we validate our measures of physical and indirect aggression. Our sample sizes were also small, preventing us from detecting small-to-moderate effect sizes typical of sex biases in indirect aggression, or physical aggression among middle-aged adults.

Finally, inter-rater reliability was high among adult raters but low among child and adolescent raters. We are not sure why. The same two investigators (CH & EHH) and their two translators interviewed both children and adults with essentially identical protocols, and within a relatively brief timeframe of about one month. We computed ICCs for younger and older children separately, on the theory that younger children might be less familiar with the behavior of older children, but this did not improve reliability; the same procedure also did not improve reliability among adolescents (tests not reported). It is possible that adults might simply have much more information about the aggression of other adults than juveniles do of other juveniles: When adults hit, it causes considerable gossiping; when children or adolescents hit, it does not. That fact that eliminating a relatively few child and adolescent raters dramatically improved inter-rater reliability in most cases also suggests that some juveniles might have either have been relatively new members of the community, or simply have had quite different relationships with other juveniles. Whatever the reasons for low inter-rater reliability, our

results were quite robust to the choice of raters. Results computed with data from the large subset of raters with relatively high consistency were virtually identical to results computed with data from all raters.

Overall, our results provide mixed support for evolutionary strategic models of aggression that emphasize a male-bias in physical aggression, a female-bias in indirect aggression, and a positive effect of physical strength on anger and physical aggression. We found strong support for the hypothesis that a male bias in physical aggression is a human universal unexplained by a sex bias in social norms, at least in children and adolescents, but not in adults. After controlling for anger, we also found a female bias in indirect aggression among adults, but not in children or adolescents, whereas previous studies indicate that the largest female bias is probably in adolescents (Archer 2004). Finally, with the exception of healers, physical strength played an important role in anger, as predicted by a recent evolutionary model of anger, and, as expected, it also played an important role in physical aggression (Sell et al. 2009).

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[1] Note that we did not specify whether “most other Aka” included only Aka in one’s own age category.